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# How do ecological factors shape diversity in menopause experience?


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# II Abstract

Background: Menopause is a fundamental aspect of human female ageing which marks the end of reproductive function. Despite its ubiquity in the female ageing process, menopause is seldom studied in a public health capacity. My study seeks to capture the breadth of variation in menopause experience within the UK, and the extent to which ecological factors can explain this variation. In order to do so, I explore how a deficit of knowledge production surrounds menopause in the biomedical paradigm and employ an interdisciplinary and integrative mixed methods approach to alleviate these limitations.

Methods: A mixed methods approach was employed, involving secondary quantitative data analysis of the UK Biobank dataset and thematic analysis of an online qualitative survey. An analytical sample was derived from the UK Biobank dataset containing participants who had experienced natural menopause (N= 97797) and tested to explore whether patterns in age at menopause exist across temporal and spatial dimensions of the dataset, and whether variation in age at menopause was associated with wider measures of the ageing process. Thematic analysis was performed on an online qualitative survey dataset (n=377) exploring breadth of variation in menopause experience in both a 'normal' and Covid-19 lockdown context. The results from both were integrated at the interpretive stage of this thesis.

Findings: From the quantitative analysis, patterns in variation of age at menopause were identified across both spatial and temporal dimensions. Furthermore, associations were identified between age at menopause and more general markers of ageing, suggesting that a later age at menopause is associated with a slower rate of overall ageing. However, the dataset itself was a very limiting factor in the quantitative analysis, which calls into question the ability of quantitative data to capture menopause experience.

The qualitative analysis identified multiple facets of menopause experience and how menopause experience amongst participants is co-produced by the interaction between physical manifestations of menopause and the wider environment. Participants would situate themselves in the menopause transition based on bleeding status and symptom presence, with range of symptoms extending beyond those typically associated with menopause in the biomedical paradigm. Menopause impacted the wider lived experience of participants in 2 ways – by disrupting everyday life and by producing discomfort in participants. Disruption and discomfort as a result of menopause were identified in home and personal lives, in a workplace context and socially. In the specific ecological context of the 2020 COVID-19 lockdown, changes to menopause experience did not stem from changes in symptoms but rather from the novel environment in which participants were living.

When integrated together, my findings suggest that both menopause experience and the impact of ecological factors in shaping variation were better captured through qualitative data production and analysis. While the ecological context was limited to singular measures of location and socioeconomic status within the quantitative data, the qualitative research captured the multiple layers of the ecological context extending from the micro-level to macro-level structures.

Conclusions: Variation in menopause experience in the UK was found to be present, both in timing of menopause and wider menopause experiences. This variation can also be linked to interactions between individuals and the ecological context, indicating that determinants of menopause experience extend beyond symptom experience and absence of bleeding. In the context of increasing public demand for menopause support and information, this thesis presents ways in which menopause can be reconceptualised in a public health research context.

# III Abbreviations and terminology

| | |
|---|---|
| AMH | Anti-Mullerian Hormone |
| ASMR | Age specific mortality rates |
| COP | Combined oral contraceptive pill |
| CVD | Cardiovascular disease |
| FMP | Final menstrual period |
| FSH | Follicle stimulating hormone |
| GWAS | Genome wide association study |
| HRT | Hormone replacement therapy |
| LARC | Long-acting reversible contraception |
| LH | Luteinising hormone |
| LMA | Lifetime menstrual activity |
| LMC | Lifetime menstrual cycling |
| OC | Oral contraceptive |
| OR | Odds ratio |
| POP | Progesterone only pill |
| PPE | Personal protective equipment |
| RCS | Reactive carbonyl species |
| ROS | Reactive oxidative species |
| SES | Socioeconomic status |
| SIMD | Scottish index of multiple deprivation |
| VMS | Vasomotor symptoms |

- When talking about coronavirus, references to COVID-19 relate specifically to the virus whereas 'lockdown' relates more specifically to the lockdown restrictions imposed by the UK Government in March 2020.
- Menopause is a feature of the female biological sex, and many experiential factors are inherently linked to gendered experiences of women. However, not all who have menopause are women and not all women have menopause. In this thesis, I endeavour to use female to describe features of the biological sex and woman to describe features of gender.

# IV Publications

Fraser, A., Johnman, C., Whitley, E. and Alvergne, A. (2020) “The evolutionary ecology of age at natural menopause: implications for public health,” Evolutionary Human Sciences. Cambridge University Press, 2, p. e57. doi: 10.1017/ehs.2020.59.

# V Acknowledgements

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We started strongly with the project, navigated a global pandemic, and had a questionable dismount thanks to international warfare. I would like to express gratitude to 3 cultural events that really pulled me through lockdown – the *Serotonin* playlist on Spotify, RuPaul's Drag Race UK Series 2, and the 2021 Eurovision Song Contest.

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This thesis is dedicated to all the strong and formidable women I am grateful to have in my life.

# VI Author's declaration

I declare that, except where explicit reference is made to the contribution of others, this thesis is the result of my own work. The contents of this thesis have not been submitted for any other degree at the University of Glasgow or any other institution.

*Abigail Georgia Fraser*

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# 1 Chapter 1: Introduction

Menopause traditionally refers to the cessation of reproductive function in human females and is a universal biological phenomenon present in the female ageing process. This process comprises several experiential features including the end of menstruation and the experience of physical signs and symptoms. Studies of menopause sometimes feature in biomedical literature, which explore the physiological process of menopause and the study of patterning in menopause timing and symptoms. Menopause is also studied from a social scientific perspective, with particular focus on the lived experience of menopause, and the ways in which menopause experience can differ within and between different populations throughout the world. Despite this multi-disciplinary interest in menopause as a subject, and the considerable experiential impact of menopause in the lived experience, understanding of many dimensions of menopause experience is lacking, and menopause does not feature heavily in public health research.

In this introduction, I outline key literature relevant to exploring the research question which I pursue in this thesis, namely: *How do ecological factors shape diversity in menopause experience?* This review includes the biomedical approach towards menopause, focusing on the physiological processes of menopause and epidemiological studies of variation into age at menopause. I will include a focus on current public health approaches to the study of menopause, including the ways in which menopause is largely ignored in public health. Following this, I highlight key areas of menopause experience which are not considered by the biomedical approach and will explore literature from sociology and anthropology which explores further ways in which menopause experience can vary, particularly in relation to the lived experience. I will then define what I mean by an 'ecological approach' by explaining key concepts such as biocultural approaches to health, and synergistic relationships between the environment and human health. In the final section of this chapter, I outline how I intend to incorporate insights from the literature review to adopt an ecological approach in the study of menopause variation.

## 1.1 Biomedical and public health approaches to menopause

In the biomedical and population health sciences, 'natural menopause' is defined as an event reached when a woman has not had a menstrual cycle in the preceding 12 months (Hillard et al., 2017). Following this final menstrual period (FMP), a woman is considered to have experienced menopause. Natural menopause - which also effectively indicates the cessation of reproductive function, most often occurs between the ages of 40 and 60. In the UK, 51 is considered the mean age at FMP (NCC-WCH, 2015). While menopause is commonly defined by the complete cessation of periods, it is arguably better understood as a process rather than an event (Sievert, 2006). Indeed, individuals are considered to be 'peri-menopausal' for some years before and after their FMP. Peri-menopause is a period characterized by the irregularity of menstrual cycle length and frequency (Paramsothy et al., 2017) and the potential to experience vasomotor symptoms (e.g. hot flushes/night sweats (Hillard et al., 2017)), urogenital discomfort, anxiety, depression, and joint aches (Hillard et al., 2017). Note that not all women experience natural menopause, as some may experience menopause due to a pathology of the reproductive system before the expected age of cessation of reproductive function, or accelerated surgical menopause due to procedures such as bilateral oophorectomy, hysterectomy, chemotherapy or gonadotropin-releasing hormone analogues (Hillard et al., 2017).

This thesis sits within the discipline of 'Public Health'. By public health, I refer to the research, practice and policy surrounding organised efforts to improve population health and wellbeing (Hanlon, 2012). In the UK – considerably more than in other nation-states (Manyara et al., 2018) – there is an emphasis on multidisciplinarity within the discipline of public health (Berridge, 2007). Thus, there is significant input from non-medical professions in public health research and practice. Public health, however - as either an occupation, discourse or institution (Berridge, 2007) - remains grounded in, and inextricably linked to, the biomedical paradigm (Quirke and Gaudillière, 2008, Jansen and Roesch, 2022) through its hegemonic positionality within contemporary western medicine. As a result, public health focuses, funding, and practices are often shaped by the central tenets of biomedicine, and therefore its conceptual limitations, which are discussed in Chapter 2.2.

In common with many menopause researchers, I take as my starting point for the conceptualisation of 'menopause' based on its principal physiological manifestation: that is, the cessation of menstrual cycles. This is in line with the ontological positioning of 'critical realism', whereby the locus of experiential interrogation is grounded in biological phenomena (Pope and Mays, 2019, Ormston et al., 2003). I will expand on this ontological positioning in Section 2.4. I therefore centre my operationalisation of menopause around the characteristics of menopause as recognised in the western biomedical paradigm – the cessation of reproductive function, and the associated physiological symptoms. As this thesis sits within Public Health, this positioning is in part a pragmatic approach, as it is concordant with the literature I will be engaging with in the coming chapters. However, throughout this thesis, I adopt a critical approach to this conceptualisation, and interrogate the strengths and limitations of this monolithic conceptualisation of menopause, particularly in research contexts.

In the coming section, I outline the literature surrounding menopause in a biomedical paradigm, in order to contextualise how menopause is approached within the disciplines of public health and clinical medicine. I offer an outline of the physiology of menopause, and the ways in which menopause has predominantly been studied in public health. I then explore the limitations to studying menopause through this approach, its limited scope, and the shortfalls in current public health research into menopause.

### *1.1.1 The physiology of menopause*

During a biomedically 'normal' menstrual cycle, levels of reproductive hormones Follicle Stimulating Hormone (FSH); Luteinising Hormones (LH); oestrogens and progesterone fluctuate in response to the maturation and ovulation of the follicle. LH, released from the pituitary gland, triggers the selection and development of viable follicles in the ovaries which release oestrogens (Alvergne, Högqvist Tabor 2018). The release of oestrogens both proliferates the endometrium in anticipation of implantation as well as inhibiting the release of FSH and stimulating the release of LH from the pituitary gland. Positive feedback of oestrogen from the developing follicle and the release of LH causes a surge of LH when the follicle is matured, triggering ovulation. Progesterone is produced by the corpus luteum – the remnants of the oocyte follicle which suppresses FSH and oestrogen production. If fertilisation does not occur, progesterone from the corpus

luteum depletes and the inhibitive effect on FSH production is alleviated. As progesterone levels decrease, the endometrium is shed from the uterus as menstruation. The biological female is born with a finite supply of oocytes, with there being 6-8 million during the foetal stage of development, decreasing to 1.5-2 million by birth and to 300,000-600,000 by puberty (Sarris, Bewley et al. 2009).

A biomedically 'normal' menopause is characterised as follows: as the female gets older, the oocyte supply begins to run low and decreases in quality. As a result, the menstrual cycle becomes dysregulated through a decrease in the reproductive system's ability to produce oestrogens and progesterone from poor quality follicles (Sarris, Bewley et al. 2009). Pulsatile release of FSH from the pituitary gland increases in an effort to stimulate oestrogen production from the ovaries, but as follicle numbers deplete the menstrual cycle becomes increasingly non-functional. When all follicles are lost, the reproductive system is considered to have reached 'end organ failure', characterised by cessation of menstrual cycles and decreasing circulating levels of oestrogens (Sarris, Bewley et al. 2009). Biomedically recognised vasomotor symptoms of menopause (hot flushes and night sweats) are aetiologically linked to the increase in pulsatile release of FSH and decreasing levels of oestrogens, while genital symptoms such as vaginal pain, itching and prolapse are associated with vaginal atrophy and dryness from hypo-oestrogenism (Sarris, Bewley et al. 2009). The same dysregulation of the menstrual cycle can be induced iatrogenically – either indirectly through chemotherapy and radiotherapy, or through the direct pharmaceutical and surgical intervention of GnRH analogues used in oestrogen reduction or through an oophorectomy (removal of the ovaries) (Sarris, Bewley et al. 2009).

### *1.1.2 Measuring menopause*

Intrinsically linked to the physiology of menopause are the ways in which – and what aspects of - menopause can be measured. Within biomedicine, the most common measurement of menopause relates to the age at final menstrual period. As such, most biomedical studies into menopause regard timing of (i.e. Age at) FMP as the timing of menopause. Before exploring studies of menopause timing, I wish to introduce the implications associated with measuring menopause in this way, as they pose considerable limitations to the interpretation of studies into timing of menopause.

The most notable limitation to identifying age at menopause is that the precise timing of the FMP can be difficult to identify. Owing to the nature of the dysregulated menstrual cycle during peri-menopause, it is possible that a woman may not have a period in 12 months, then experience bleeding. The irregularity of menstrual cycles may result in intervals of time longer than 12 months where a female appears to not be ovulating, especially towards the later peri-menopause when menstrual cycles tend to be longer (Harlow and Paramsothy, 2011). While this bleeding may be menstruation, it can also be the result of reproductive malignancies which can occur in the post-menopausal body (Hillard et al., 2017). Furthermore, menstrual cycling is often more variable than a consistent 28-day cycle throughout reproductive life (Gorrindo et al., 2007, Kato et al., 1999). This is especially pertinent amongst contemporary natural fertility populations (where there is little to no use of hormonal contraception) where menstrual cycles may be much less frequent than in contemporary western populations (Strassmann, 1997).

Adding to the difficulties of measuring facets of menopause is the lack of clinical diagnostic tools able to discern menopausal status through measuring hormone levels. While FSH levels may be diagnostic for cases of early menopause (under 45 years), FSH levels are nonetheless unreliable for assessing menopausal status due to fluctuations in levels throughout peri-menopause (NCC-WCH, 2015, FSRH, 2017). Additionally, levels of the anti-mullerian hormone (AMH), even in multiple assessments, are unreliable for measuring ovarian reserve, due to the wide variation in circulating levels of AMH within populations, as well as lack of a uniform AMH decline during the ageing process (de Kat et al., 2017).

Ultimately linked to the two prior points, the measurement of FMP may only be confirmed retrospectively. This increases the difficulty of recruiting women who are newly post-menopausal for cross-sectional studies. Additionally, many current cohort studies use the midpoint between 2 cohort waves where menstruation is present and then absent as age at final menstrual period. Such data are then often analyzed using discrete categories or "binning" (e.g., <45, 46-50, 51-55, 56+), which may obscure any smaller trends in age at menopause.

A further consideration when measuring age at FMP relates to the use of hormonal contraception and hormone replacement therapy, where the true age at final

menstrual period may be masked pharmaceutically (FSRH, 2017, Hillard et al., 2017). If a woman is taking combined oral contraceptives or hormone replacement therapy, bleeds are not menstruation but rather 'withdrawal' bleeds under the control of medication (FSRH, 2017). Prescription guidelines advise a change away from combined oral contraceptives to a progesterone based contraceptive over the age of 50 (or 35 for smokers or people with other risk factors (Hillard et al., 2017)), given the high risk of thromboembolism (FSRH, 2017). After this, bleeding may stop, and the individual may be considered post-menopausal. However, any bleeding experienced while using oral contraception is a withdrawal bleed, and a woman's reproductive capacity may in fact have ceased some time earlier.

Similarly, use of combined HRT during the peri-menopausal stage can also produce withdrawal bleeds (Hillard et al., 2017). These examples highlight the importance of defining menopause as the cessation of menstrual cycles, rather than all forms of reproductive bleeding, as bleeding can also originate from the use of hormonal contraceptives and HRT. Conversely, if a woman is using progesterone-only contraceptive methods, age at menopause may also be masked by amenorrhoea produced by contraceptive usage. This is potentially a frequent issue: the chance of amenorrhoea at 12 months using the Mirena/levonorgestrel releasing intra-uterine system (the hormonal coil) is 20-80%, and this form of contraception has the highest continuation rates in women aged 39-48 (Currie, 2019).These examples highlight the importance of defining menopause as the cessation of menstrual cycles, rather than all forms of reproductive bleeding, as bleeding can also originate from the use of hormonal contraceptives and HRT.

### *1.1.3 Epidemiological studies of menopause timing*

Self-reported age at menopause, based on age at FMP, is variable both temporally and spatially. Mean age throughout the 20th century has been reported as being anywhere between 44.6 and 54.5 years of age across different geographic regions (Laisk et al., 2018), and between 46 and 51.7 years of age in studies conducted between 1990-2010 (Figure 1.1). Broadly, mean age of menopause is higher in the Global North than in the Global South, but due to the lack of measurement of age at menopause across populations, there is a sizeable uncertainty associated with this pattern. Temporal changes in age at FMP have been reported across different

birth cohorts, with a cohort study in Sweden identifying a 1 month increase of menopausal age with each year of birth (Rodstrom et al., 2003).

Epidemiological studies - for the most part conducted in high-income countries and based on clinical rather than population-based samples - shed some light on macro-level determinants of menopause timing. First, genetic contribution to age at menopause appears modest: GWAS-identified loci only explain 2.5-4.1% of

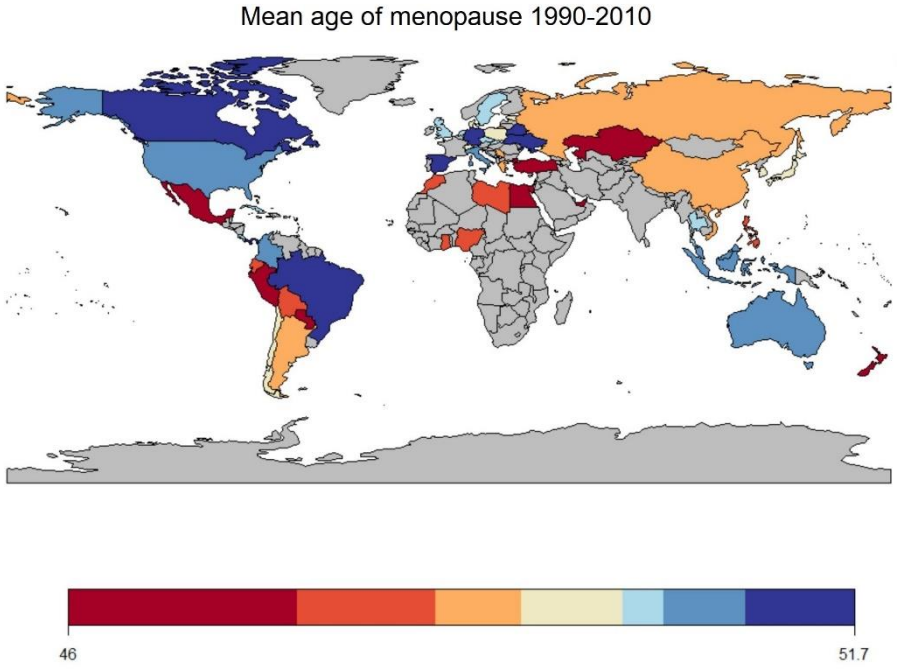


*Figure 1.1: Variation in final menstrual periods (FMP). This map was replicated from Laisk et al. (2018), with additional segregation of data based on the decade in which it was collected.*

population variation in menopause timing (Stolk et al., 2012), suggesting that genetic diversity holds little explanatory power for understanding diversity in age at menopause. Other studies identified mixed associations between menopausal age and reproductive life history, socio-economic status (SES) and lifestyle factors. For instance, early age at menopause has been associated with early menarche (Mishra et al., 2017, Ruth et al., 2016) and nulliparity (Mishra et al., 2017, Duarte et al., 2014) while increasing parity (number of pregnancies) is associated with later age at menopause (Mishra et al., 2017, Duarte et al., 2014, Gold et al., 2001, Mishra et al., 2007). Various markers of lower SES or indicators of stress both in early life (household crowding; father's social class; parental divorce, poor cognitive ability, maternal smoking; perception of being thin) (Ruth et al., 2016, Mishra et al., 2007, Hardy and Kuh, 2005) and later life (educational status, regional purchasing power (Duarte et al., 2014, Schoenaker et al., 2014)) are

associated with an earlier age at menopause. Those relationships are not mediated by the correlation between age at menarche and poor early life conditions given that most studies control for age at menarche (Schoenaker et al., 2014). Age at menopause is consistently associated with lifestyle factors - smoking has a strong association with earlier age at menopause (Laisk et al., 2018, Ruth et al., 2016, Gold et al., 2001, Schoenaker et al., 2014, Hardy and Kuh, 2002, Gold et al., 2013) while there is a weak association between lower BMI and earlier age at menopause (Henderson et al., 2008).

While there seems to be significant variation worldwide in age at menopause, the data underpinning this picture are somewhat problematic due to methodological considerations, including an overrepresentation of clinical based studies in the global North, debatable inclusion/exclusion criteria, data binning bias and cross-cultural bias. Thus, much of the literature reviewed in this thesis can only approximate global variation in menopause timing. Additionally, whether the different associations between determinants of menopause timing are globally salient is unknown, given most epidemiological data are derived from clinical studies conducted in high-income countries.

### *1.1.4 Other biomedically recognised features of menopause experience*

Aside from interest in timing of menopause, public health and clinical medicine also hold interest in other facets of the peri-menopause, such as the length of the peri-menopausal period and the type and severity of menopausal symptoms. Research into patterns of bleeding within North American populations has identified a general pattern of increasing cycle lengths, and heaviness of bleeding as FMP approaches (Harlow and Paramsothy, 2011). However, 12%-25% of women across various studies reported minimal to no changes in bleeding patterns before amenorrhoea indicative of the FMP (Harlow and Paramsothy, 2011), suggesting that there is significant unexplained variation in the experience of the peri-menopausal period within populations.

The emergence and duration of symptoms can be used in conjunction with menstrual cycle irregularity to identify if a woman is peri-menopausal, especially in a clinical context. The most commonly cited symptoms of menopause, as

recognised biomedically, are vasomotor symptoms such as hot flushes and night sweats, genitourinary symptoms, and cognitive symptoms such as 'brain fog' (Hillard et al., 2017, NCC-WCH, 2015). The importance of these symptoms to the biomedical characterisation of menopause is established by their inclusion in the National Institute for Health and Care Excellence's Clinical Guidelines for Menopause (NCC-WCH, 2015). Literature reviewed for these guidelines featured studies into the efficacy of therapeutic treatments for these symptoms, and thus clinical decisions surrounding menopause tend to be contingent on the efficacy of treatments in relation to these symptoms.

However, there is increasing clinical recognition against assuming uniformity of symptomatology across populations (Sievert, 2006). The prevalence and severity of symptoms across populations vary, e.g. symptoms such as hot flushes are widely reported in Western countries but are seldom reported in other populations, for instance throughout East Asia (Sievert, 2006). Several epidemiological studies note that reports of vasomotor symptoms are more likely and more frequent amongst certain groups: women of European and Latin American descent, African American and Hispanic women in the USA, women living in South-East Asia, women with anxiety, hypertension as well as HIV and women who are obese (Monteleone et al., 2018). Studies have similarly found that women from India and the Middle East, as well as Chinese and Japanese American women, reported fewer VMS (Monteleone et al., 2018). Variation also occurs in reports of symptom manifestations such as the locations where VMS are felt in the body. For example, American women may report flushing of the face and upper chest, Mexican women may flush on the back of the neck, while women who wear headscarves may flush on the top of their heads, under their scarves (Sievert, 2014b). In addition, women who have undergone a bilateral oophorectomy (surgical removal of both ovaries) also report experiencing more severe VMS from the onset, rather than the gradual increase in severity found amongst most other women (Sturdee et al., 2017). Other symptoms may be framed as more important to menopausal experience in some populations, such as joint aches and pains amongst Asian populations (Sievert, 2014b). These variations suggest that care must be taken in extrapolating biomedically derived symptom profiles from the West to other populations, and that symptoms of menopause can present differently across social and cultural contexts (Blell, 2015).

### *1.1.5 Outstanding questions in public health research into menopause*

Despite a substantial focus within public health on ageing (Beard and Bloom, 2015), menopause as a facet of the female ageing experience is often excluded from research questions into ageing and subsequent public health interventions (e.g., breast cancer screening). For instance, out of the 15 ageing cohort studies found on the Gateway to Global Ageing Data (USC programme on Global Ageing and Policy, 2018), a harmonised dataset aiming at providing resources to support cross-national research on ageing, only 5 studies collected any form of data on menopause from their female participants (Figure 1.2). The observation that menopause is excluded from ageing cohort studies, which premise themselves on collecting data on the multifactorial nature of the ageing experience, reveals the absence of menopause from public health discourses of ageing, which suggests that its impact on the ageing experience is neglected.

| Cohort | Region | Years | Variables |
|---|---|---|---|
| **TILDA** | Ireland | Pilot | • gone through menopause;<br>• age menopause started;<br>taken prescription hormones;<br>• number of years taking hormones;<br>• number of years took prescription hormones |
| | | 2010 | |
| | | 2012 | |
| **NICOLA** | Northern Ireland | 2015 | • gone through menopause;<br>• age menopause started;<br>• used prescription hormones;<br>• number of years taking hormones;<br>• number of years took hormones |
| | | 2017 | • used hormones since menopause;<br>• still using/stopped using hormones;<br>• number of years taking hormones;<br>• number of years took hormones |
| **HRS** | USA | 2008 | • current stage of menopause;<br>• how old when finished menopause (>40, >45, >55) |
| | | 2010 | |
| | | 2012 | |
| | | 2014 | |
| | | 2016 | • current stage of menopause;<br>• how old when finished menopause;<br>• year finished menopause |
| **CHARLS** | China | 2011 | • Age at menarche;<br>• has menopause started |
| | | 2013 | |
| | | 2015 | • age at menarche;<br>• has menopause started;<br>• age at menopause |
| **CRELES** | Costa Rica | 2005 | • age at menarche;<br>• age at last menstruation;<br>• ever used HRT to treat menopause for 3+ years |
| | | 2010 | |

*Figure 1.2: Menopause-related variables in the Gateway to Global Aging Data, produced by the USC Program on Global Aging, Health & Policy, with funding from the National Institute on Aging.*

Since the 90s, several longitudinal studies have been started, many with the specific aim of understanding the impact of HRT usage on later life health among post-menopausal women such as The Women's Health Initiative (WHI, (Rossouw et al., 2003, Nabel, 2013)) and Million Women Study (MWS,(The Million Women Study Collaborative, 1999)). Study of Women's Health Across the Nation (SWAN) and the International Collaboration for a Life Course Approach to Reproductive Health and Chronic Disease Events (InterLACE) are currently collecting and synthetizing health data on peri- and post-menopausal women. However, without widespread inclusion of menopause variables in ageing cohort datasets worldwide, public health research into menopause will remain stunted.

Consideration should also be made into the purpose of public health research into menopause. Age at menopause has previously been associated with varying health outcomes, with earlier age at menopause being generally associated with increasing risk of all-cause mortality (Schoenaker et al., 2014, Forman et al., 2013). Assumptions are made about the directionality of this relationship, with menopause itself often considered as the cause of changes in mortality risk. This influences the research paradigm into menopause, limiting the scope of research into relationships between age at menopause and later life health outcomes. As such, research into variation of the actual menopause experience is sidelined.

Extending a public health approach to menopause beyond its relationship with later life health outcomes may be equally important to consider how and why variation in age and experience affects an individual's capacity for "successful" ageing (Rowe and Kahn, 2015). There is an increasing awareness of "successful ageing" in Public Health and Gerontology, which encompasses the social, cultural and psychological impact of growing older beyond the increasing health risks. In this view, the ageing experience is expanded beyond the disease risk and frailty to include facets of the ageing experience that are more important to the individual (Rowe and Kahn, 2015). Therefore, approaches to menopause as a component of female ageing is a tangible site of research expansion beyond focusing on health risks.

Given the constraints to biomedical approaches to menopause outlined above, I will now introduce perspectives on menopause found outwith biomedical literature in the social sciences. Expanding to an interdisciplinary approach will

permit me to consider alternative views on menopause beyond the biomedical paradigm's focus on timing of FMP and clinical presentations of menopause.

## 1.2 Menopause in the social sciences

A large component of anthropological and sociological literature on menopause is centred on identifying variation in experience, focusing on outlining culturally specific experiences of menopause. Most prominent in this work is Lock's *Encounters with ageing (*1993*)*, a text which explores differences in menopause experience between North American women and women in Japan (Lock, 1993). Lock examines the differences in prevalence of VMS between populations in North America and Japan, where Japanese women report vastly fewer hot flushes and night sweats compared to their Northern American counterparts. Further ethnographic studies into menopause experience have included Beyene's cross-cultural ethnographies of menopause amongst rural Greek and Mayan women (Beyene, 1989) which describe the absence of VMS amongst rural Mayan women, while they were considered a normal experience of menopause amongst the Greek participants. Ethnographies from Lock, Beyene and Sievert highlight the lack of significance attributed to menopause in some Japanese, Mayan, and Bangladeshi populations, respectively (Lock, 1993, Beyene, 1989, Sievert, 2014). Longitudinal variation in menopausal symptoms has also been explored in relation to the emergence of menopausal treatment in Traditional Chinese Medicine, and the concurrent increase in treatment of the Chinese population for novel symptoms associated with menopause (Scheid, 2008).

Anthropological studies into menopause have also uncovered the impact of linguistics in shaping the menopause experience. In China, menopause is conceptualised in two different forms – with *juejing* referring to the cessation of menstruation, and *gengnianqi* as a non-gendered transition into old age (Shea, 2020). While western attitudes towards menopause tend to be negative, *gengnianqi* is often welcomed in China as an invitation to express displeasure and irritability in response to growing older (Shea, 2020). Socio-political contexts can also be seen to shape menopause experience. Amongst Palestinian women, an implicit relationship between the pervasiveness of conflict and diminution of menopause experience has been posited (Hammoudeh et al., 2017) impacting Palestinian women's attitudes towards their menopause experience. This also intersects with an increase of social power amongst Palestinian women as they

age, nuancing perspectives on menopause beyond the negative/positive binary (Hammoudeh et al., 2017). Thus, the symbiosis between menopause and cultural systems is often highlighted by studies into menopause experience from anthropological perspectives.

In exploring these variations in menopause experience, culture itself is given as an explanatory factor in cross-population differences documented in symptoms. The body is "simultaneously a physical and symbolic artefact, as both naturally and culturally produced, and as securely anchored in a particular historical moment" (Scheper-Hughes and Lock, 1987). As such, corporeal experiences are not solely physiologically determined, but are also shaped by the ecological context. Lock and Scheper-Hughes describe this as the 'social body', whereby the embodied experience of health and disease reflects the relationship between the state of the body and the environment in which it lives (Scheper-Hughes and Lock, 1987). In the context of menopause, experiences of menopausal symptoms may reflect not only physiological changes in the body during menopause, but also the social and cultural positionality of the menopausal woman (Lock, 1993). The production of *feeling menopausal* also incorporates socially and culturally shaped ways of 'making sense' of menopause (Lock and Kaufert, 2001), in that recognition and description of symptoms is influenced by the linguistics of menopause and culturally transmitted ideas of what menopause does, and should look like (Lock and Kaufert, 2001).

In the UK context there has been some exploration into determinants of menopause experience, but understandings of experience are largely influenced by the biomedical conceptualisation of menopause. Studies into narratives surrounding menopause experience identify the importance of menopause as a sign of growing old in British contexts, particularly given the influence of consumer-based lifestyles promoting youthfulness as a desirable trait (Wray, 2007, Ballard et al., 2009). However, this attitude is also likely to vary across women within the UK from different ethnic backgrounds, and means that approaches to narratives of menopause and midlife must be sensitive to the diversity of life experience produced through ethnic and cultural differences (Wray, 2007). Further narratives associated with menopause by British women include an indifference to menopause, menopause as a struggle, and menopause as a transformative experience (de Salis et al., 2018).

As the preceding paragraphs indicate, in contrast to the biomedical approaches to menopause outlined earlier, anthropological and sociological perspectives on menopause acknowledge a much greater degree of variation in experience. Menopause is not solely limited to the cessation of reproductive function and the presence of symptoms – rather, the experience of menopause also embodies larger social and cultural systems in which women live. This perspective introduces the importance of the ecological context of the person experiencing menopause as a significant factor explaining variation in experience. Utilising an interdisciplinary approach, I aim to incorporate this ecological context into the study of variation in menopause experience. Following from this literature review, the next section sets out the specifics of a human ecological approach, and how I will incorporate an ecological approach in the pursuit of my overarching research question. In doing so I extend the scope of my research project into that of an interdisciplinary project, focusing on understanding menopause as a subject matter from the perspective of different disciplines.

## 1.3 What is an ecological approach?

Compared to the approach towards disease taken by epidemiology, an ecological approach emphasises the role of the environment in shaping health and disease (McElroy et al., 2015). In this context, environment refers to not just the physical environment of the person, but also incorporates the social and cultural dimensions of the environment in which a person lives. An ecological approach therefore foregrounds the interaction between the person and their lived environment and seeks to understand how this interaction shapes how the person will experience health and disease. This approach contrasts with that of biomedicine, in that causal factors are not limited to those that are biological in nature. By including focus on the culturally constructed environment, an ecological approach facilitates the study of the impact of structural and socially constructed differentials between groups when exploring disease aetiology (Turshen, 1984). An ecological approach to disease allows the examination of the non-physical boundaries between groups displaying different metrics of human experience such as race, class and age (Turshen, 1984). These boundaries do not exist in the positivistic manner that biological laws and boundaries are postulated to exist but are crucial for understanding the social determinants of health, and how disease can manifest itself differently across social stratifications.

Fundamentally, an ecological approach recognises that there is no single cause of a disease but that the manifestation of a disease is part of a chain of factors resulting in ecosystem imbalances or relationships between the biotic, abiotic and cultural environment (McElroy et al., 2015). As environments, like pathogens, can be inherited and passed on between individuals and groups, causal factors shaping health and disease outcomes can produce patterns of incidence similar to those found for communicable diseases (Allen and Feigl, 2017). Thus, an ecological approach acknowledges the role of the environment in transmitting patterns of health and disease within populations.

Also incorporated into an ecological approach is the role of the social and cultural environment in shaping experiences of health and disease – a recognition that health and disease exist in both a biological and social realm. An ecological perspective differs from that of a biomedical perspective by recognising the role that culture plays not only in the transmission of the disease but also the experience of the individual with the disease. Unlike biomedicine, which views the agent as a passive actor against the activities of biological laws, biocultural approaches to health acknowledge the holistic experience of disease, illness and sickness within the individual (Wiley and Allen, 2013). Culturally specific and appropriate 'ways to be ill' can affect human behaviour in group level patterns (Wiley and Allen, 2013). This biocultural approach exists within the ecological context and proffers a more specific focus on the interaction between manifestation of health and disease and lived experience.

Culture, in this context, refers to the broad environmental and social institutions in which humans live (Banwell et al., 2013). This includes macro-level institutions such as global systems, assemblages (Collier and Ong, 2005) and nation-states; meso-level institutions such as local authorities, workplaces and residences; and micro-level institutions of family, social networks and individual levels (Banwell et al., 2013). Within each of these institutions, there are shared values, norms, ideas and processes which influence the expected behaviour of individuals existing within the institution (Banwell et al., 2013). Thus, culture can be considered as "a blueprint guiding but not dictating what is imaginable, moral and possible" (Banwell et al., 2013).

Within medical anthropology, a biocultural approach focuses not only on how biological and cultural factors coproduce variation in human health (e.g., bodily plasticity, disease), but also how the cultural setting shapes the individual's experiences of this variation (Young, 1982, Joralemon, 2010, Wiley and Allen, 2013). A biocultural approach of health and medical related phenomena makes distinctions between disease, illness and sickness (Young, 1982, Wiley and Allen, 2013).

Disease refers to the physiological locus of variation – the reductionist perspective that is most often referred to in clinical western biomedicine (Wiley and Allen, 2013). The focus on disease operates at a physiological or biochemical level, and aims to identify functional abnormalities at a biochemical, physiological or anatomical level which cause the body to deviate from normal function (Young, 1982, Wiley and Allen, 2013). Clinical treatment is often pharmaceutical or surgical, with an aim of restoring 'normal' function. The ontological representation of disease – that a pathological entity will respond predictably to a medical action – reinforces the positivistic goals of biomedicine and equates identification of the cause of disease to an effective cure (Canguilhem et al., 1978). It is important to recognise that when addressing disease, especially in a western biomedical context, personal experience is stripped away from focus (Wiley and Allen, 2013) and symptoms are used to point the clinician in the direction of the disease.

Contrary to disease, the concept of 'illness' refers to the subjective personal experience of not feeling well (Wiley and Allen, 2013, Young, 1982). Illness recognises the perceptions of the person who does not feel well, and its impact on their experience of being in the world (Young, 1982). Illness therefore incorporates a phenomenological component – that the body is not just a passive locus of function and dysfunction (as often approached in biomedicine), but that it is the very vessel through which the individual experiences the world (Komesaroff et al., 1997). In this way, variation from the average function of the body disrupts the very way in which our reality is constructed (Komesaroff et al., 1997).

'Sickness' is the process through which behavioural and biological signs, which originate from disease, become socially recognisable indicators to others of the

person being unwell (Young, 1982). As such, sickness conceptualises the interaction between the person who is unwell and their social environment, which includes the individual being recognised as unwell and restructuring of activities to facilitate the individual in getting better when they undertake a sick role (Wiley and Allen, 2013). Drawing from Scheper-Hughes and Lock's *social body*, the body in sickness can offer insight into "social disharmony, conflict and disintegration" (Scheper-Hughes and Lock, 1987) especially when sickness is not legitimised – that is, inconsistencies between people not feeling well, but not recognised as sick can highlight areas where social understandings of illness and sickness are lacking. As much as the sick role can be afforded to someone, it can also be refused in cases where the illness/disease is not readily socially recognised as such (Wiley and Allen, 2013).

### *1.3.1 Studying menopause variation from an ecological perspective*

Incorporating an ecological approach to my research question allows the expansion of exploration of determinants of menopause variation into larger facets of the environment which would not be considered through traditional public health enquiry. In this thesis my ecological approach is visualised in Figure 1.3, which outlines different levels of ecological interaction starting at the individual level, extending towards the micro-level, the meso-level and macro-level interactions. As a starting point, there are many features of the individual which can interact with the ecological context to produce variation in menopause experience. This ranges from genetic and physiological heterogeneity, characteristics of ethnicity, body shape and composition, gender identity, disabilities, comorbidities, and neurodivergence. This is by no means an exhaustive list – rather it is to illustrate that the body itself can be a source of variation in how it interacts with the wider environment.

This model also does not differentiate between biotic and abiotic features of the environment – interactions can occur between people, infrastructure, and systems of knowledge. Also significant to the model is spatiality – that a person's physical location is also a possible locus of interaction with potential to produce variation in experience. Additionally, this model incorporates temporality. This is the recognition that these interactions are in a constant state of flux and change over the life course of the person. As ecological interactions can manifest in epigenetic and developmental plasticity, these past interactions can continue to influence

lived experience into adulthood and old age. Thus, a consideration of the past environment is equally important in the ecological context.

Beyond the individual level, this model also incorporates micro- and meso-level interactions between individuals and their environment. Micro-level factors include those which interact directly with the individual during their lifetime. Micro-level ecological interactions therefore include those with the individual's family and household, work and career pathways, friends and social acquaintances, and their finances. Extending beyond the micro are meso-level ecological interactions, which are largely characterised by the organisational structures the individual will frequently interact with such as healthcare access, local authorities, and their environmental surrounds.

As ecological interactions extend beyond the micro and meso levels, the interactions between the person and macro-level structures become less tangible but, nonetheless, can still be influential in manifesting variation in menopause experience. Macro-level structures such as national economy, global assemblages of knowledge sharing, and systems of knowledge production interact by shaping the form of infrastructure and access to information that people interact with. Covid-19 is also included in this level, as the global event of a pandemic manifested in considerable restrictions and limitations to people's lives from a national scale to a household scale. Furthermore, there are sociocultural phenomena which manifest across all levels, such as the shared ideas, practices and values which shape individual behaviours, opinions and comportment. These behavioural influences can be shared across family and social units, or groups extending towards regional, or national populations. These shared ideas, practices and values can also be transmitted through mainstream media discussions around menopause.

This ecological model builds on the previous literature review, incorporating previously identified factors shaping menopause experience from both the biomedical and social sciences literature. It is from this model that I will draw on features of the ecological context to explore the interaction between ecology and menopause experience in my subsequent analysis.

While introducing the ecological concepts that I will explore in this thesis, I want to state two dimensions of lived experience that I will not be approaching through

my analysis – those of gender identity and race. I recognise that race and gender identity play a significant role in shaping the experience of not only menopause but also everyday life. It is the magnitude of this difference that has shaped my decision to not include the intersections of race and gender identity in my research scope – I believe that both these facets merit their own dedicated research agendas, and that any conclusions I draw from my thesis will not do justice to the true impact of race and gender identity in shaping lived experience. In my position as a white, cis-gender researcher I do not possess a familiarity with the lived experience of navigating systems of racism and transphobia which would allow me to make meaningful contributions to understanding how race and gender identity shape menopause experience.

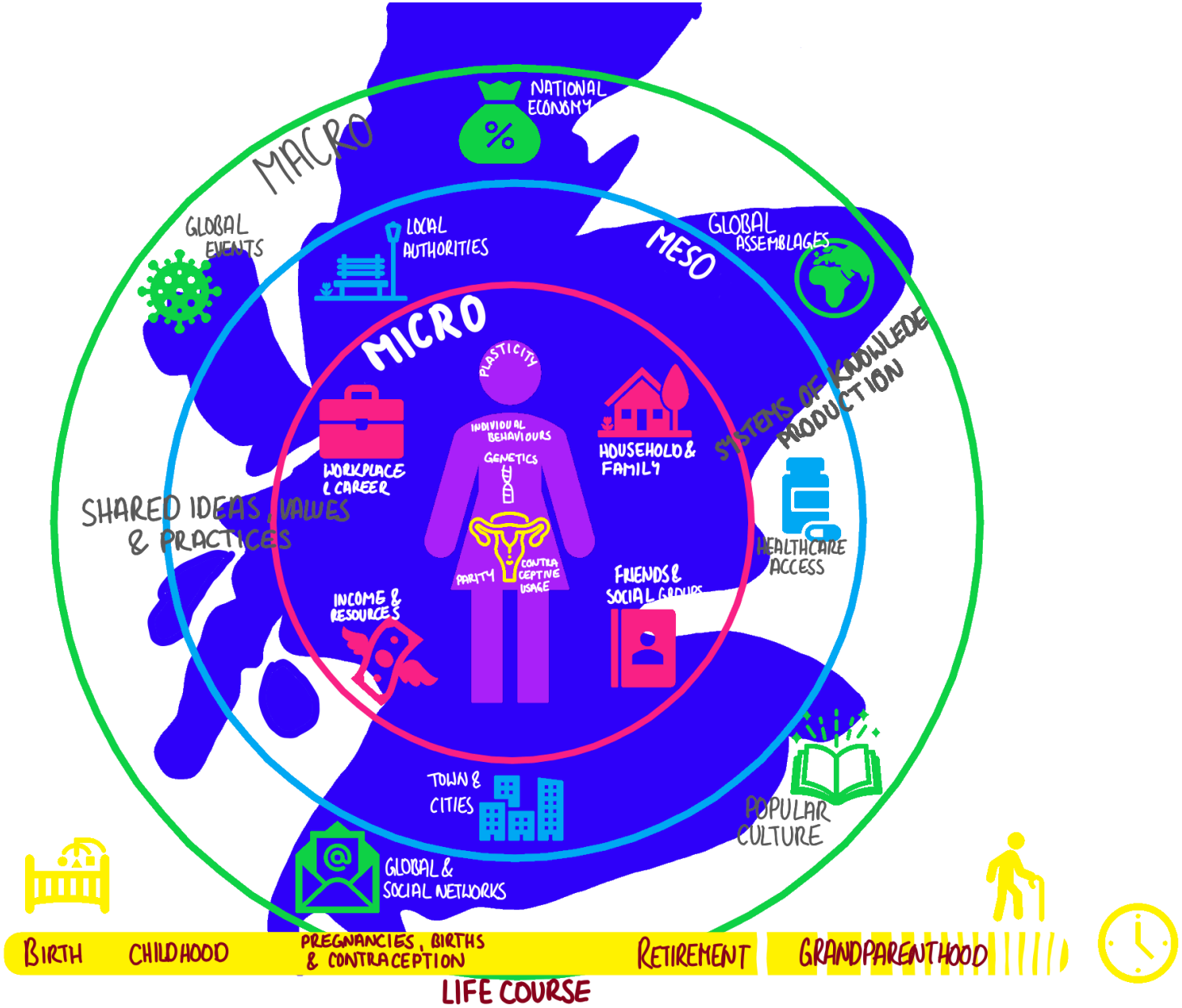


*Figure 1.3: An ecological model. This model indicates potential interactions which could produce variation in menopause experience.*

## 1.4 Research questions and thesis outline

In this thesis, I aim to explore how ecological factors shape diversity in menopause experience of women in the UK. At a more detailed level, this overarching question is broken down into 4 sub-questions:

- *Do patterns in age at menopause exist across temporal or spatial distributions in the UK?*
- *Do trends in age at menopause mirror trends in rates of ageing?*
- *What is the breadth of variation in menopause experience within the UK?*
- *What role does the lived environment play in shaping menopause experience?*

As these questions indicate, intrinsic to my research questions is the ability to capture not only the breadth of diversity in menopause experience, but also the scope of ecological interactions and their role in influencing menopause experience. To do so, I use both quantitative and qualitative methods to maximise my ability to answer this question. I also situate my research into menopause in the context of menopause as a facet of the female ageing process which has been systematically excluded from public health research. Thus, I maintain a critical and reflexive approach throughout, which considers ways in which knowledge production in public health contributes to this exclusion, and how this can be mitigated.

This thesis is structured as follows: in Chapter 2, I explore ways in which biomedicine as a system of knowledge production underpins public health research, as well as the limitations to its conceptualisation of women's health. In doing so, I establish the ontological and epistemological implications of quantitative and qualitative methods in addressing my research question, and how I will utilise both in a mixed methods approach in this thesis. In Chapter 3 I explore how variation in menopause experience can be understood from an evolutionary ecology perspective. The purpose of this exploration is twofold – I use it as a basis for the formation of the hypotheses I test in my quantitative exploration, as well as to address conceptual limitations to women's health in public health that I outline in Chapter 2. In Chapter 4 I discuss my quantitative research on variation in age at menopause within the UK Biobank. This chapter aims to explore whether

patterns of timing in age at menopause exist spatially and temporally, and to explore whether age at menopause is associated with other measures of rates of ageing. In Chapter 5, I introduce my qualitative research which consists of development interviews and an online qualitative survey designed to capture the diversity of menopause experience in the UK. I expand on these results in Chapter 6, where I explore the results of my qualitative analysis through a biocultural lens. In Chapter 7, I integrate the findings from my quantitative and qualitative research in order to address the overarching questions I have introduced above. I will explore whether I have been successful in capturing the ecological context through my research, and the extent to which each method was effective in capturing breadth of variation in menopause experience. In this final section I will also consider the real-world implications of my findings, particular with regard to the increasing visibility of menopause in a public context.

# 2 Chapter 2: The epistemology of quantitative, qualitative, and mixed methods

## 2.1 Situating a mixed-methods approach to menopause

In my menopause research I aim to place considerable emphasis on not only the subject matter, but also the research methods used to pursue my research question. This is due to the particular positionality of menopause within the biomedical context – one that has caused it to be systematically excluded from public health research. As methodology can be just as influential over the results as the planning of a research project and the data generated, I adopt a reflexive approach to all my research methods, in order to incorporate understanding of how my methodology has shaped my findings. In this Chapter, I outline current conceptual approaches towards women's health and menopause within biomedicine and how this has shaped its study specifically in public health research. I then explore how quantitative methods are informed by this biomedical conceptualisation, and the epistemological implications this may have regarding my use of quantitative methods in this thesis. I go on to outline the ontological and epistemological basis of my qualitative approach, and how this may address the deficit in knowledge production generated by quantitative methods. Finally, I will consider how the two approaches can be consolidated into a mixed methods research design, and the strength of this approach relative to using one research method over the other. This chapter will act as a prelude to the contents of this thesis, where I will outline my specific methods further in my respective quantitative and qualitative chapters.

## 2.2 Biomedicine and women's health: epistemological approaches

### *2.2.1 Biomedicine and the conceptualisation of health*

In this section, I outline current biomedical approaches to women's health and menopause, to illustrate how women's health is reduced, pathologised and controlled for in the biomedical sciences. I will also explore how these conceptualisations extend to menopause, and how they shape biomedical approaches towards menopause in a research and clinical setting.

Epidemiology is the study of disease incidence and prevalence within a population, and a discipline whose results heavily influence public health practices, which aim to improve population health. The aims of the two disciplines are complementary,

with epidemiology understanding disease incidence and public health aiming to address it. Thus, both disciplines inform each other and, more importantly, tend to rely on Western biomedical principles to construct the perception of the very diseases they strive to study.

Western biomedicine originated around 300 years ago, when medical practitioners attempted to emulate the successes of the fields of physics, chemistry and biology who were discovering the 'natural laws' - a focus on cause and effect (Lock and Nguyen, 2010). To find these natural laws of medicine, the focus of medicine became the physiological and biochemical processes at the objective level of the tissue. Central to biomedical theory is the importance of reductionism, empiricism, and causation in the study of disease. Reductionism is fundamental to the biomedical view of health, and postulates that nature, society and the body are separate discrete entities of life and that all systems within each can be reduced to the pure level of natural law (Davis-Floyd, 2003). Further reductionism occurs to distinguish separate factors of the body and health from one another. Thus, it is imperative to look beyond “layers of rationality, culture and anatomical differences” in order to access the pure physiological and biochemical processes of the body to be objectively studied (Gordon, 1988). This view posits that all organs and bodily systems are autonomous units within the person, functioning separately within the same space. To separate and reduce all functions of the body in this way allows biomedicine to consider itself separating the ‘facts’ of the body from ‘values’ imposed by non-biological confounders (Gordon, 1988). To achieve neutrality and universality in laws of health and disease is to achieve a biomedical positivistic view of health, namely that biochemical and physiological mechanisms will follow a law in response to a stimulus. In this way, medicine and the act of treating illness becomes a universal for physicians, allowing one treatment to be applicable for any individual.

The biomedical definition of ‘disease’ is ontologically positioned in the context of positivistic laws, especially in relation to the difference between health and disease. Health, in this context, is often based on a disease/non-disease model. Biomedically preferred boundaries between the two are those which are discrete, objective, valid and reliable (Kaufert, 1988). Biomedicine aims to identify the chemical and physiological mechanisms that underlie physical manifestations of disease in the body. The ontological representation of disease – being able to

identify a pathological entity is to be able to foresee a medical action – reinforces the positivistic goals of biomedicine and equates identification of the cause of disease to an effective cure (Canguilhem et al., 1978). To restore health, pathological processes should be eradicated. From the disease/non-disease model advocated by biomedicine, health is considered as the condition of being that remains when illness and dysfunctions are eliminated from the individual. Disease, therefore, is equated with deviation from the norm. The importance of deviation in restoring health positions pathological phenomena as variations in physiological functioning (Canguilhem et al., 1978). From this perspective, there is no variation in nature which does not constitute a degree of pathology.

### *2.2.2 Biomedical approaches to women's health*

Biomedical conceptualisations of health in turn frame conceptualisation of women's health more specifically. This is evident not least in the inherent pathologisation of women's health, and in the biomedical hegemony within public health institutions which has perpetuated a limited research scope and systematic exclusion of women from clinical research. As I explore below, the inherent pathologisation of women's health is directly related to the biomedical tenet of the pathologisation. The hegemony of biomedical institutes in public health also reinforces limitations to women's health research.

A major limitation of the biomedical framework in public health research specifically involving women's bodies is a systematic exclusion of females from many levels of biomedical research. Given the importance of positivistic, systematic objectivity in biomedical research, the pathologisation of women's reproduction is often used as a valid reason for the exclusion of females from biomedical studies ranging from cellular experiments to clinical trials. The 'unpredictability' of women's health stemming from the cyclicity of the menstrual cycle, as perceived by the biomedical model, is used to justify its exclusion on the grounds of 'ensuring controllability' within test subjects (Mazure and Jones, 2015). By perpetuating the idea that women's health is predisposed to dysfunction, the use of all-male test subjects is argued as an appropriate solution to controlling for health in the sample. The systematic exclusion of females occurs at all levels of biomedical knowledge production, throughout preliminary cellular and animal trials into human trials. Thus, at every stage of biomedical research male bodies are upheld as the standard of health, propagating the assumption of female bodies

as deviant (Johnson and et al., 2014). Explicit studies into women's health also reinforce this dichotomy between the 'normal' male body and the female body – *women's health* as an area of interest distances research into aspects of women's health apart from other areas of health and disease.

The conceptual limitations explored above have come to pervade biomedical public health discourse, due to the ways in which public health as a discipline has been constructed. Biomedicine is a dominant perspective and thus its prominence in research perpetuates the limitations it confers. To understand how biomedicine has achieved its place of prestige in public health, the biomedical tenet of causation must be addressed. The prominence of causation follows from a positivistic approach to human health. The social construction of disease within epidemiology and public health builds upon these tenets of biomedicine as well as leaning heavily on the history of public health and germ theory to inform its perception of disease. Public health as a discipline originated from the identification of pathogenic sources of disease, cementing the central tenet that specific disease states are achieved only by necessary causal factors (Lock and Nguyen, 2010). Germ theory identified discrete, specific and external causal agents for disease processes such as pathogen spread (Trostle, 2005). Through the early success of public health campaigns against infectious diseases, causal factors affecting biochemical and physiological processes in the body became emphasised in public health campaigns and epidemiological studies (Trostle, 2005). The success of this approach relative to other medical approaches, stemming considerably from mid-20$^{th}$ Century public health campaigns against infectious disease, has granted the systematic objectivity in biomedicine therapeutic efficacy over a broad range of other medical approaches (Lock and Nguyen, 2010). Additionally, the focus on causal factors and identifying population-level patterns within epidemiology reifies the use of quantitative data and analysis to address research questions in population health (Trostle, 2005). Public health, based on the biomedical conceptualisation of health, becomes primarily associated with the eradication of deviant pathologies.

Aside from the conceptual limitations of the biomedical perspective, functional limitation can be found in the dominance of biomedical research in funding and public health academia (Gabbay, 1999). This in turn perpetuates the limitation of

biomedical research regarding women's health, as the avenues of research which are funded and facilitated are those most acceptable to the biomedical paradigm.

Bias in favour of biomedically-informed research has arguably impacted the establishment of interdisciplinary biocultural research studies, limiting the number of studies focusing on novel approaches to public health questions (Gabbay, 1999). Thus, despite efforts to expand public health research to address women's health needs, biomedical institutions will not enable such research to be funded or conducted. This has been attributed to the co-evolution of public health as a discipline with biomedical studies, causing students and academics to naturally follow well established biomedical paths in research (Gabbay, 1999). Interdisciplinary studies which are not inherently grounded in biomedicine are not easily facilitated by public health institutions. Within the UK specifically, most funding for public health programmes comes from NHS research and development programmes, the Medical Research Council, and medical/health charities (Gabbay, 1999). The hegemony of biomedicine in the UK is also coproduced by the politicisation of healthcare in relation to the welfare state. Power over health policy has been ceded by politicians to the medical profession given their importance in the running of the NHS (Quirke and Gaudillière, 2008). This situates professionals with a biomedical background as gatekeepers of public health funding (Quirke and Gaudillière, 2008). Empowerment of clinical medics and academics with biomedical backgrounds has allowed the hierarchy of biomedicine over biocultural approaches to be maintained. As long as this hegemony persists, structural barriers will exist for conducting research which exists outwith the biomedical context.

### *2.2.3 Biomedical approaches to menopause*

Having foregrounded some of the conceptual limitations to biomedicine and public health, I continue this conceptual exploration by exploring how menopause is situated within this landscape. When viewing biomedical understandings of menopause from a critical perspective, two key themes emerge in its conceptualisation. The first is a propensity for biomedical texts to place great emphasis on linking menopause aetiologically to other health issues that may arise with ageing. For example, osteoporosis is a health condition that is often intrinsically linked to oestrogen deficiency through menopause due to the role of oestrogen in maintaining bone mass. A post-menopausal woman is considered to

have elevated risk of bone fracture through bone mass depletion (Petersen and Bray, 2007, Johnson, 2013). Furthermore, when menopause is presented to a health professional, biomedical texts place emphasis on 'management' of menopausal symptoms through the prescription of hormone replacement therapy (HRT) – the exogenous administration of artificial oestrogen and progesterone to counteract the effect of depleting endogenous sources of the hormones (Sarris et al., 2009, Petersen and Bray, 2007). HRT is posited to help alleviate symptoms of menopause related to oestrogen deficiency as well as a protective measure against the impact of oestrogen deficiency on other facets of health such as bone maintenance.

The second theme which is evident in the biomedical framing of menopause is that it separates menopause from cessation of reproductive capacity. Despite menopause being considered as termination of reproductive function, biomedicine rejects the notion of menopause as permanent infertility except in cases where menopause is induced by a bilateral oophorectomy (Sarris et al., 2009). The 'end organ failure' of menopause can be reversed with reproductive technologies - a post-menopausal female provided with a 'young' oocyte and administered with exogenous hormones in the early part of the pregnancy should be able to carry a pregnancy to full term (Johnson, 2013). The ability for post-menopausal women to carry a child reinforces the biomedical understanding of menopause to be mediated by oocyte and follicle loss. Biomedicine accepts menopause as cessation of the menstrual cycle but rejects that infertility must bring an end to a female's reproductive capacity. When viewed from the perspective of biomedical pathologies where deviations from normal function become pathologised (Canguilhem et al., 1978), menopause, as mediated through oocyte loss, becomes a deviation from 'normal' female reproductive capability. It therefore lends itself to becoming pathologised through the rhetoric of reproductive organ 'failure', 'dysregulation' and oestrogen 'deficiency'. This justifies biomedical curative powers which restore 'normal' function to the female body even as it ages, such as HRT. Furthermore, objectifying menopause as inherently pathological presents menopause as a universally negative experience across all females – undergoing menopause becomes inextricably linked to adverse health outcomes associated with oestrogen deficiency. Biomedical intervention, through reproductive technologies or HRT, to 'treat' the cessation of reproductive functions become

universal solutions to menopause despite huge variation in lived experience of menopause within and between populations (Lock, 1993). The inherent pathologisation of menopause within biomedicine therefore ignores the lived experience of menopause in a reductive manner.

## 2.3 Quantitative research: epistemological considerations

As explored in the previous section, the research focus of epidemiology and the quantitative methods used for knowledge production in epidemiology are intertwined, sharing the same values of striving for the objective study of causal aetiological factors behind population level variation in health and disease. This biomedical basis also shapes the ontological positioning of quantitative research. From an ontological perspective, quantitative methods take a realist approach. Realism refers to the idea that an external reality exists independently of people's beliefs about or understanding of it (Ormston et al., 2003, Pope and Mays, 2019). Thus, in order to understand the way in which the world works, quantitative methods must strip down all confounding variables in order to seek the objective truth beneath.

Values in a research context refer to the commodifiable properties of the knowledge production which increase its desirability as a form of knowledge (Dussauge et al., 2015), in relation to how both other academics and other industries assess its validity. Values in a research setting relate to dimensions such as who decides what is worth knowing; what analytical dimensions are given more weight than others; and how data, methods and objectives acquire value. In a biomedical context, knowledge production increases in value through the quantitative analysis process which forms research hypotheses around an outcome and exploratory variable, and adequately controls for confounding variables (Trostle, 2005). Both quantitative research and epidemiology are concerned with identifying population level trends in health and disease outcomes whose patterns can be explained beyond that of chance. Analytical processes which share the same values of the theoretical background of the research project are therefore considered good practice, and as the standard for scientific interrogation within disciplines (Dussauge et al., 2015). This reproduction of these values within epidemiology and the use of quantitative methods is sustained through the standardisation of good research practice, research protocols, and tools used in data generation and analysis. Therefore, knowledge 'production' through the use

of quantitative methods in public health requires recognition that this knowledge production is tightly bound by the confines of valuable practices. Furthermore, expanding beyond these boundaries of good and acceptable practice risks depreciating the value of the knowledge production in the eyes of hegemonic biomedical systems.

Understanding the importance of these values also provides a perspective for understanding conceptual limitations of quantitative analysis, especially in health-related research questions. Quantitative methods emphasise the need to remove (or 'control for') external factors which may 'confound' the results of statistical analysis, so as to, theoretically at least, achieve conditions where all individuals differ only in terms of their exposure factor of interest (Elwood, 2007). This process mirrors the theoretical principles of biomedicine, which reduces all layers of analysis (such as social and cultural) to the physiological locus of health and disease (Gordon, 1988). In doing so, however, the applicability of knowledge obtained through such practices to the wider context is questionable. Latour raises the issue of modifications made by scientists in order to produce scientific knowledge, and their consideration (or lack thereof) of the social context:

> *"The cost of making society conform to the inside of labs so that the latter's activity can be made relevant to the society is constantly forgotten, because people do not want to see that universality is a social construction as well"* (Latour, 1983)

While the ability to control for external factors increases the value of knowledge produced by quantitative methods to biomedicine - especially in a global context where biomedical approaches to health occupy a hegemonic position - it is important to consider the implications of this. If all knowledge relating to health is purposefully conducted to remove the social context of individuals, then the actual impact of social context on health remains undisclosed. Furthermore, research which does include social context may attempt to approximate social contextualisation through numerical variables such as the Townsend Deprivation Index or Scottish Index of Multiple Deprivation (Conway et al., 2019), which also calls into question how effectively complex social context can be condensed into a simple numerical variable. Conversely, research which includes multiple social factors may also risk being deemed unvaluable through a lack of standardisation.

## 2.4 Qualitative research: epistemological considerations

In public health, qualitative research is very often defined in contrast to quantitative research to justify its purpose in the research agenda. However, the uses of qualitative research differ inherently from quantitative research ontologically and epistemologically in a way which stands independently from quantitative research. Qualitative approaches do not seek to measure the scope of health and disease within a population, but more so focus on the lived experience of health and disease, such as an individual's experience with healthcare settings and treatment options.

Epistemologically, qualitative methods approach reality as grounded in an individual's perceptions or interpretations (Ormston et al., 2003, Pope and Mays, 2019). This stance is less ontologically rigid than the realism adopted by quantitative research (Pope and Mays, 2019, Ormston et al., 2003), and places the researcher in a position where they acknowledge the subjective nature of tools, frameworks, and judgements used in the research process. Furthermore, qualitative researchers within the health sciences may take a stance of subtle realism, or critical realism which accepts that biological phenomena can exist independently of our perception of them, but that our experience of this is enshrined in subjectivity (Ormston et al., 2003, Pope and Mays, 2019). This approach also allows recognition of how a singular biological basis, for example the physiological component of disease, can be experienced in a multitude of different ways by different people. This introduces the ability to research the breadth of these experiences related to the disease given the role of the individuals' perception of the event in shaping their lived experience.

From the ontological basis of critical realism, we can understand the epistemology of knowledge generated through qualitative research. Compared with the deductive approach of quantitative analysis, whereby statistical analysis seeks to support or counter a hypothesis derived prior to the analysis, qualitative analysis - particularly thematic analysis - takes a more inductive approach (Ormston et al., 2003, Pope and Mays, 2019). In this form, the data are collected and analysed first, after which knowledge and theories are built upon the results. This process is not entirely inductive, however, as qualitative analysis necessitates the understanding that the initial research plan has been inherently shaped by the researcher's background knowledge (Ormston et al., 2003, Braun and Clarke, 2020). Reflexivity

around the inextricable link between the researcher and the knowledge being produced foregrounds the role of the researcher in shaping the data collection, analysis, and interpretation (Braun and Clarke, 2020, Ormston et al., 2003, Pope and Mays, 2019).

Qualitative research has been used to describe and understand phenomena of health and disease in a way which captures depth and richness of lived experience (Ritchie and Ormston, 2003). The locus of interest is not the prevalence of health and disease but how these are experienced, made sense of and communicated to researchers (Ritchie and Ormston, 2003). In line with a critical or subtle realist perspective, the underlying physiological mechanism of these experiences may be the same, but the experience of these can only be accessible through the perception of individuals (Ormston et al., 2003). Such an approach ultimately reduces the influence of the conceptual limitations relating to women's health as outlined earlier, particularly when this may be implicitly introduced through the data and analytical techniques. This does not entirely remove these influences, as they may still enter through the researcher and their decision-making, but overall knowledge production is less conceptually constrained to current frameworks.

## 2.5 Mixed methods: Bringing the two together

Given the questions I aim to address in this thesis, a mixed methods approach allows me to explore how women's health may best be understood, and which ontological positioning may be the most useful to adopt. Indeed, given the above differences in ontology and epistemology between quantitative and qualitative methods in public health, it becomes salient to question how quantitative and qualitative data can be synthesised to produce a mixed method enquiry into variations in menopause experience. Mixed methods approaches in public health have previously come under scrutiny, particularly when quantitative analysis is foregrounded in a way which does not invite collaboration with the qualitative analysis (Ritchie and Ormston, 2003). However, an awareness of the ontological and epistemological differences in both methods of analysis can be used to the advantage of a mixed methods approach, with each compensating for the others' methodological blind spots (Ritchie and Ormston, 2003), contributing to a more rounded research project. In this integrative approach, both research methods can be conducted separately, and then are corroborated together to assess each

method's utility and power in addressing the research question (Flick, 2017, Ritchie and Ormston, 2003, O'Cathain, 2019). As such, the conceptual differences between methods becomes an area of exploitation – while the methods are incommensurate, they are not incompatible, as I go on to explore here and over the course of this thesis.

I aim to use quantitative methods in this thesis to explore patterns in age at menopause by utilising conventional public health and epidemiology approaches. My aims of this are threefold: I first aim to address my specific research questions, and explore what we can learn about menopause from a quantitative perspective. In a wider context, I also want to learn about the realities of researching women's health within biomedical conceptualisations; and to explore whether using an alternative framework or approach to women's health within a quantitative space may produce more salient knowledge. The alternative framework to biomedical approaches I propose to use is an evolutionary approach to women's health, which I introduce in the following chapter. With this approach, I hope to address and alleviate some of the conceptual limitations and assumptions surrounding menopause research.

As the ontological positioning of qualitative methods does not subscribe to the same conceptual limitations found in quantitative analysis, knowledge produced through qualitative interrogation is not subject to the specific epistemological and conceptual limitations found in biomedical approaches towards women's health. By using qualitative methods, I aim to explore the breadth of variation in menopause experience as it relates to the lived experience of research participants. Through this, I hope to understand how menopause experience is constituted and what elements of that experience matter most to those who experience it, as well as interrogating how the environment may shape these experiences.

By incorporating both quantitative and qualitative methods in a research project to explore variation in menopause experience, I aim to increase the scope of knowledge production in a broad sense - such as exploring population level patterns of age at menopause, as well as exploring wider variation in lived experience of menopause to add rich detail to menopause as a phenomenon which is currently poorly understood. Utilisation of quantitative and qualitative

approaches within the same research project will also permit me to assess the relative strengths and weaknesses of both approaches in their ability to answer my overarching research question. Indeed, as the research question includes two components – that of variation in menopause experience and the role of ecology – an integrative mixed methods approach will also allow me to assess each method's ability to capture environmental influences during the research process. In the discussion section, I will evaluate each method's abilities to capture both the environmental context of the research question, and dimensions of the menopause experience. By integrating two ontologically and epistemologically contrasting methods, I aim to gain a clearer picture of the process of knowledge production in Women's Health research, including barriers and how we may be able to alleviate them.

# 3 Chapter 3: The evolutionary ecology of age at natural menopause

In the previous chapter, I outlined the ways in which the biomedical conceptualisation of women's health exists as it does, and how this is perpetuated throughout clinical medicine and public health. This understanding of health and disease recognises only proximate causes of disease, that is, the biochemical and physiological mechanisms mediating health and disease during the lifetime of the individual. Viewing biomedicine through the perspective of the Tinbergen-Mayr framework, which considers both proximate and ultimate origins of a trait, reveals this proximate perspective cannot offer a complete biological explanation for health and disease (Nesse et al., 2010). A complete biological explanation considers proximate and ultimate origins of a mechanism – what is the mechanism; how did the mechanism develop; whether and how was it given a selective advantage; and what is its phylogeny. Evolutionary perspectives therefore allow the understanding of why issues of health and disease manifest in the body the way that they do. In this section I will explore how an evolutionary approach to health can be used to alleviate some of the conceptual limitations present in biomedical approaches to menopause. I will also extend an evolutionary ecological approach to understand both how and why timing in menopause varies within and between populations. From this evolutionary perspective, I will suggest hypotheses which can be used to explore the causes of this variation.

## 3.1 Evolutionary approaches to women's health

Evolutionary medicine consists of all areas in which evolutionary thought productively informs medical and epidemiological issues (Stearns, 2012). In particular, evolutionary approaches to medicine take the perspective of finding the ultimate causes of health and disease and thus aiming to answer the question 'why does the body function as it does in health and disease'. Through reconceptualising any vulnerabilities and patho-physiologies as evolutionary trade-offs, evolutionary medicine aims to describe health and disease in terms of adaptive functions. While modern medicine and the biomedical approach to health allows understanding of how a patient has become ill, evolutionary medicine adds the dimension of the evolved history of the complaint itself and how it has

intersected with the developmental history of the individual to produce the end result of sickness (Cournoyea, 2013).

The four main pillars of research in evolutionary medicine can be separated into: investigating the origin and adaptive function of physiological processes; the adaptive use of supposed dysfunctions mismatched to modern lifestyles; evolutionary mechanisms that shape modern host-pathogen interactions; and genetic dynamics of human populations (Cournoyea, 2013). Through these aims evolutionary medicine as a discipline has distanced itself substantially from the aims of historic 'evolutionary medicine'. The pseudoscience of early evolutionary medical thought, namely racial superiority, health-emphasised racial superiority and fears of degeneration have been repudiated by the discipline not only through advances in modern genotyping methods but also, hopefully, through reduction of institutionalised prejudice and bigotry.

By understanding the origin and adaptive function of a physiological process, its relative importance within the body in terms of trade-off and resource allocation can be understood. Broad physiological systems such as the reproductive and immune systems both exhibit distinct patterns in time of nutritional stress that allow their relative importance to the fitness of an individual to be seen. Physiological systems which are preferentially treated in times of nutritional stress, at the detriment of other bodily functions, in contemporary humans can show their importance in the maintaining or increasing fitness of the individual in the past. Biases towards different physiological systems can then affect the general health of an individual through influencing development of diseases later in life. This understanding that an individual organism's adaptation may sacrifice future health for short-term survival may prove itself to be an increasingly important concept in the study of non-communicable diseases and geriatric medicine (Boyd, Cordain & Lindeberg., 2002).

An evolutionary approach to health recognises patterns of frequency in phenotypic variation of health and disease within and between populations. This genetic variation can emerge through several evolutionary processes such as random mutation, drift, migration and bottlenecks (Stearns, 2012) (Nesse, 2010). Statistically significant changes to distribution of population phenotypes can occur through natural selection, an evolutionary process which involves the concept of

fitness and reproductive success in causing adaptive phenotypes. Thus, the more a trait increases the fitness of the individual, the more likely it is to be fixed in the gene pool of a species. Health can therefore be conceptualised as bodily processes that confer reproductive success (Alvergne & Tabor, 2007)

This previous point has a significant impact for the conceptualisation of women's health in evolutionary medicine. As health becomes a means to an end of reproductive success, and reproductive effort and output differs between the sexes, sex-specific approaches to health become crucial to an evolutionary approach. This suggests two things: that there is a blurring of the boundaries between 'reproductive' health and non-reproductive health, where non-reproductive functions can be at the mercy of control by the reproductive system, to maximise fitness. Secondly, as males and females have two different reproductive systems, male and female health will have an inherently different reaction to the interaction between their reproductive system and health. This perspective justifies for considering women's health beyond reproduction, and recognising that the reproductive system has the capacity to affect the whole body. It also justifies a sex-specific approach to health and disease – the female body is not simply a variation of the male body, but exists as an entity in its own right. To consider the interaction between the reproductive system and other physiology necessitates a sex-specific approach to questions of health and disease.

As a point of clarification, in this thesis I will explore evolutionary approaches to health and disease. This approach shares similar terminology to evolutionary approaches to human behaviour. I do not engage with any such approaches, including evolutionary psychology, behavioural economics or behavioural ecology, in this thesis. This bounds the context of my focus on the physiology of menopause and menopause timing, and that the hypotheses I engage with do not extend to behaviours surrounding menopause.

## 3.2 Integrating ultimate and proximate explanations

As detailed in the previous section, I seek to answer the ultimate question "*Why does variation in age at natural menopause exist?*" together with the proximate question "*How does variation in age at natural menopause occur*". In other words, I aim to integrate proximate understandings of ovarian ageing with evolutionary, historical approaches to menopause timing, which include both adaptationist (i.e.

menopause timing has fitness benefits) and by-product (i.e. menopause timing has no fitness benefits) hypotheses (Stearns, 2012, Nesse et al., 2010)). Recent studies on menopause timing view age at menopause as a facultative adaptation – i.e. menopausal age varies in response to ecology in a way that maximizes fitness (Galbarczyk and Jasienska, 2013, Skjaervo and Roskaft, 2013, Yang et al., 2019, Chan et al., 2020). However, these studies are generally silent with regards to physiological understandings of ovarian ageing. By contrast, the hypothesis viewing human menopause as an evolutionary by-product of the selection for an elongated lifespan is consistent with the finding that ovarian ageing is constrained by somatic processes rather than triggered. In this way, the determinants of age of natural menopause may be similar to the genetic, developmental and ecological determinants of somatic ageing.

### *3.2.1 Physiological understanding of menopause timing (proximate approach)*

At the physiological level, the transition towards menopause is generally understood in terms of the processes of ovarian ageing and follicular atresia - the apoptosis (or programmed cell death) of oocytes (egg cells) (Narkwichean et al., 2017). Ovarian ageing is the process whereby the ovaries decline in their ability to recruit and develop successful oocytes (Wang et al., 2017). Ovarian ageing adversely affects female fertility, reducing the probability of successful pregnancy due to increasingly poor quality of follicles. The follicle is the cellular structure containing both the oocyte and surrounding granulosa cells and is recruited during the follicular phase of the menstrual cycle. If the follicle is of low quality, it will undergo atresia – programmed cell death - hypothesised to be under the control of the supporting granulosa cells (Tatone and Amicarelli, 2013, Banerjee et al., 2014). As the ovary ages, both the quantity and the quality of follicles decreases (Zhang et al., 2016), a process referred to as follicular depletion. At menarche the number of follicles is approximately 300,000-400,000 and reduces to below 1000 at menopause (Forman et al., 2013). The ovary loses follicles through 2 ways: ovulation and follicular atresia. As ~400 follicles are released through ovulation during the reproductive lifespan, the main source of follicle loss during the lifetime is atresia (Forman et al., 2013), with the rate of follicle loss also being influenced by multiple factors. Thus, while menopause is co-produced by ovarian

ageing and follicular depletion together, ovarian ageing is constrained by somatic ageing of the follicle.

Perhaps one central issue to integrating ovarian ageing with somatic processes of ageing is that the oocyte itself is a germ cell. While the oocyte may possess multiple defense mechanisms against ageing, the somatic granulosa cells which surround the oocyte in the follicle *are* subject to somatic ageing. As the somatic granulosa cells decrease in quality, the quality of the overall follicle (including the oocyte itself) decreases and is at risk of undergoing apoptosis.

Ovarian ageing is often centred on the role of mitochondria, exploring the role of dysregulated respiration in the ageing process. Mitochondria are responsible for energy production and also producing damaging reactive oxygen species (ROS) and reactive carbonyl species (RCS) through respiration. Primordial follicles can be kept in a state of arrested prophase for upwards of 50 years and so there is potential during this arrest for damage to accumulate in the oocyte while it is quiescent (Hammond et al., 2016). However, the oocyte itself is well protected against oxidative damage, and it has been suggested that localised antioxidant production around the oocyte offers adaptive protection against DNA damage caused by ROS and during its suspended lifespan (Hammond et al., 2016, Zhang et al., 2015). Localised production of melatonin in the ovary, which has antioxidant properties, also supports the presence of protective measures in the ovary against the impact of long-term exposure to ROS (Tamura et al., 2017). As such, mitochondrial DNA in the oocyte is not shown to accumulate mutations during

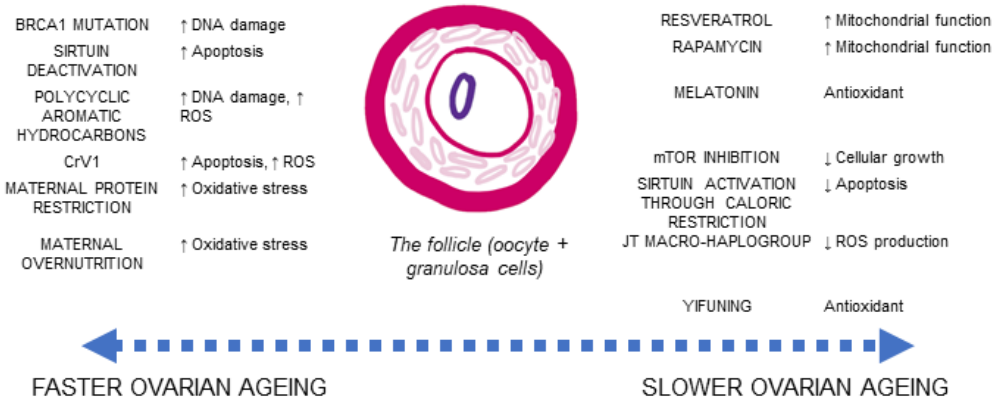


*Figure 3.1: Agents which influence ovarian ageing. Agents with their respective effect on rates of ovarian ageing. ROS (reactive oxidative species) produces oxidative stress, which contributes to cellular senescence and cell apoptosis. Conversely, agents which contain antioxidants improve overall mitochondrial function, slowing down the rate of cellular senescence. However, while some physiological processes are known, there has been no ecological study accounting for fast or slow ovarian ageing.*

ovarian ageing in the way predicted if there were no methods of oxidative shielding (Boucret et al., 2017).

The granulosa cell therefore becomes the locus for attention on processes leading to follicular atresia, as well as the site of increasing genomic instability of ageing oocytes (May-Panloup et al., 2016, Banerjee et al., 2014, Zhang et al., 2015, Boucret et al., 2017). Follicular atresia is initiated through the granulosa cells, which accompany the oocyte from oogenesis to the creation of the antral follicle. Thus, the process of follicular atresia depends on the quality of the granulosa cells – not the oocytes. The senescence of the somatic cells in the ovarian microenvironment becomes the locus for studying determinants of ovarian ageing (Tatone and Amicarelli, 2013, Banerjee et al., 2014).

Follicular depletion becomes implicated in determining the age at menopause when depletion causes the number of follicles to be below that required to support menstruation (Leidy et al., 1998). At this point, menstrual cycles become dysregulated and ultimately cease. Conventional understandings of follicular atresia rates have considered the rate to be biphasic – whereby rates of atresia are constant prior to age 35, but accelerate beyond the age of 35 (Leidy et al., 1998). This, however, is shown to be the result of misinterpreting plots of follicular atresia rates (Leidy et al., 1998). Rather, accelerated rates of follicular atresia tend to occur much later, and are more likely within several years of the onset of menopause (Leidy et al., 1998). This suggests that processes underpinning the process of follicular atresia are key to the transition towards menopause.

The rate of follicular atresia is potentially influenced by the inflammatory profile of the menstrual cycle: ovulation is characterized by inflammation of the ovaries, while menstruation has been deemed a “massive inflammatory event” (Alvergne and Högqvist Tabor, 2018). Inflammation is a major determinant of the ageing process because it releases ROS, which are free radicals implicated in the aetiology of many non-communicable diseases through the promotion of cell senescence (Franceschi and Campisi, 2014). It remains to be investigated how repeated cycles of ovulation and menstruation influence ageing of the granulosa cells and thus follicular atresia. Diversity in cyclical life-history due to either anovulatory cycles, pregnancies or hormonal contraceptives is likely to be

important for explaining patterns of reproductive senescence and the onset of menopause.

### *3.2.2 Evolutionary understanding of menopause timing (ultimate approach)*

From an evolutionary standpoint, menopause is often equated with another feature of the female reproductive lifespan – age at last birth. Most evolutionary approaches investigating the origins of menopause focus on the cessation of fertility rather than the cessation of reproduction function per se, especially in non-menstruating species. While reproductive capacity may coincide with age of last birth in other species displaying early reproductive cessation, e.g. the killer whale (Orcinus orca) (Cant and Croft, 2019, Croft et al., 2017), menopause and age at last birth do not always coincide in humans: an individual becomes post-fertile following their last birth, but they are not necessarily post-reproductive if they are still cycling (Levitis et al., 2013). Indeed, the two phases are reached on average 10 years apart in contemporary populations (Towner et al., 2016) and there is only limited correlation between age at last birth and age at menopause (reviewed in (Towner et al., 2016)). Thus, one cannot assume that the cessation of fertility is dependent solely on physiological reproductive decline. Rather, age at last birth is influenced by sociocultural and biological factors other than reproductive senescence (Bongaarts, 1978), including exposure factors (partner availability), deliberate fertility control factors (family planning, induced abortion), and natural fertility factors (lactational infecundability, frequency of intercourse, pathological sterility, spontaneous intrauterine mortality) (Bongaarts, 1978).

Why menopause timing varies has attracted little research to date (but see (Laisk et al., 2018) for a review), most research focusing on the question of why menopause - defined as the permanent cessation of fertility - exists at all in humans and in some other species. Adaptationist perspectives consider the paradoxical occurrence of fertility cessation to hold an adaptive benefit given females do not directly increase their fitness consistently throughout their adult life. In this framework, menopause - by enabling women to avoid later-life reproduction – reached fixation in humans because it conferred fitness benefits through increased alloparental care and decreased reproductive conflict and mortality risk (Cant et al., 2009, Williams, 1957, Hawkes et al., 1998, Peccei, 2001,

Ellison, 2001, Packer, 2001, Cant and Johnstone, 2008, Kirkwood and Shanley, 2010, Hawkes and Coxworth, 2013, Croft et al., 2017). By contrast, by-product theories view the emergence of menopause as an epiphenomenon – a spandrel (Gould and Lewontin, 1979) - co-produced by the finite nature of a female's oocyte supply and extended lifespan longevity which allow females to outlive this supply (Peccei, 2001, Ellison, 2001, Cohen, 2004). In this view, menopause emerged in human females because somatic longevity increased, while reproductive longevity did not. My purpose here is not to dispute which framework is more salient for understanding the emergence of menopause, as indeed processes underpinning the emergence and the maintenance of traits might differ. Rather, I use these hypotheses as a guiding framework for explaining why age at menopause varies.

Recent research into the timing of menopause has taken an adaptive stance. In this view, menopause is a facultative trait where menopause timing responds to ecological factors such as daughter's reproductive success, dispersal patterns and living in the matrilineal/patrilineal household (Cant and Johnstone, 2008, Skjaervo and Roskaft, 2013, Yang et al., 2019). Studies have found little support for modification of menopausal age based on either mediating factor, nor have they given suggestions for physiological mechanisms to explain how age at menopause could be affected by factors such as dispersal and daughter's reproductive success. Additional adaptationist theories, such as the 'shifting mate choice/shifting menopause' hypothesis posit that variation in age at natural menopause occurs in response to later age of reproduction, through the removal of deleterious alleles selecting for menopause, which have accumulated due to male preference for younger mates (Chan et al., 2020). Fundamentally, adaptationist perspectives have not proposed or found a genetic or physiological pathway producing a cascade which triggers reproductive senescence during midlife and would allow menopause timing to be facultative.

Comparatively, menopause timing has been seldom explored from the premise that menopause is a by-product of selection on longevity, following the decoupling of somatic and reproductive lifespan in human females. This may be due to the unclear directionality of mechanisms considered to be involved in the decoupling of reproductive and somatic lifespan - a prerequisite for this hypothesis. Female reproductive skew, and the front loading of reproductive events, is invoked as a

mechanism that could be the cause of the evolution of menopause as it would decrease selection on extended reproductive lifespan (Peccei, 2001). However, given that the preference for younger females is found in humans (Chan et al., 2020, Takahashi et al., 2017) but not particularly in chimpanzees (Takahashi et al., 2017), the human male mate preference is likely a derived trait and thus the outcome, rather than the cause, of early reproductive cessation in women. Nevertheless, the length of the female reproductive lifespan in humans is comparable to that of other species of similar body sizes (Peccei, 2001), while the length of somatic lifespan is not, suggesting that extended longevity is a derived trait in humans, while the length of the reproductive lifespan is not. This raises the possibility that age at menopause (rather than age at last birth) is at least partly determined by processes underpinning somatic ageing. In this line, ageing of the human female reproductive capacity is constrained by somatic ageing of the follicles, as measured by the rate of follicular atresia. The somatic cells supporting reproduction age faster than the oocyte and the ovary are because they are less well protected from oxidative damage. Thus, reducing exposure to factors implicated in increasing longevity could increase reproductive lifespan.

### *3.2.3 Towards a Multi-level framework*

Patterns of diversity in age at menopause are poorly understood. To address this, I propose a multi-level, inter-disciplinary framework, combining proximate, physiological understandings of ovarian ageing with ultimate, evolutionary ecological perspectives on ageing. I hypothesize that evolutionary ecological factors known to influence somatic ageing variation (the genetics of longevity, early life environments, infections) can also explain rates of ovarian ageing, follicular depletion and diversity in the onset of menopause.

Overall patterns of ageing and senescence are understood evolutionarily through the Disposable Soma hypothesis, (Kirkwood, 1999, Kirkwood, 1977) where the body's capacity to accumulate deleterious senescent cells is attributed to declining selection pressure of maintenance mechanisms as age increases, due to increasing extrinsic mortality risk (Kirkwood, 1999). Through the evolutionary lens, age-related health decline results from accumulated damage and sub-optimal functioning of bodily systems on the molecular, cellular and organ level (Kirkwood, 1999). When menopause becomes conceptualized as the by-product of ageing of the reproductive system, by-product hypotheses of menopause are

compatible with current physiological understandings of ageing and cellular senescence. Exploration into variation therefore allows overarching theories of ageing rate variation to be applied to the female reproductive system.

Rates of cellular senescence can vary depending on the interaction between an organism and ecological factors (e.g., food availability, stress, pathogen load), producing patterns of ageing rates which vary within and between populations. Ecological factors might also influence women's cyclical life-history, producing diversity in anovulatory cycles, pregnancies, or hormonal contraceptives, which are likely to be important for explaining patterns of reproductive senescence and the onset of menopause. These ecological factors will be explored in the next section in relation to current epidemiological understandings of variation in age of natural menopause.

## 3.3 Understanding Patterns of Menopause Timing

In this section, I review the role of genetic, environmental and reproductive factors in explaining diversity in somatic senescence rates - in other words, ecological interactions which influence somatic ageing. This follows from the previous section where we suggest how these might be applied to understanding diversity in ovarian ageing. I suggest that there are common genetic factors between extreme longevity and age at menopause with regards to genes mediating metabolic profiles, metabolism, and oxidative shielding. Following research showing that the early life environment influences the pace of reproductive development and life-history "strategy", I hypothesize that poor early life environment may result in lower embodied capital, and thus earlier age at menopause. Finally, I propose that women who experience a higher number of cumulative ovulatory menstrual cycles may experience earlier age at menopause through the cumulative exposure of localised inflammation in the female reproductive organs during ovulation. I suggest that the phenotype of age at menopause is the result of an interaction between genetic, ecological factors and the cycling life-history.

### *3.3.1 Genetic factors*

Genetic factors between ovarian ageing and overall somatic ageing show similarities in the biochemical pathways in which they are implicated. Human longevity is a complex biosocial trait, with genetics being highly context-

dependent and rates of senescence resulting from a dynamic process (Giuliani et al., 2018). There are no genes which "code for" longevity in humans (Giuliani et al., 2018), and associations between alleles and longevity occur where such alleles produce a phenotype conducive for long life, especially amongst centenarians (individuals who have lived to age 100). Such phenotypes include metabolic profiles characterised by preserved glucose tolerance and insulin sensitivity; compressed morbidity and disability in later life, and general avoidance or postponement of age-related diseases; and decreased DNA methylation compared to others of the same chronological age (Giuliani et al., 2018). Such phenotypes are conducive to reduced levels of accumulated damage contributing to the functioning of bodily systems on the molecular, cellular and organ levels. These phenotypes may therefore promote both somatic longevity and reproductive longevity, thus postponing age at menopause.

Genetic factors which have been identified as contributing to the phenotype of somatic longevity, reproductive longevity or both include the following:

***APOE*:** the *APOE* gene codes for apolipoprotein E, which helps maintain structural integrity and function of cholesterol rich lipoproteins. The protein structure of APOE varies and is found to exist in 3 different isoforms which alter its function. Isoforms APOEe2, APOEe3 and APOEe4 are positively associated, not associated or negatively associated with longevity, respectively (Abondio et al., 2019). Regarding menopause, association between isoforms and reproductive longevity have been inconclusive. Heterozygous APOEe3/4 carriers show a delayed age at menopause compared to APOEe3/3 carriers in a Chinese population (Meng et al., 2012). Both APOEe4 and APOEe2 isoforms have been associated with predicted an earlier age at menopause amongst Iranian females and women of European descent, respectively (Koochmeshgi et al., 2004, Tempfer et al., 2005).

**Sirtuins:** Sirtuins are proteins which modulate metabolism, cell proliferation and genome stability. Regulation of several sirtuin genes – *SIRT5* and *SIRT7*- have been found to have a positive association with longevity, while a minor SIRT6 homologous allele, affecting its function, has been associated with decreased lifespan (Giuliani et al., 2018). Variation in sirtuin regulation has been linked to reproductive longevity, with downregulation of *SIRT1*, *SIRT3* and *SIRT6* being linked to an increased rate of ovarian ageing (Zhang et al., 2016).

**Mitochondrial Haplotype J:** Mitochondrial DNA Haplotype J is hypothesised to reduce the output of both ATP (the product of respiration) and ROS. The mtDNA J haplotype has been positively associated with somatic longevity in European populations (Giuliani et al., 2018), and was underrepresented amongst French women with depleted ovarian reserves undergoing fertility treatment (May-Panloup et al., 2014), suggesting it plays a role in reproductive longevity.

***FOXO3*:** *FOXO3* is a gene which downregulates activity on the IGF1 pathway, helping to maintain a metabolomic profile conducive to longevity (Giuliani et al., 2018). Associations between expression of *FOXO3* and reproductive longevity are unknown.

***IL6*:** Modulation of interleukin 6, a multifunctional cytokine associated with inflammatory responses by a minor allele has also been associated with longevity and the aetiology of age-related disease (Giuliani et al., 2018). Associations between *IL6* modulation and reproductive longevity are unknown.

Additional single nucleotide polymorphisms (SNPs) associated with age at menopause have been linked to genes involved in hormonal regulation, immune function and DNA repair pathways (Stolk et al., 2012). A candidate gene located on the Human Leukocyte Antigen (HLA-B) transcript has been associated with age at menopause as well as Type-1 diabetes and rheumatoid arthritis (Stolk et al., 2012). Such a gene implicates a pro-inflammatory component to physiological pathways mediating rates of ovarian ageing (Stolk et al., 2012). *BRCA1* mutations also confer an increased rate of ovarian ageing, hypothesised to be due to increased rates of double strand DNA breaks in follicles, causing subsequent increase in the rate of follicular atresia (Lin et al., 2017) (Figure 3.1).

Determinants of longevity and somatic senescence are hugely complex, with genetic factors only explaining a small proportion of variation in longevity (Giuliani et al., 2018). GWAS-identified loci and their related function only explain 2.5-4.1% of population variation in the age at menopause (Stolk et al., 2012). The genetic contribution to age at menopause, and overall senescence rates may be overpowered by ecological and environmental factors and so must be considered in relation to other exogenous factors. Despite the low contribution genetic variation makes, these studies indicate that processes of non-communicable

diseases and ovarian ageing are underpinned by similar metabolic and inflammatory processes.

### *3.3.2 Ecological factors*

Rates of age-related health decline are in part mediated by an individual's ability to accrue somatic capital – a factor dependent on environmental constraints on energy available for their growth and development. Somatic capital can be understood as the energetic investments made by the body in growth and maintenance of tissue beds and organs (Kaplan et al., 2003) which will depreciate over time through wear and tear. As the body's ability to maintain cellular and tissue function decreases over time, mechanisms in the ageing body must rely on their existing somatic capital to ensure optimal function is maintained. Somatic capital accrual can be influenced by the life history strategy of the individual. Life history theory (Ellison, 2003, Gluckman et al., 2009) broadly describes patterns of growth, reproduction and mortality in an individual's life and in a given environment. One particularly influential concept in life-history evolution is that of the "fast-slow continuum", which accounts for the fact that many life-history traits co-vary across and within species (Stearns, 1992). Age at menopause may therefore be understood as an outcome of a life-history strategy, itself contingent on the somatic capital of the female reproductive system, determined by ecological factors (e.g. food availability, stress, pathogen load). Using a life history theory approach allows investigating whether variation in age at menopause reflects overall rates of ageing in the body or is specific to reproductive senescence.

Extrinsic mortality

Life history theory posits that in environments with high extrinsic mortality (i.e. mortality independent of an individual's phenotype), metabolic investment in reproduction is prioritized at the expense of other fitness components (somatic maintenance, growth) (Stearns, 1992). This leads to the acceleration of an organism's life-history (hence a "fast life-history" strategy) (Stearns et al., 2000, Hidaka and Boddy, 2016, Nettle, 2010) and is hypothesised to affect rates of ageing and the development of age-related diseases. In humans, age at first birth in England is younger in deprived areas compared to more affluent areas, which is interpreted as a response to the ecological context of poverty (Nettle, 2010), with girls from moderately stressful environments of nutritional inadequacy

experiencing accelerated pubertal timing (Ellis, 2004). In turn, low embodied capital of the reproductive system may cause sub-optimal tissue defense (Noguera, 2017) against the oxidative stress of menstruation and reproduction, increasing rates of follicular atresia. This may ultimately accelerate reproductive ageing towards menopause. In comparison, those living in energy rich, low mortality environments may accrue higher somatic capital due to a slower life history strategy (Ellis, 2004). Higher socio-economic living conditions may therefore be associated with later age at menopause given the prolonged ability for tissue maintenance in those with higher somatic capital.

It is important to clarify at this point that life history strategies are often used in a behavioural context, to explain patterns of behavior – often related to reproduction (Nettle, 2010). Here, I use life history strategies to refer to the allocation of physiological resources, contributing to the embodied capital of the individual rather than in a more behavioural context.

Fast/slow life history theories as a predictive framework is in line with trends in epidemiological studies where earlier age at menopause is found amongst low/middle-income populations, as well as amongst those who were exposed to poor environmental conditions earlier in life (Ruth et al., 2016, Duarte et al., 2014, Mishra et al., 2007, Hardy and Kuh, 2005, Schoenaker et al., 2014). Furthermore, in Western populations, earlier age at menopause has been associated with an increased risk of cardiovascular diseases (CVD), atherosclerosis, stroke and osteoporosis (Schoenaker et al., 2014, Forman et al., 2013) while later menopause has been associated with both a reduced risk of CVD and all-cause mortality and an increased risk of breast and ovarian cancer and osteoporosis (Schoenaker et al., 2014, Henderson et al., 2008, Forman et al., 2013, Ossewaarde et al., 2005). Finally, studies into oestrogen-receptor negative breast cancer rates suggest that a fast life history strategy may result in a higher incidence of breast cancer amongst women from lower socioeconomic backgrounds (Hidaka and Boddy, 2016).

Infectious diseases

Additional metabolic trade-offs between growth, maintenance and reproduction can occur in the presence of infectious disease where energy is allocated to the immune system at the expense of other bodily functions (Ellison, 2003). Sievert

has previously explored the relationship between age at menopause and exposure to infectious diseases over the life course amongst Bangladeshi women living in London. They were found to have a significantly earlier age at menopause than other women living in London, with earlier age being strongly associated with a history of infectious disease exposure on multiple occasions (Sievert, 2014a). As immune defenses against pathogens are energetically costly, pathogen load may also contribute towards reducing bodily investment in the growth and maintenance of the body. Studies researching the effect of prolonged infection on age at menopause show a younger age at menopause amongst women with HIV compared to women without HIV in the Bronx (Schoenbaum et al., 2005), although this result is not entirely consistent (Conde et al., 2008).

Cyclical Reproductive Life History

Variation in rates of ovarian ageing may result from the cumulative exposure of the female reproductive system to cyclical inflammation, which may vary across ecologies. Reproduction in human females is characterised by cyclical fertility, with menstrual cycles completed approximately between 24 and 38 days (Alvergne and Högqvist Tabor, 2018), with the end of non-conceptive cycles characterized by menstruation, a massive inflammatory event. Localised inflammation also occurs in the ovaries during the inflammation-mediated repair of the corpus luteum immediately after ovulation (Alvergne and Högqvist Tabor, 2018). Furthermore, the ovaries are the site of oestrogen production – hormones which can act as pro-inflammatory, depending on dose. Through menstrual cycling, cyclical, systematic inflammation may contribute to damage of the granulosa cells and ovarian microenvironment, resulting primarily in the accelerated senescence of the female reproductive function relative to other organs of the body.

There is some evidence that ovarian ageing rates may vary according to the total number of menstrual cycles experienced in a female's reproductive lifespan. First, high cumulative levels of oestrogen exposure are known to be a risk factor for the development of oestrogen receptor positive breast, ovarian and endometrial cancers (Jasienska et al., 2017a, Aktipis et al., 2014, Jasienska et al., 2017b, Strassmann, 1999). Given tumorigenesis also operates through cellular damage and mutations, it is not implausible to consider the effect of concentrated cumulative oestrogen exposure on cellular senescence of the reproductive organs. Second, preliminary epidemiological data show that nulliparity (as a discrete

entity) is significantly associated with earlier ages of menopause (Mishra et al., 2017, Duarte et al., 2014). Normally cycling nulliparous women who are not taking any form of hormonal contraception do not experience the gaps in ovulation that occur during the gestation period and breastfeeding. This suggests that the female reproductive life history should be considered in its entirety – e.g., as total number of menstrual cycles experienced - rather than as a composite of discrete entities (e.g., age at menarche, parity, breastfeeding and use of hormonal contraception) as it is often approached within epidemiological studies. This approach has already been used in several epidemiological studies of breast cancer, where higher numbers of cumulative menstrual cycles have been associated with an increased risk of breast cancer (Chavez-MacGregor et al., 2005, Clavel-Chapelon and Grp, 2002, Rautalahti et al., 1993).

How ecology influences a woman's cumulative exposure to cyclical inflammation is poorly understood. A 1994 study estimated that women in contemporary western populations experience up to 400 cycles during the lifetime, compared to a median of 94 within a contemporary natural fertility population (Strassmann, 1997). In the absence of data on the cycling life-history, reproductive traits across the lifespan could be used as a proxy to estimate a woman's cumulative exposure to inflammatory menstrual cycles. Note that, ideally, it is the number of ovulatory, as opposed to anovulatory, cycles that is the most relevant measure. Proximate determinants of the number of menstrual cycles might themselves be the outcome of life history strategies explored earlier (see (Ellis, 2004)), but similar life-history 'strategies' may have different impact on the number of menstrual cycles depending on socio-cultural contexts (i.e. availability of contraception, norms around breastfeeding etc.). (Ellis, 2004)), although these life-history strategies are not necessarily prescriptive (Sheppard and Van Winkle, 2020, Nepomnaschy et al., 2020). Nevertheless, life-history and reproductive cyclicity approaches are not mutually exclusive.

Accounting for the cost of cumulative menstrual cycles may have implications for evolutionary models. First, it adds nuance to what may count as a 'cost of reproduction' – this is often referred to as the impact of reproduction and pregnancy on the female body, at the expense of physiological functioning (Ryan et al., 2018). While pregnancy may incur a physiological cost to somatic functioning (Ryan et al., 2018), it may also be protective over ovarian function

with regards to the onset of menopause (Mishra et al., 2017, Duarte et al., 2014). Thus, cyclical menstruation and pregnancy may be better considered as separate entities rather than falling under the all-encompassing 'cost of reproduction'. Second, given the physiological processes of reproductive and somatic ageing are physiologically similar, reproduction might entail costs not only for somatic senescence, a trade-off often studied by evolutionary biologists (see (Kirkwood and Westendorp, 2001)), but also for reproductive senescence. While cyclical inflammation confers fitness benefits early in life, more frequent cyclical ovulation in humans might directly influence the onset of menopause through the antagonistic pleiotropic effects of cyclical inflammation.

## 3.4 Incorporating an evolutionary ecological approach into quantitative research

In this chapter I have aimed to stimulate an interdisciplinary, multi-level framework for understanding the role of evolutionary and ecological factors in shaping diversity in age at natural menopause. By engaging with the definitions of menopause across disciplines, I ensure that proximate and ultimate approaches to menopause are addressing the same phenomenon, i.e., the cessation of menstrual cycles, rather than broader features of the post-fertile lifespan. I have shown the compatibility of biomedical and physiological understandings of ovarian ageing with evolutionary theories viewing the emergence of menopause as a by-product of recent increases in longevity (e.g. the reproductive-somatic mismatch hypothesis (Cohen, 2004)). This suggests that evolutionary hypotheses usually applied to somatic senescence (e.g., the Disposable Soma hypothesis, the antagonistic pleiotropy hypothesis, the embodied-capital theory) may also become fruitful for understanding patterns of diversity in menopausal traits.

The purpose of this chapter in the context of my wider thesis is to consider an alternative approach to hypotheses which I can test quantitatively. As I explained in Chapter 2, many quantitative approaches to women's health perpetuate the conceptual limitations towards women's health present in biomedicine. By adopting an evolutionary ecological approach, I have directly challenged the inherent pathologisation of menopause by positioning it within the normal female ageing process, and highlighting similarities between the determinants of reproductive ageing and overall somatic ageing. By utilising this theoretical underpinning, my quantitative exploration is grounded in complementary ultimate

and proximate approaches to menopause, strengthening its positioning of offering a complete biological explanation into determinants of age at menopause. I bring forward these hypotheses into the next chapter, where I present quantitative research on the timing of menopause drawing on data from the UK Biobank. Through this, I hope to examine whether patterns of variation in age at menopause exist, and whether utilising an evolutionary ecological approach supports the understanding of these patterns.

# 4 Chapter 4: Quantitative analysis

## 4.1 Background

Building on the conceptual and methodological approach detailed in the previous 3 chapters, I designed a quantitative arm to this study, using UK Biobank data. Given the paucity of knowledge on patterns of age at menopause in the UK, I had two aims for this quantitative interrogation: to investigate whether temporal and spatial variation could be identified in menopause timing; and to test the hypothesis that age at menopause (or reproductive lifespan) follows patterns of variation in rates of ageing, as quantified by life expectancy estimates and frailty measures. This avenue of interrogation followed a more traditional epidemiological approach and intended to explore whether patterns in menopause timing could be identified through quantitative research. Identification of these patterns and relationships would both aim to support the hypotheses surrounding variation in menopause timing outlined in Chapter 3 and would be integrated with the results of the qualitative analysis to explore the importance of timing to the menopausal experience. At the outset of this quantitative analysis, I initially proposed a number of analyses to explore the evolutionary hypotheses presented in the previous chapter (i.e., Reproductive cyclicity, impact of early life environment). However, I encountered many barriers to these analyses due to the structure of the dataset. As such, this chapter will not only outline the analyses I was able to conduct but will also reflect on those I was not, exploring along the way how the structure of the dataset was impacting my research plans.

### *4.1.1 Research background*

In the previous chapter I outlined an evolutionary ecological approach to age at menopause, by reconceptualising menopause timing as a facet of the overall female ageing process. In the following analysis, I will explore specifically whether an association exists between age at menopause and measures of accelerated ageing, particularly life expectancy estimates and handgrip strength.

As mentioned in the thesis introduction, there has been little study into the breadth of variation in reproductive lifespans. However, the breadth of variation in actual lifespans, and life expectancies has been widely studied both within and between populations (Welsh et al., 2021). For countries considered to have progressed through the epidemiologic transition, mortality rates are largely

determined by “degenerative and man-made diseases” (Caselli et al., 2002) – which refers to non-communicable diseases such as cardiovascular and cardiometabolic diseases, and cancers. Many countries in the global north (High income countries in Europe, North America, Asia and Oceania) are considered to be post-transitional, with mortality rates mostly determined by non-communicable diseases and diseases of old age. Non-communicable diseases and processes of ageing are physiologically characterised by cellular senescence (Childs et al., 2017) and processes such as chronic inflammation (Franceschi and Campisi, 2014), which result in the loss of function of many organ systems, and ultimately lead to death (Pickard, 2014). The rates at which cellular senescence and disease development occur also vary between individuals and can explain the variation in life expectancies found throughout post-transitional populations.

Within the UK, variation in life expectancy estimates exist both temporally and spatially. Life expectancy for women in the UK rose from 52.4 to 80.6 between the years of 1900 and 2000 (Office for National Statistics, 2015), with more recent increases from 81.8 to 83 between 2008 and 2016 (Welsh et al., 2021). In addition to this temporal variation, spatial variation is present in life expectancy estimates across the geographic regions of the UK. Female life expectancy at birth in 2001 was 80.7 for England, 80.4 for Northern Ireland, 78.9 for Scotland, and 80.1 for Wales (Office for National Statistics, 2020). Even across smaller geographical distances, variation in life expectancy can be significant – within Glasgow there is an 11 year difference in female life expectancy over a 2km distance (Whyte, 2016), and a similar 7 year decrease in female life expectancy is found in Manchester across 26km (Purdam, 2017).

Given the presence of such variation in overall life expectancy along temporal and spatial dimensions of the UK population, and the similarities between the physiological mechanisms between overall senescence and reproductive senescence, I suggest that such variation may also be present in reproductive life expectancies across the UK population.

If age at menopause patterns spatially and/or temporally in the same way as life expectancy, this may also suggest that similar factors underpin life expectancies and age at menopause. Currently, several factors which influence age at menopause have been identified, and can largely be categorised as relating to

reproductive life history, socioeconomic status and lifestyle factors (summarised in (Fraser et al., 2020)). If temporal and spatial patterning of age at menopause does exist, it may be attributed to differences in the prevalence of the above characteristics between different subdivisions of the UK population.

These risk factors provide further similarities between reproductive lifespan and actual lifespan. Factors attributed to rising life expectancy in the UK during the 20th Century include improved sanitation, nutrition and living standards, and a reduction in the prevalence of infectious diseases (Hanlon and Ebooks Corporation, 2012). Variation in life expectancy across geographical locations of the UK is associated with socioeconomic status and levels of deprivation, with low socioeconomic status and areas of high deprivation associated with a lower life expectancy (Seaman et al., 2014, Demakakos, 2019, Welsh et al., 2021).

As outlined in Chapter 3, there are many purported evolutionary mechanisms for the influence of socioeconomic status, deprivation, and life expectancy. One such interaction is the body's ability to accrue somatic capital – the energetic investments into growth and maintenance of tissue beds and organs made by the body (Kaplan et al., 2003). As the body ages, its ability to maintain cellular and tissue function decreases over time, with this declining function increasing susceptibility to many non-communicable diseases (Kaplan et al., 2003). As such, the body's somatic capital influences the rate at which the body's function can be maintained as it ages.

Relating somatic capital to overall rates of ageing, a lower somatic capital can reduce individual resilience against interactions with the environment which can lead to non-communicable diseases. Low socioeconomic status, as well as other factors associated with disadvantage and deprivation such as race and ethnicity, are associated with increased psychological stress throughout life (Lam et al., 2021, Muscatell et al., 2020, Kraft and Kraft, 2021). As such, exposure to chronic systemic inflammation through mechanisms such as allostasis of stress response (Kraft and Kraft, 2021, Muscatell et al., 2020) and increased adiposity (Lam et al., 2021) is associated with low socioeconomic status and deprivation. This is considered a factor responsible for the disparities in health outcomes and life expectancy across socioeconomic status. Therefore, a lower somatic capital and continued exposure to chronic inflammation mediated by ecological interactions

coproduce health inequalities and differences in life expectancy due to a reduced resilience against sustained environmental stressors (Lam et al., 2021).

A reduced somatic capital due to the ecological interactions between the individual, low socioeconomic status, and experience of deprivation may explain the patterns of life expectancy variation across the UK seen temporally and spatially. Furthermore, given the identified link between low socioeconomic status and earlier age at menopause, similar variation in age at menopause across the UK population may also be found. If similar variation does exist, this could suggest that reproductive life expectancy, and thus age at menopause, is influenced by the ecological interactions between the individual and their environment, beyond the risk factors previously identified (Fraser et al., 2020).

### *4.1.2 Dataset*

The UK Biobank comprises data from a cohort of men and women aged 40-69 years recruited between 2006-2011, from across Scotland, England and Wales (Fry et al., 2017). Questionnaire data was collected over four waves between 2006-2019. My choice of this dataset is based on two factors: the UK Biobank is a reputable and widely used dataset due to its considerable population size and wide range of questionnaire, biomarker and imaging data (Fry et al., 2017); and the UK Biobank indeed collects some data on menopause. The second point, that the UK Biobank hold data on menopause is a particularly crucial factor in its choice – as outlined in Chapter 1, these variables are not routinely collected in ageing cohort studies (Fraser et al., 2020). Relating to menopause, the UK Biobank provides the variable 'age at menopause' which asks the participants the age of their final menstrual period. This dataset also holds a considerable number of other covariates which have previously been associated with age at menopause:

- *Reproductive variables including age at menarche and parity*
- *Biometric and characteristic variables including BMI, smoking, ethnicity and socioeconomic status*
- *Early life variables including age left education, breastfed status, comparative size and height at age 10, part of multiple birth and exposure to maternal smoking.*

Furthermore, as this cohort was recruited from throughout the UK, there is considerable geographic spread of participants which allows for exploration of

spatial patterning of age at menopause. Additionally, date of birth in the UK Biobank spans from 1936-1970, which allows the investigation of temporal patterning in age at menopause within this dataset.

All data analysis conducted with this dataset was done through RStudio version 4.0.1 (R Core Team, 2020) using the packages *Tidyverse* (Wickham et al., 2019), *Survival* (Therneau and Grambsch, 2000), and *psych* (Revelle, 2017).

### *4.1.3 Variables of interest*

The variables of interest for exploring the relationship between ecological factors and age at menopause are outlined below – including impetus for their inclusion and discussion of their limitations.

Temporality

In relation to ecology, temporality is an auxiliary measurement for differing rates of ageing across the UK Biobank population - with auxiliary measurement referring to the use of specific variables to represent an underlying theory (Trostle, 2005). Date of birth is used as a measure of cohort effects in patterns of ageing - i.e. Those with an earlier date of birth may experience an earlier age at menopause compared to those with a later date of birth (Trostle, 2005).

Spatiality

Participants were grouped by assessment centre they attended as a proxy for their location within the UK. Spatiality is used as another auxiliary measurement of the socioeconomic environment of participants, reflecting the different ecological contexts of participants as they change across the UK. While this measurement may reflect geographic location of the participants at the time of data collection, it doesn't account for migration of participants across the lifespan or indeed their location of birth.

Rates of ageing

Rates of ageing are approximated in two ways in this analysis: through the ecological linkage of life expectancy estimates and through hand grip measurements. Life expectancy estimates at age 65 were obtained from the Office for National Statistics (ONS) (Office for National Statistics, 2020) at a similar level of spatial and temporal distribution as used with the UK Biobank dataset. These measurements are used as an approximation of population health and rates of senescence as they reflect the aggregate Age Specific Mortality Rates (ASMR) of a

region. Due to restrictions in data available from the ONS, the only estimates available were those of life expectancy at age 65. These measurements reflect the ASMRs of those 65+ in a region and thus are contingent on those measured reaching age 65. Thus, they are not representative of early life mortality in a region.

Handgrip strength is a biomarker often used as a proxy for frailty in older age, where a lower handgrip strength is associated with increased frailty and a faster rate of ageing (Gedmantaite et al., 2020, Chan et al., 2021). Compared to life expectancy estimates, it may be considered as an intrinsic measurement of rates of ageing, which reduces depending on both chronological age and muscle strength. The mean of handgrip strengths of both hands measured at initial data collection was used due to having the highest response rate.

Confounding variables

Based on the prior epidemiological studies into timing of menopause outlined in Chapter 1, I used the following variables as confounders in my fully adjusted analyses (Table 4.1).

| Risk factor | Measure | |
|---|---|---|
| Age of menarche | Continuous | |
| Parity of women with children | Continuous | |
| Pack years smoking | Continuous | |
| BMI | Continuous | |
| Age completed full-time education | Continuous | |
| Summed MET Minutes | Continuous | |
| Nulliparous | Yes | |
| | No | |
| IPAQ activity group | Low | |
| | Medium | |
| | High | |
| Ever smoked | Yes | |
| | No | |
| Breastfed as child | Yes | |
| | No | |
| Comparative size at age 10 | About average | |
| | Plumper | |
| | Thinner | |
| Comparative height at age 10 | About average | |
| | Shorter | |
| | Taller | |
| Part of multiple birth | No | |
| | Yes | |
| Maternal smoking around birth | Yes | |
| | No | |
| Ethnic background | White | British |
| | | Irish |
| | | Other |
| | Mixed | White & Black Caribbean |
| | | White & Black African |
| | | White & Asian |
| | | Other |
| | Asian | Indian |
| | | Pakistani |
| | | Bangladeshi |
| | | Other |
| | Black | Caribbean |
| | | African |
| | | Other |
| | Chinese | |
| | Other | |

*Table 4.1: Confounding variables used in fully adjusted analyses, as found within the UK Biobank. Derived from characteristics previously associated with age at menopause.*

## 4.2 Deriving the dataset

### *4.2.1 Data cleaning*

Raw data from all female participants was obtained from UK biobank and cleaned in Microsoft Excel. Most questionnaire questions had 4 waves of potential responses (2006-2010 Initial assessment visit, n= 165,354; 2012-2013 First repeat assessment visit, n=7,715; 2014+ Imaging visit, n=20,294; 2019+ Repeat imaging visit, n=1,345). Later data collection waves primarily focused on those able to attend imaging centres and thus had a much lower response rate compared to the initial and first repeat assessment visits. Indeed, the response rate for the first repeat visit was only 5% compared to the initial assessment, and 12% for the first imaging visit. Given that several variables of interest for my research questions were collected in later waves of the questionnaire data, this very low response rate has significant implications for my subsequent analysis. Also important to note is that only 4 of the 22 initial assessment centres were used for imaging visits – Newcastle upon Tyne, Stockport, Reading and Bristol served as imaging centres. Thus, data collected during the later imaging assessment waves were also largely restricted to those who lived nearby the imaging centres.

In cases where respondents provided multiple continuous variable responses to the same question, the highest value given for each participant was used. When these values related to a question where ages were being asked to be recalled (e.g. for age at menopause), this would return the greatest age given by the participant at any point over data collection. By capturing the highest value available, participants who may have experienced bleeding after their initial visit had their values updated. Given the nature of bleeding irregularity during the perimenopausal period, this accommodates the uncertainty of identifying the end of menstruation common during peri-menopause. Different responses to categorical values were also combined into one variable, as UK Biobank codes these values in respect to numbers (e.g., -3 = prefer not to answer, -1 = Do not know, 0 = No, 1 = Yes). Eliciting the maximum value given by each participant allows capturing of positive responses which may have changed during the waves of data collection, such as in cases where participants were asked whether they had used oral contraceptives or HRT.

Additional cleaning was undertaken with medication codes corresponding to participants self-reported medications during each wave of questionnaires. Selected medication codes referring to any form of long-acting reversible contraception (LARC), progesterone-only contraception (POP), or combined oral contraception (COP) were identified and matched to the brand or generic names of such medications as identified within the BNF (British National Formulary) (2019). New variables were created indicating whether the participant had identified use of LARCs, POP, or COP during the initial questionnaire, or at any point during the follow-up questionnaires.

Prior to starting a descriptive exploration of age at menopause, I had identified several potential areas of exploration from the preceding literature review, and which the initial descriptive data exploration aimed to address. First, as outlined in the introduction, I was required to clarify the exclusion criteria I would use to derive the dataset. As such, I was required to test whether different exclusion criteria for the analytical sample made a difference to the descriptive characteristics of the sample. Having done this, I would then seek to explore whether variation existed in age at natural menopause across space and time within the UK Biobank analytical sample. The results from these initial explorations would help with the quantitative analysis as well as clarifying the parameters of the analytical sample.

Regarding exclusion criteria, the prior literature review indicated inconsistencies in exclusion criteria used to capture an analytical sample containing only participants who had experienced a 'natural' menopause. In order to capture 'natural' menopause, all instances of iatrogenic menopause must be excluded, as well as cases where bleeding is influenced by exogenous factors such as hormonal medication. As summarised in the introduction, previous epidemiological research into menopause has based exclusion criteria on whether participants had undergone a hysterectomy, oophorectomy, or chemotherapy prior to age at reported menopause. Additional exclusion criteria used in previous research also involves the exclusion of participants who were taking HRT prior to reported age at menopause. However, no exclusion criteria has involved the exclusion of participants who reported stopping oral contraceptives in the same year as reported age at menopause. Given my interest in the role of oral contraceptives

masking age at menopause, outlined in the introduction, I sought to explore whether including this exclusion would impact population characteristics.

The data obtained from UK Biobank were requested in May 2019 and received in November 2019. A practical limitation to the data available for the subsequent analyses lies with closure of the UK Biobank data request process from late 2021 to early 2022 due to upgrading works on the data showcase. As such, for the duration of the quantitative research portion of this thesis, I was unable to access further data points. Indeed, even had further data points been requested, the data points would still have been subject to the limitations of low response rates for the subsequent waves of data.

### *4.2.2 Sensitivity analysis of exclusion criteria*

To obtain a dataset containing women who had experienced 'natural' menopause (i.e., those where menopause was not induced iatrogenically, or masked by the use of hormonal contraceptives or hormonal replacement therapy), the following exclusions were applied to create the 'incomplete' exclusion criteria:

- *Where age of menopause is greater than, or equal to age of cancer diagnosis (to exclude possibility of iatrogenic menopause due to chemotherapy)*
- *Where age of menopause is greater than, or equal to age of bilateral oophorectomy (to exclude iatrogenic menopause due to removal of ovaries)*
- *Where age of menopause is greater than, or equal to age of hysterectomy (to exclude iatrogenic menopause due to removal of the uterus)*
- *Where age of menopause is greater than, or equal to age where HRT is stopped (to exclude cases where age of menopause may be masked by bleeds produced by cyclical HRT regimens, and menopause is erroneously identified by the cessation of these bleeds)*

These exclusions are common to identify age at natural menopause, (see Ruth et al. (2016) for similar UK Biobank exclusions). However, I also considered the following exclusion, which isn't currently used when identifying populations with natural menopause. The addition of this condition creates the 'complete' exclusion criteria.

- *Where age of menopause is equal to age last used oral contraceptives (to exclude cases where age of menopause may be masked by withdrawal bleeds produced by oral contraceptives, and menopause is erroneously identified by the cessation of these bleeds)*

In consideration of this extra exclusion, two datasets were initially maintained to test whether this further exclusion made an impact on the mean age of menopause obtained. Additionally, a dataset was maintained including those where age of menopause was given as equal to age last used oral contraceptives, to obtain descriptive statistics of this population.

The first investigation into age of menopause in the UK Biobank population was to obtain summary statistics for age of 'natural' menopause within the population, depending on two sets of exclusion criteria outlined previously. The results are as below:

| Population | N | Mean | Median |
|---|---|---|---|
| Incomplete exclusion | 135795 | 50.2 | 51 |
| Complete exclusion | 130617 | 50.4 | 51 |
| Newly excluded population | 5178 | 47.5 | 49 |

*Table 4.2: Summary statistics for age of menopause within UK Biobank populations identified with incomplete exclusion criteria, complete exclusion criteria, and the newly excluded population.*

Overall, the summary statistics show the mean age of natural menopause in the UK Biobank population to be around 50, with a standard deviation of around 4.5 – indicating that most women will experience menopause between the age of 45 and 55. As shown in the histogram in Figure 4.1, the distribution of age of menopause is somewhat left-skewed suggesting that those who experience menopause older than the mean age will do so in a more condensed range of years. Peaks at age 40, 45 and 50 may indicate that recall bias impacts the age given for menopause, perhaps for older women within the UK Biobank population.

These statistics show the impact of incomplete exclusion criteria compared to complete exclusion criteria, namely that the newly excluded population (where age of menopause was equal to the age where oral contraceptives were last used) has a lower mean and median. This suggests the newly excluded population is

found more so within the lower values of the incomplete exclusion population and, when removed, slightly reduces the negative skew of the complete exclusion population. Beyond its statistical characteristics, this suggests that the population of women where age of menopause is equal to age where oral contraceptives were last used appear to have a lower-than-average age of menopause than the 'natural' menopause population, rather than being distributed evenly throughout the curve. Thus, women with an earlier age at menopause tend to exhibit an age at final menstrual period at the same time as cessation of hormonal contraceptive usage. Based on the above results, I used the full exclusion criteria to identify participants in the UK Biobank who had experienced a natural age at menopause.

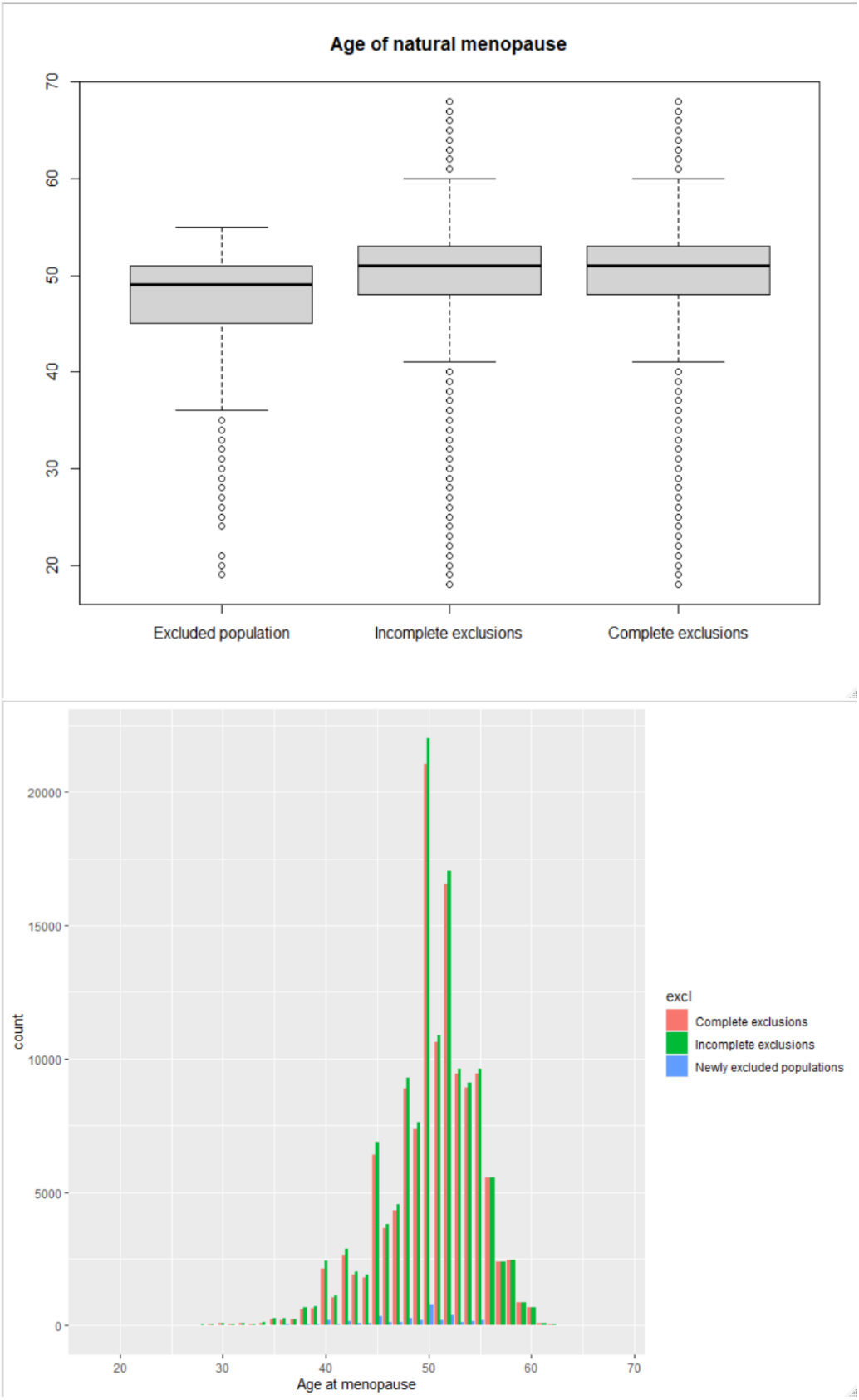


*Figure 4.1 Comparative box plots and histogram showing distributions of ages of menopause. The comparative groups are the 'incomplete' exclusion group, the 'complete' exclusion group, and the newly excluded group.*

### *4.2.3 Descriptive statistics*

Descriptive statistics methodology

Following the establishment of the complete exclusion criteria, I conducted descriptive statistics on this analytical sample. A Kaplan-Meier plot was created to visualise the reporting of age at menopause across time for the UK Biobank population with the updated exclusion criteria (Figure 4.2).

Participants were grouped into 'Scotland' and 'England and Wales' to explore variation in age at menopause across spatial populations. For identifying temporal changes in age of natural menopause, the population was initially stratified by 5-year groupings of date of birth. This results in the following stratification: 1936-40, 1941-45, 1946-50, 1951-55, 1956-60, 1961-65, 1966-70. In order to visualise differences between 2 populations stratified by date of birth, the population was separated into 2 populations: those born before 1960, and those born during or after 1960. 1960 was chosen as participants born on and before this year would have reached the mean age at menopause by the end of the initial data collection period.

To explore differences in age at menopause spatially and temporally, summary statistics were obtained for the national groupings, and DOB groupings.

Descriptive statistics results

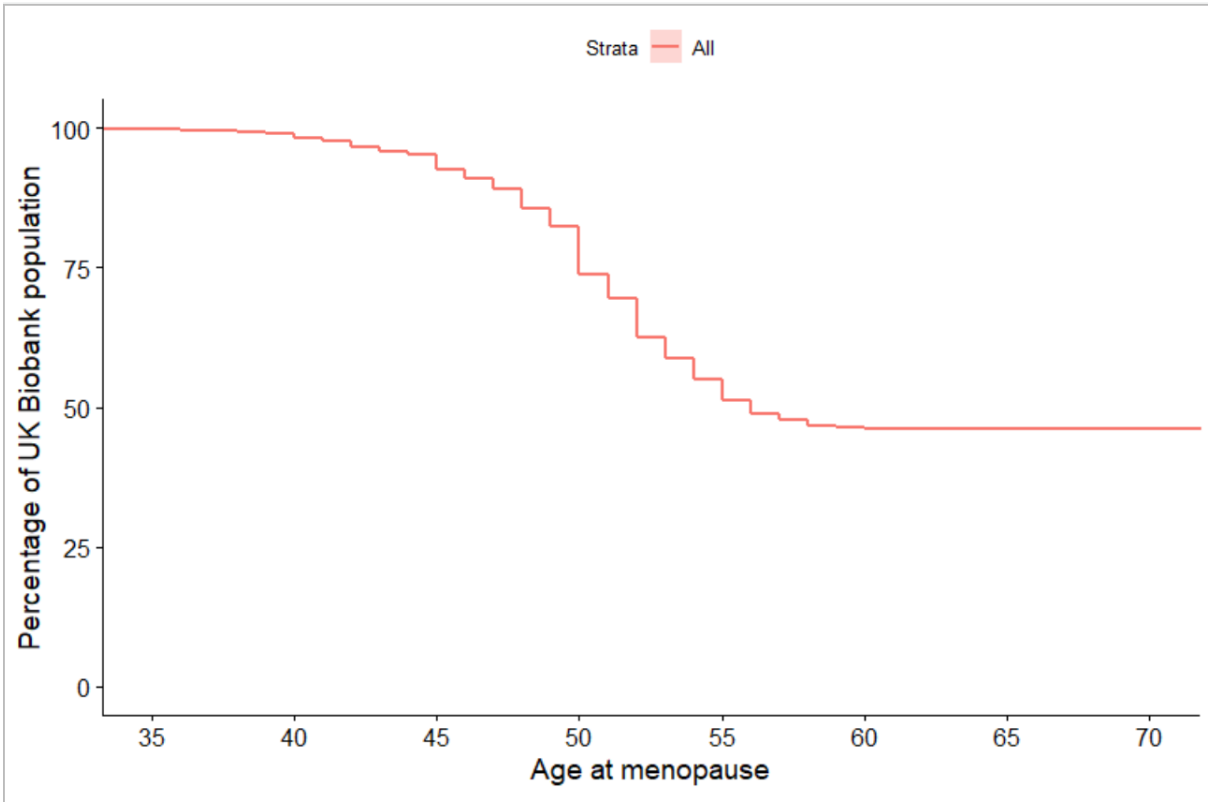


*Figure 4.2 Kaplan-Meier survival curve showing time to menopause within the complete exclusion UK Biobank population.*

The survival curve produced for the complete exclusion UK Biobank population (Figure 4.2) suggests that 18% of Biobank women reach menopause by the age of 50, and 45% reach menopause by the age of 55. Figure 4.2 also shows 46% of the UK Biobank population (with complete exclusions) have no reported age of menopause. This may be in part due to women within the cohort born closer to 1970 who were yet to reach menopause, or by women reporting 'Do not know' or 'Prefer not to answer' when asked during the questionnaire.

### *4.2.4 Spatial differences*

The spatial investigation into age at menopause in the UK Biobank population looked at whether differences in age at menopause exist between those who attended each individual assessment centre, as well as between participants from Scotland (as Glasgow and Edinburgh combined) and England and Wales. The summary statistics are as follows:

| Population | N | Mean | Median |
|---|---|---|---|
| England and Wales | 120625 | 50.4 | 51 |
| Scotland | 9992 | 50.0 | 50 |

*Table 4.3: Summary statistics for age of menopause in Scotland, and England and Wales*

The values in Table 4.3 indicate that the 2 populations differ slightly in means – with the England and Wales population showing a slightly higher mean age at menopause.

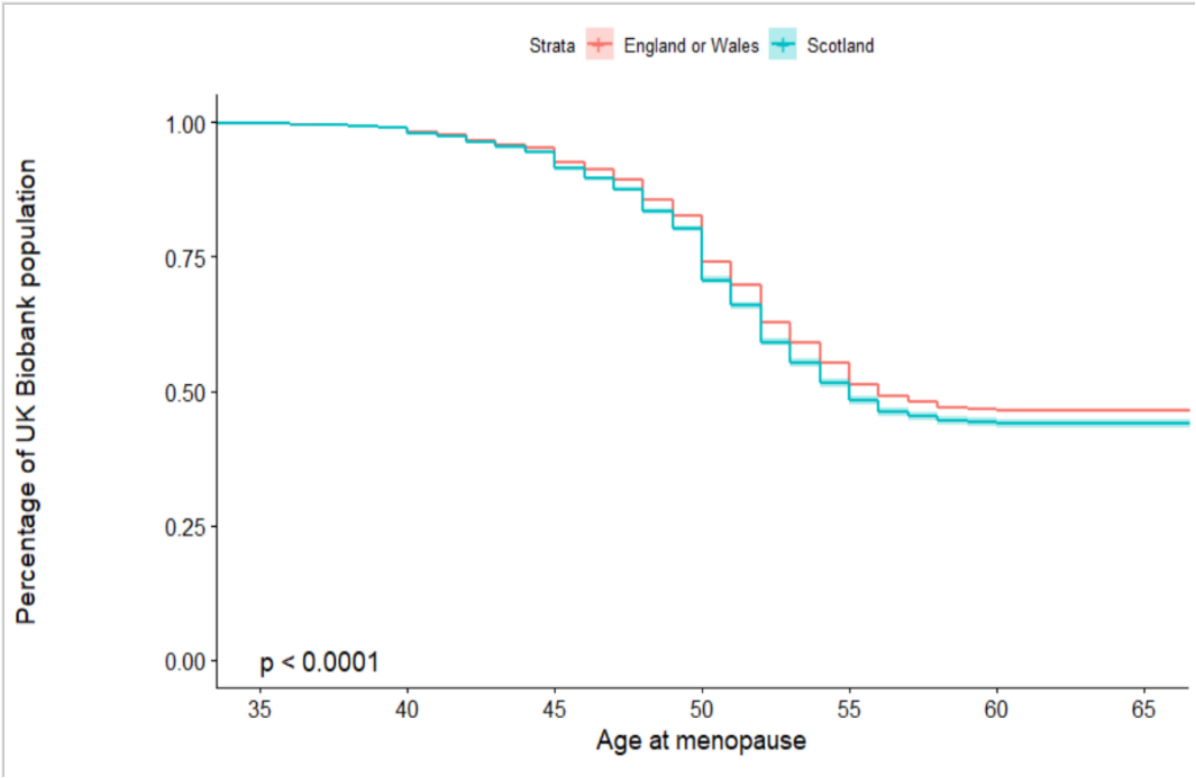


*Figure 4.3: Kaplan-Meier plot illustrating differences between survival curves for England & Wales and Scotland*

The Kaplan-Meier plot supports the summary statistics, and shows that the Scottish population reached menopause earlier than the combined England and Wales population. To test whether there is a difference between time to event (i.e., Age at menopause) between the different populations, a log rank test was conducted between England & Wales and Scotland. This produced a p value <0.0001, indicating significant differences between population survival curves (Figure 4.3).

To further investigate the differences between age at menopause in the England & Wales population and Scotland population, I also considered differences

between known risk factors for age of menopause between the two populations (Table 4.4 & Table 4.5).

| Risk factor | Mean value England and Wales | Mean value Scotland | T-test P value |
|---|---|---|---|
| Age of menarche | 13.01 | 13.03 | 0.2325 |
| Parity of women with children | 2.26 | 2.33 | <0.01 |
| Pack years smoking | 20.97 | 24.16 | <0.01 |
| BMI | 26.98 | 27.04 | 0.28 |
| Age completed full-time education | 16.63 | 16.40 | <0.01 |
| Townsend Deprivation score | -1.51 | -1.23 | <0.01 |

*Table 4.4: Comparison of risk factors measured as continuous variables between England & Wales, and Scotland. Welch two-sample t-test conducted between mean values to measure difference between means*

| Risk factor | | England and Wales | Scotland | Chi-squared test P value |
|---|---|---|---|---|
| Nulliparous | *Yes* | 16.6% | 18.6% | <0.01 |
| Ever smoked | Yes | 56.0% | 55.8% | 0.7119 |
| Breastfed as child | Yes | 60.0% | 54.0% | <0.01 |
| Comparative size at age 10 | About average | 51.2% | 53.5% | <0.01 |
| | Plumper | 16.7% | 16.3% | |
| | Thinner | 30.6% | 29.0% | |
| Comparative height at age 10 | About average | 53.5% | 52.7% | 0.0592 |
| | Shorter | 20.5% | 20.5% | |
| | Taller | 24.1% | 25.2% | |
| Part of multiple birth | Yes | 2.2%% | 2.2% | 0.599 |
| Maternal smoking around birth | Yes | 24.0% | 24.8% | 0.47 |

*Table 4.5: Comparison of risk factors measured as categorical variables between England & Wales, and Scotland. Pearson's Chi-squared test conducted to test whether significant differences exist between expected and observed frequencies*

Significant differences found between England & Wales and Scotland which were consistent with known risk factors for earlier menopause include higher means of pack years smoking, lower age completed full time education, and higher Townsend deprivation index amongst the Scottish population. Additionally, observed frequencies were lower than expected in the Scottish population for those who reported being breastfed, as well as those observed as nulliparous. However, mean parity was higher amongst Scottish women - counter to factors which are considered to reduce age at menopause. The extent to which differences between known risk factors influencing age at menopause contributes to these spatial differences is explored further in my hypothesis testing analysis.

### *4.2.5 Temporal differences*

| DOB | N overall | N reporting menopause | % | Mean | Median |
|---|---|---|---|---|---|
| 1936-40 | 14886 | 10809 | 72.6 | 50.3 | 50 |
| 1941-45 | 45289 | 33016 | 72.9 | 50.7 | 51 |
| 1946-50 | 54399 | 41459 | 76.2 | 50.9 | 51 |
| 1951-55 | 41306 | 28615 | 69.3 | 50.5 | 51 |
| 1956-60 | 37885 | 12977 | 34.3 | 48.6 | 49 |
| 1961-65 | 33613 | 3295 | 9.8 | 47.1 | 47 |
| 1966-70 | 14898 | 446 | 2.9 | 45.0 | 47 |

*Table 4.6: Summary statistics for age of menopause, stratified by date of birth. The column named "%" indicates the percentage of women within the stratified group who have reported menopause*

The third investigation into age at menopause within the UK Biobank was to understand whether temporal changes have occurred to mean age, based on date of birth. To investigate this, the overall cohort was segregated based on 5-year groupings of date of birth. As the summary statistics in Table 4.6 show, the mean age of menopause increases from 50.3 for DOB cohort 1936-40 to 50.9 for DOB cohort 1946-50, and then decreases to 45.0 for DOB cohort 1966-70. However, those of DOB cohort 1966-70 reporting age of menopause only represent 2.9% of the DOB cohort, indicating this lower mean age of menopause most likely represents a small proportion of the youngest cohort who have reported age of

menopause and who are likely to have reached menopause particularly early. It is worth noting the largest number of responses to this question occurred during the initial Biobank visit and were completed between 2006-2010, when members of

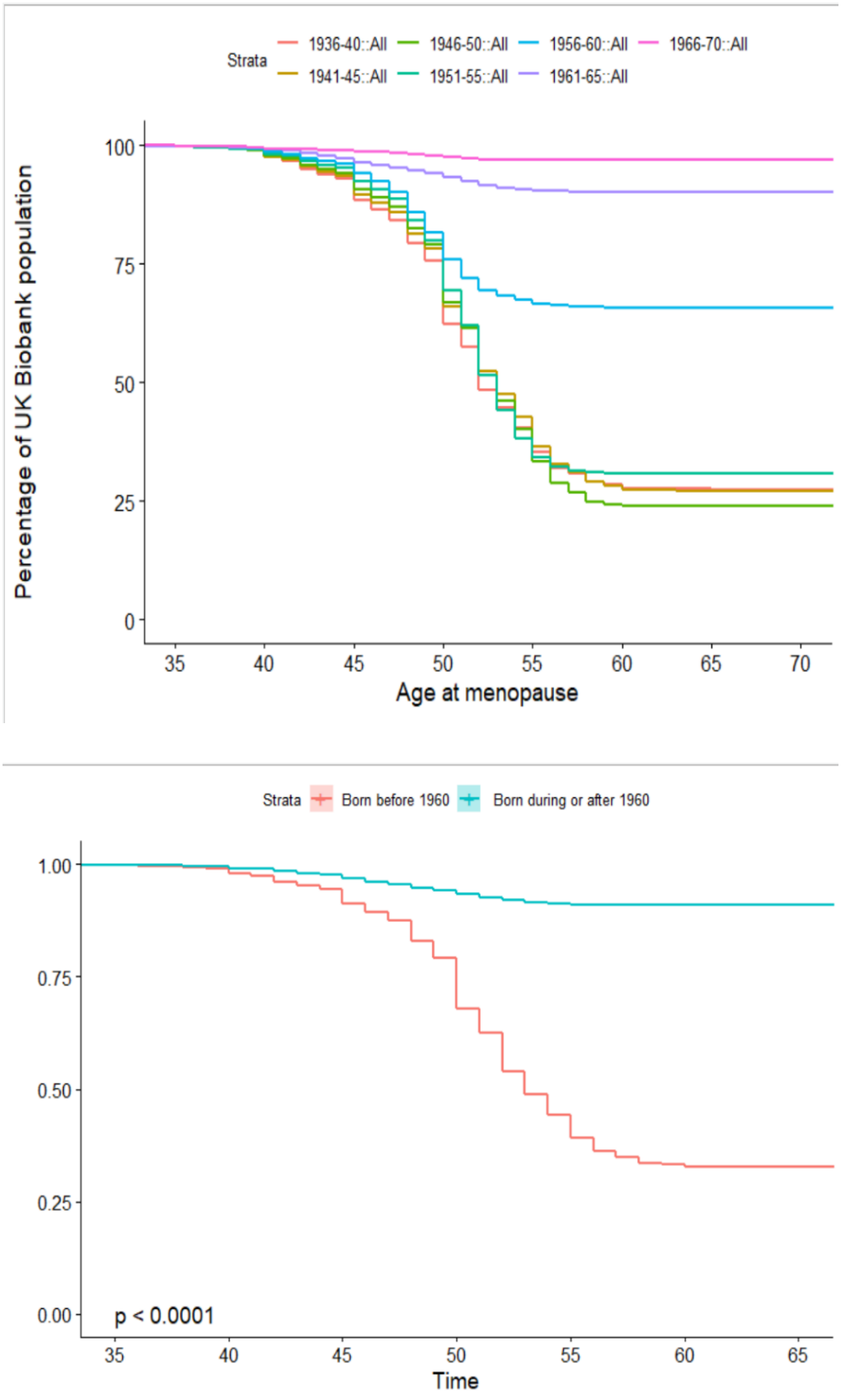


*Figure 4.4: Kaplan Meier survival curve stratified by DOB (above) and log rank test between survival curves for women born before 1960 and those born during or after 1960.*

the youngest cohort would be aged between 36 and 44 – far below the mean age of reported menopause. Thus, the decreasing mean age is most likely due to the low proportion of respondents from the younger cohorts and the overrepresentation of younger ages of menopause within these cohorts.

To further investigate the changes to age of menopause across DOB, using the same DOB cohorts, a Kaplan Meier survival plot was plotted (Figure 4.4). From this, it is clearer to see the divergence between DOB survival curves from age 40 and beyond.

### *4.2.6 Descriptive statistics discussion*

There were several factors identified from the descriptive statistics which were taken forward when conducting the hypothesis testing. Following the sensitivity analysis for exclusion criteria, I decided to use the full exclusion criteria to identify those with natural menopause within the UK Biobank dataset. Given that the newly excluded population displayed a lower mean than the fully excluded population, this supports the new exclusion criteria capturing participants whose earlier menopause may have been masked by contraceptive usage until they ceased using contraception at the recommended age of 51 (FSRH, 2017).

Furthermore, the initial explorations into variation into age at menopause temporally highlighted some potential issues with rates of reporting age at menopause amongst younger members of the cohort. As shown in Table 4.6 and Figure 4.4 there is a significant drop off in reporting of age at menopause amongst those born after 1956. Due to this, I decided to exclude all participants born after 1955 from subsequent analyses due to low reporting as this would produce overrepresentation of the few reported values from participants at this age. In order to mitigate the impact of age at menopause reporting attrition further, I also decided to approach age at menopause as a binary variable, rather than continuous. As such, I would use the binary variables *Reached menopause by age 51* and *45* rather than age at menopause. Ages 51 and 45 were chosen as the former is the mean age at menopause in the UK, while the latter is the cut off age for early menopause (NCC-WCH, 2015).

## 4.3 Hypothesis testing models

### *4.3.1 Methodology*

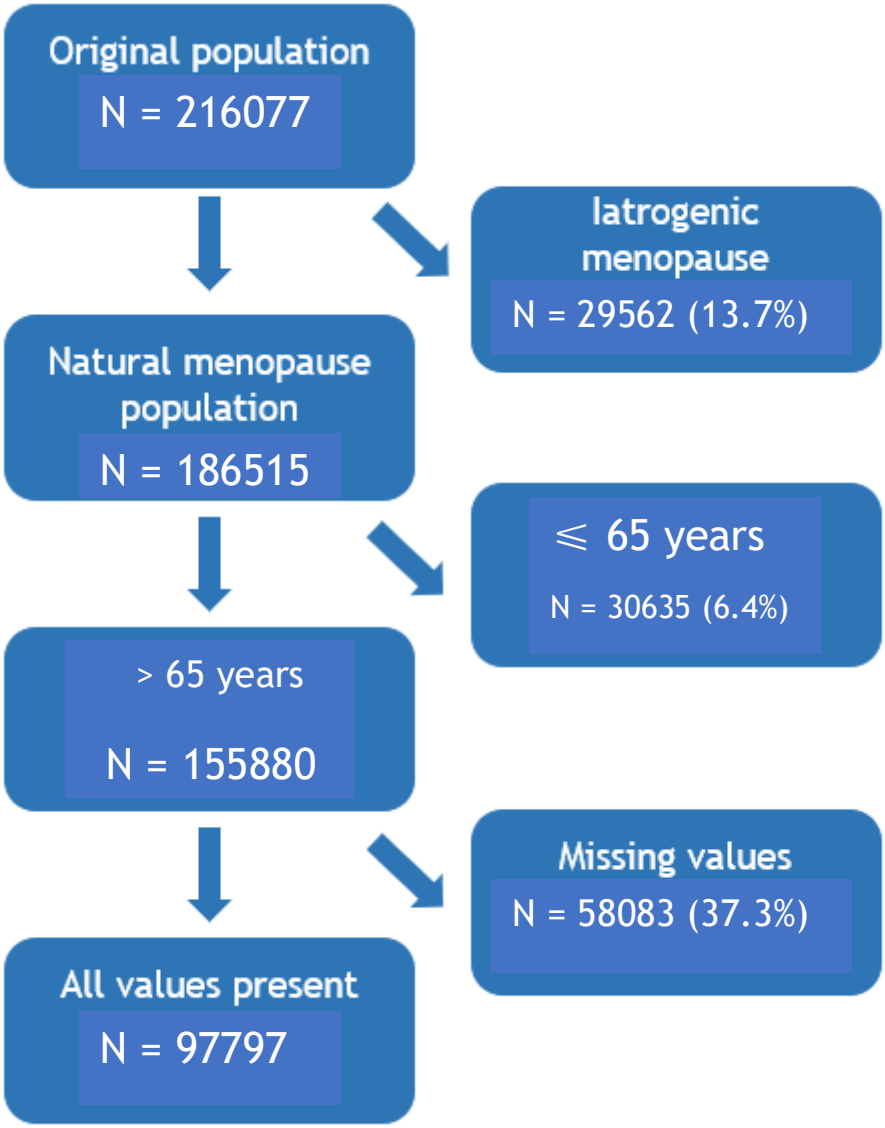


*Figure 4.5 Selection of data used for analysis*

Analytical sample

I analysed questionnaire data from 97797 women in the UK Biobank born prior to 1955 (Figure 4.5). To only capture those who experienced natural menopause, participants were excluded based on the complete exclusion criteria outlined in the initial analysis methodology (13.7%). Participants younger than 65 were then excluded from the analysis (16.4%). Participants who had missing values for any of the risk factor covariates used in this analysis were further excluded (37.3%).

Those excluded for missing data showed a similar distribution in spatial and temporal groupings compared to the final subset.

Statistical analyses

Unadjusted Kaplan-Meier models were run to visualise variation in age at menopause both spatially and temporally, where age at menopause was used as the event. Unadjusted logistic regression models were then run to obtain odds ratio (OR) of reaching menopause by age 45 and age 51. For temporal distribution, those born between 1936-40 were used as a reference group, with the English, and Greater London populations used as reference groups for the spatial distribution models.

Adjusted logistic regression models were run to assess whether temporal and spatial factors were still significantly associated with age at menopause when adjusted for known risk factors. Corresponding UK Biobank variables to identified risk factors outlined earlier are as follows: reproductive factors (Age at menarche, parity); later life socioeconomic status (Townsend deprivation index); early life environment (Comparative height and size at age 10, part of multiple birth, maternal smoking); and further lifestyle, biometric and demographic factors (Pack years, BMI, summed exercise minutes, activity group, ethnicity).

For life expectancy, unadjusted Kaplan-Meier models were run to visualise variation in age at menopause across quartiles of life expectancy values. Following this, unadjusted logistic regression models were run to calculate ORs of reaching menopause by age 45 and 51 stratified by quartiles of the life expectancy range. The same models as those for life expectancy were used, with handgrip strength inserted in place of life expectancy estimates.

For all models, I calculated percentage explained variance by each of the models to understand the degree to which the observed variation was explained by the model variables. This was calculated by (residual deviance/null model deviance) x 100.

The decision to use logistic regression was taken due to the retrospective nature of the data – in that all variables had been collected prior to this data analysis. Other forms of statistical analysis such as Cox Regression would not be suitable as this would assume a *de facto* start point for the measurements of hazard ratios. Furthermore, the descriptive statistics indicated several issues with the variables

measuring age at natural menopause. As this is a retrospective measure, there may be recall bias surrounding the exact timings of final menstrual period. As is shown in Figure 4.1, there are considerable spikes in age at menopause around ages 45, 50 and 55 relative to other ages. This suggests there is recall bias towards ages ending in 0 or 5, supporting the assertion that these ages are more approximate. In addition to this bias, Cox Regression – or indeed, any time to event analysis – assumes a degree of certainty and accuracy over measurements of time which I could not guarantee with the variables available to me. As such, I made the decision to use a binary approach to measuring age of menopause by age 45 and 51. These dates have clinical significance, with 45 indicating the cut off for 'early menopause', and 51 as the documented mean age of menopause within the UK population. Thus, the utilisation of this statistical approach is intended to reduce bias and produce clinically salient results.

## 4.4 Hypothesis testing results

### *4.4.1 Temporal distribution of variation*

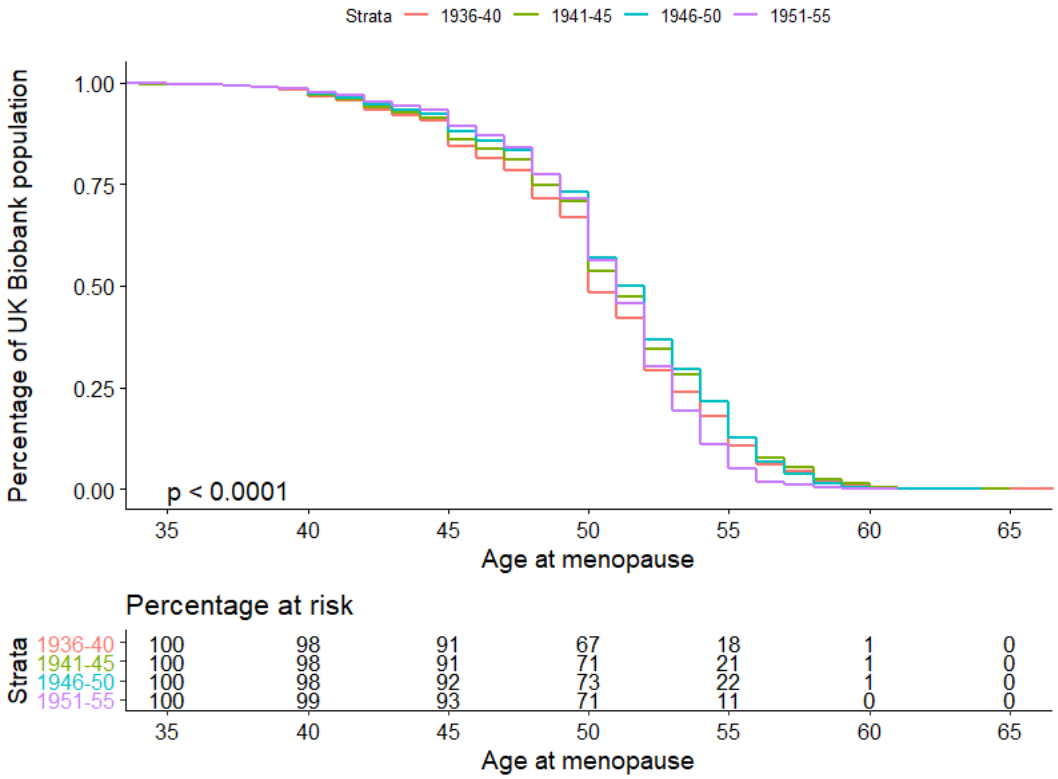


*Figure 4.6: Kaplan-Meier survival curves showing temporal distribution in age at menopause within the UK Biobank*

Unadjusted Kaplan-Meier models show that age at menopause is indeed different when the analytical sample is stratified by temporal distribution (Figure 4.6). Log-rank test of the Kaplan-Meier model shows a p value < 0.0001, indicating the survival estimates are different between temporal groups. Figure 4.6 shows that those who were in the oldest cohort (born between 1936-40) reached menopause at an earlier age than those in the younger cohorts.

Odd ratios (OR) for risk of menopause by age 51 and 45 are outlined in Figure 4.7. In these figures, those born between 1936-40 are used as reference population. The filled lines indicate ORs from the unadjusted models, while dotted lines show adjusted ORs. In the unadjusted menopause by 51 model, all DOB range cohorts display a reduced risk in age at menopause by age 51 when compared to those born in 1936-40. ORs decrease to 0.80 (95%CI 0.76-0.85) for 1941-45 and 0.73 (95%CI 0.69-0.77) for 1946-50, with an OR of 0.86 (95%CI 0.81-0.91) for 1951-55. Thus, those born in the later birth cohorts are 20%, 27% and 14% less likely to reach menopause by age 51 compared to the reference population. Similarly, odds of reaching menopause by age 45 reduced for all birth cohorts. 1941-45 had an OR of

0.88 (95%CI 0.82-0.95), which decreased to 0.74 (95%CI 0.69-0.80) and 0.66 (95%CI 0.61-0.71) for 1946-50 and 1951-55, respectively. Like the menopause by 51 model, those born in the later birth cohorts are 12%%, 26% and 34% less likely to reach menopause by age 45 compared to the reference population.

Compared to the unadjusted models, ORs decreased slightly when known risk factors were added as covariates. However, the fully adjusted temporal models continued to show strong relationships between DOB range and risk for reaching menopause by age 51 and age 45, with all groups continuing to show a reduced risk of reaching menopause by 51 and 45. Thus, the observed differences cannot be attributed fully to the differences in known risk factors affecting age at menopause between the birth cohorts.

The percentage explained variance for the unadjusted and adjusted menopause by 51 models were 0.2%. For the unadjusted and adjusted menopause by 45 models the percentage explained variances were 0.3%. Thus, while these results suggest a relationship between temporal distribution and age at menopause, the degree to which this explains the overall variation in age at menopause within the sample is very small.

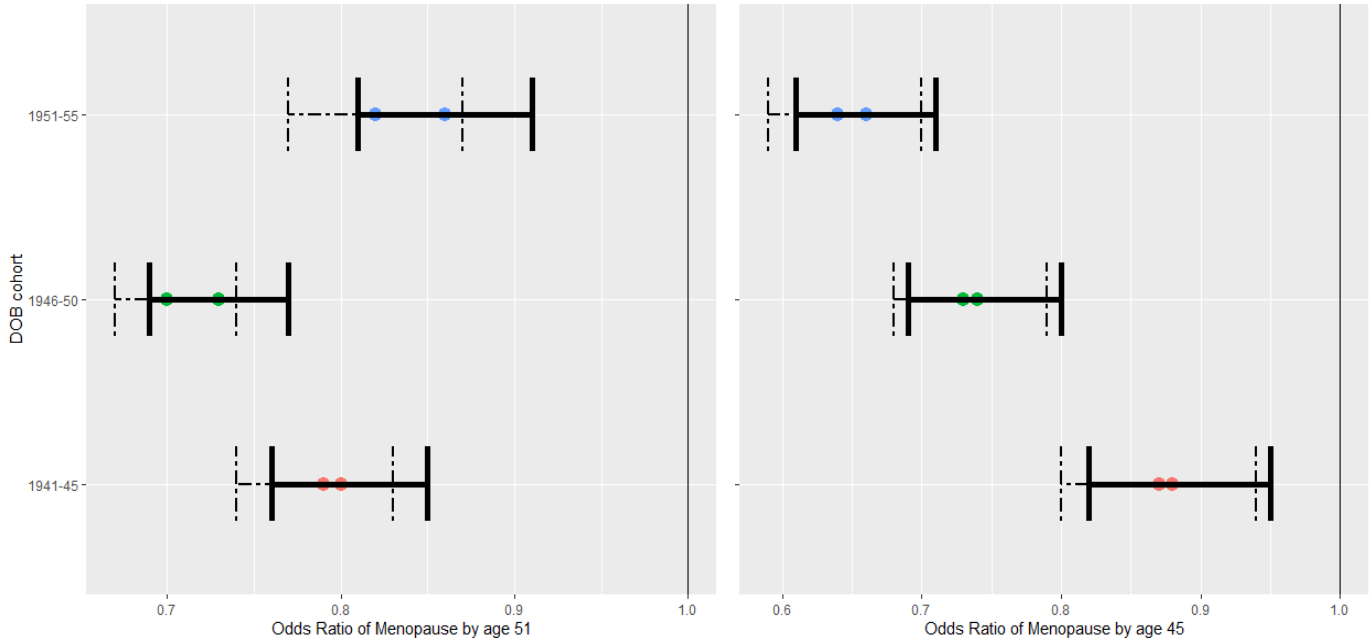


*Figure 4.7 ORs for reaching menopause by age 51 (left) and age 45 (right), stratified by DOB groupings. Those born between 1936-40 are used as reference population.*

### *4.4.2 Spatial distribution of variation*

Unadjusted Kaplan-Meier models show that, like the temporal distribution, age at menopause is indeed different when the analytical sample is stratified spatially by both national and regional populations (Figure 4.8). Log-rank test of the Kaplan-Meier model shows a p value < 0.0001, indicating the survival estimates are different between these spatial groups. Based on the national plot, the Scottish participants in this analytical sample reach menopause at an earlier age than those in England and Wales. This is mirrored in the regional plot, where participants from Glasgow were also shown to reach menopause earlier than the participants from other regions, who largely reached menopause at similar times.

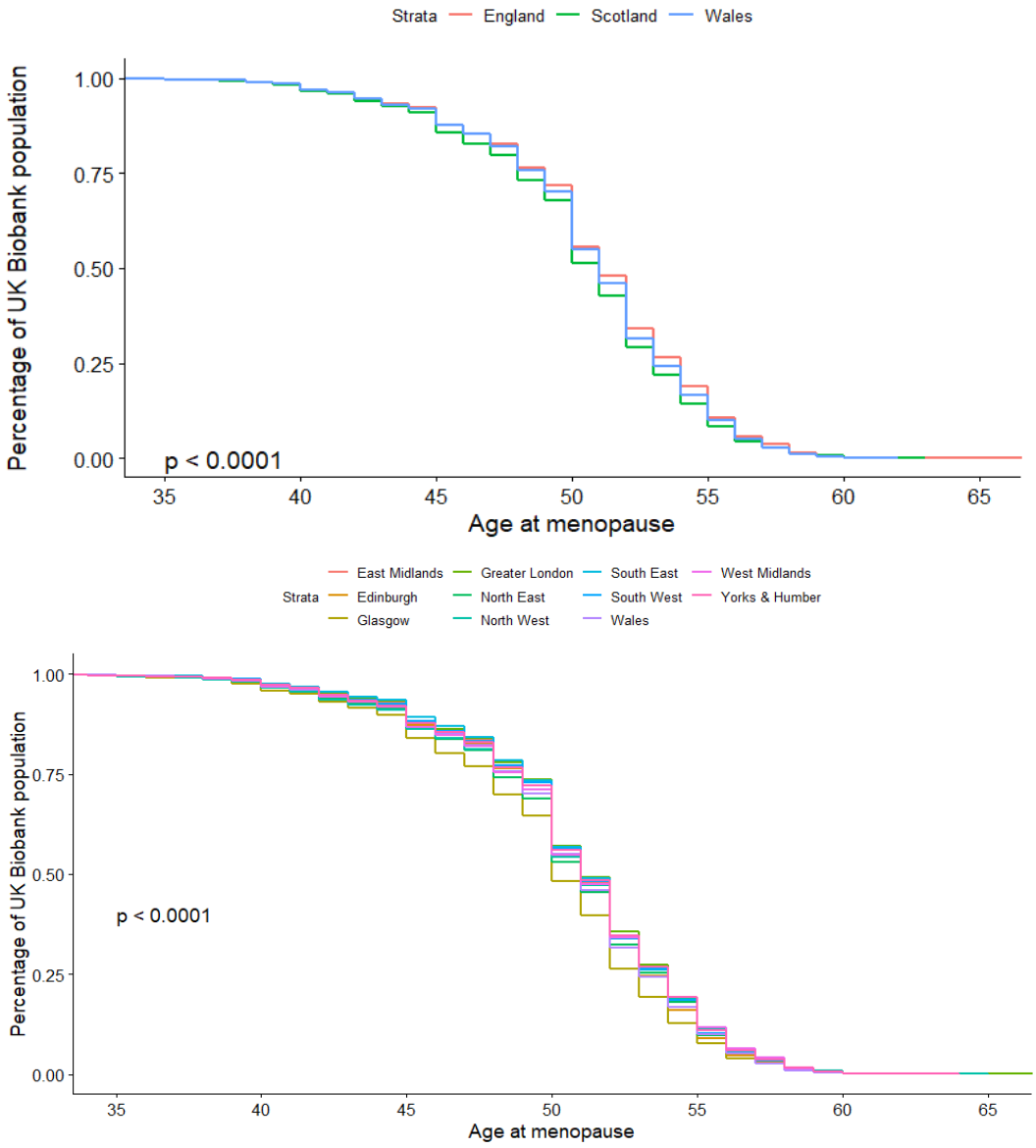


*Figure 4.8 Kaplan-Meier survival curves showing spatial distribution in age at menopause within the UK Biobank. The upper plot shows the stratifications by region, while the lower plot shows stratifications by country.*

National stratification groups

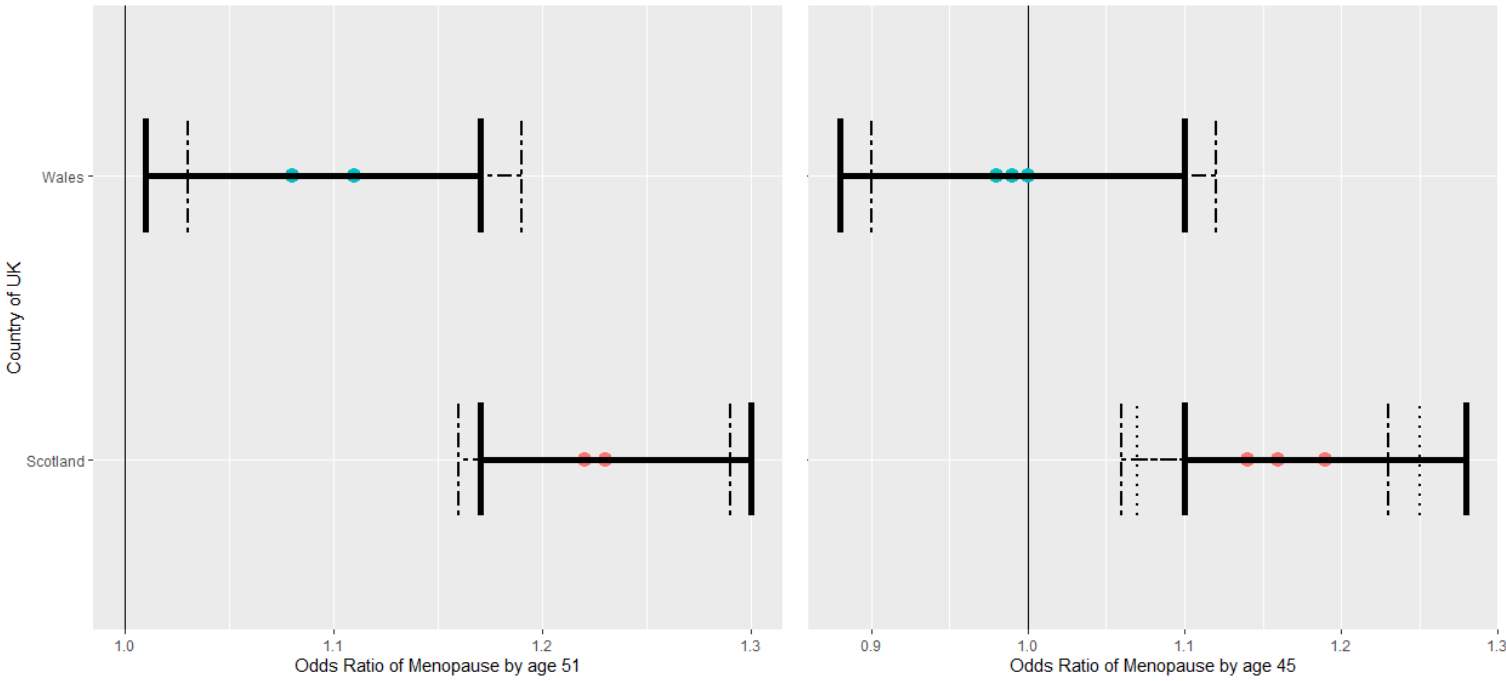


*Figure 4.9 ORs for reaching menopause by age 51 (left) and age 45 (right), stratified by national groupings.*

For spatial variation by national groupings, ORs were obtained for Scotland and Wales, with England used as the reference population (Figure 4.9). To investigate whether the age compositions of the national stratifications had bearing on the ORs, a further model where national groupings were adjusted for year of birth were also run. The filled lines in Figure 4.9 indicate unadjusted ORs, the dotted lines are ORs adjusted only for age, and dashed lines show fully adjusted ORs. As evident in the figure, unadjusted ORs and age adjusted ORs showed considerable overlap.

In the unadjusted menopause by 51 model, both Scotland and Wales show a higher OR than the English reference population. The Scottish population has an OR of 1.23 (95%CI 1.17-1.30), and the Welsh population has an OR of 1.08 (95%CI 1.01-1.17). Thus, participants from Scotland are 23% more likely than those from England to have reached menopause by age 51, while the Welsh participants are 8% more likely. After full adjustment, the Welsh OR increases slightly while the Scottish OR decreases slightly. This suggests that possible determinants of these patterns in age at menopause differ between the two populations – that more

variation can be explained by known risk factors within the Scottish population than the Welsh.

In the menopause by 45 model, the Scottish participants were 19% more likely to have reached menopause by age 45 (95%CI 1.10-1.28), while the Welsh were 1% less likely (95%CI 0.88-1.10). Again, age and full adjustment increases the effect size of spatial stratification within the Welsh population when included in the menopause by 45 model, while the effect is decreased in the Scottish population. The magnitude of this change is greater than the menopause by 51 model, suggesting the known risk factors account for more variation in rates of earlier menopause.

For both models, Scottish women are shown to have an earlier age at menopause compared to the Welsh and the English populations, as they are more likely to have reached menopause by age 45 and 51 in relation to the other participants. However, similar to the temporal models the percentage explained variance for the unadjusted, age adjusted and adjusted menopause by 51 models were all 0.1%. For the unadjusted, age adjusted and adjusted menopause by 45 models the percentage explained variances were <0.1%, 0.3% and 0.3%. These, again, indicate a low level of explained variance by these models – that national stratification only explains a small degree of the variation in age at menopause within the sample.

## Regional stratification groups

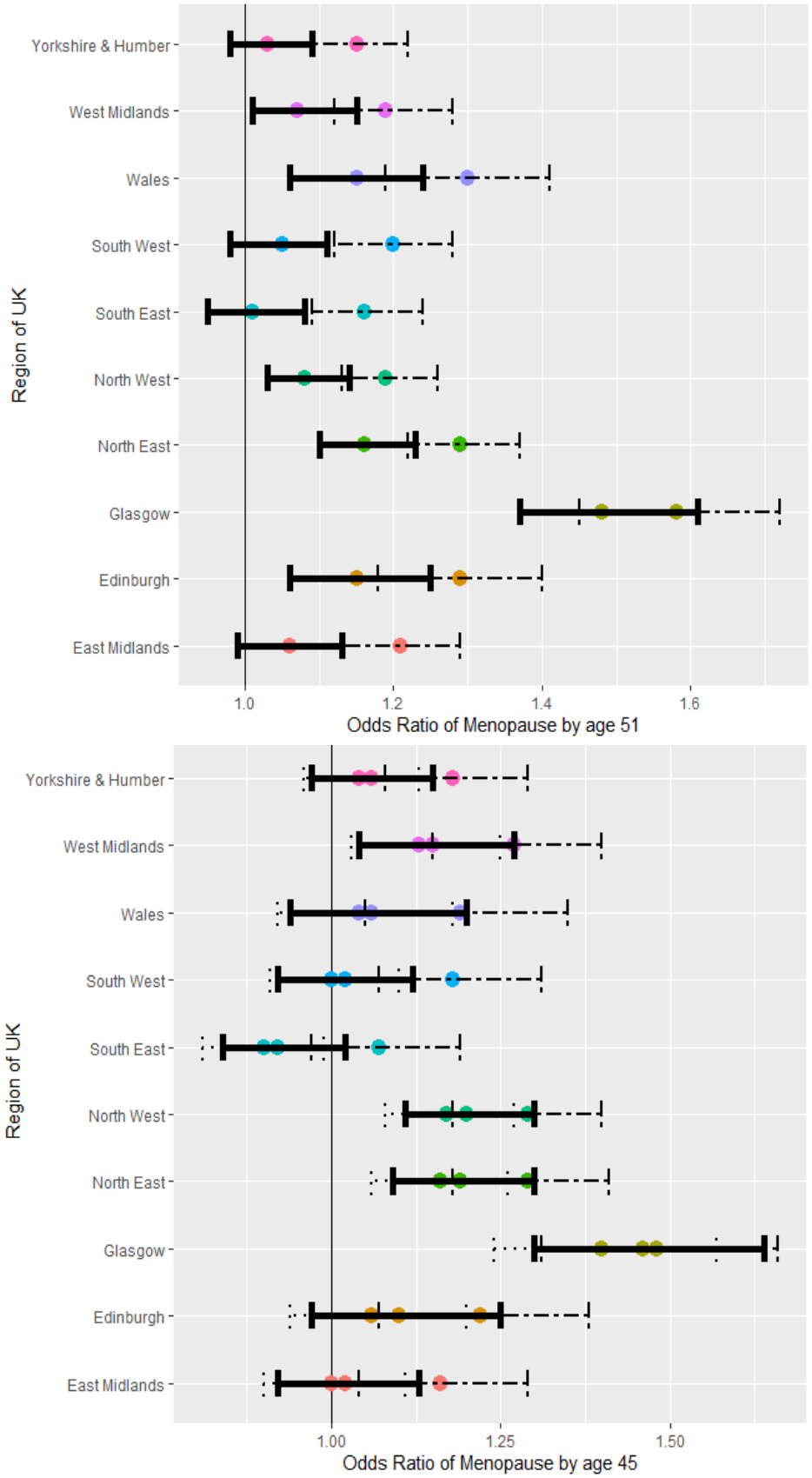


*Figure 4.10 ORs for reaching menopause by age 51 (left) and age 45 (right), stratified by region.*

For spatial variation by regional groupings, ORs were obtained for the regions of England, the country of Wales, and the local authorities of Edinburgh and Glasgow (Figure 4.10). Like the national groupings, to explore the impact of any age compositions in regional groupings a further model adjusting only for year of birth was also run. Filled lines show unadjusted ORs, dotted lines show ORs adjusted only for age, and dashed lines show adjusted ORs.

For reaching menopause by age 51 all regional groupings show an increase in OR relative to the Greater London population. Particular populations where the 95% CIs did not include 1.00 - the null value consistent with no difference in OR relative to Greater London - include the North-East (1.16, 95%CI 1.10-1.23), the North-West (1.08, 95%CI 1.03-1.14), and the West Midlands (1.01, 95%CI 1.01-1.15), Wales (1.15, 95%CI 1.06-1.24), and the Edinburgh population (1.15, 95%CI 1.06-1.25) The Glasgow population shows an OR of 1.48 (95%CI 1.37-1.61) – thus, the participants from Glasgow are 48% more likely to have reached menopause by age 51 compared to the Greater London population. This increase in ORs for regions of the North of England, Wales and Scotland follows the broader life expectancy literature outlined above, where the same regions experience lower life expectancy compared to regions of Southern England. Adjustment for age and known risk factors increases the effect of region on all the ORs, suggesting that regional location has a larger effect on age at menopause after known risk factors are accounted for. While a measure of socioeconomic status is included in the adjustments (Townsend Deprivation Score), it is possible this does not capture the true extent to socioeconomic interactions with age at menopause.

Similar results were obtained for menopause by 45 - ORs which did not include 1.00 included the North-East (1.19, 95%CI 1.09-1.30), the North-West (1.20, 95%CI 1.11-1.30), and the West Midlands (1.15, 95%CI 1.04-1.27). Compared with the menopause by 51 model, the Welsh and Edinburgh populations did not show a difference compared to the Greater London population. Displaying a similar magnitude of difference as in the menopause by 51 model, the Glasgow population shows an OR of 1.46 (95%CI 1.30-1.64). Adjustment for age reduced ORs slightly across all populations, while full adjustments increased all ORs. Again, the effect size of the regional location increases following adjustment for age and known risk factors.

Viewed in conjunction with the national stratification, Scottish women – and in particular those from Glasgow - are more likely to have reached menopause by age 45 and 51 in relation to the other participants. Compared to the national models, the regional models have a percentage explained variance of 0.2% for the unadjusted, age adjusted and adjusted menopause by 51 models. For the unadjusted, age adjusted and adjusted menopause by 45 models the percentage explained variances were 0.2%, 0.4% and 0.4%. These values are higher than explained variance in the national models, which may in part reflect the greater number of categories present in the regional analysis compared to a national level of detail. However, this regional level of interrogation has allowed identification of within-country patterns of age at menopause, such as the differences in timing of menopause between the Glasgow and Edinburgh populations. Again, the overall explained variation in these models is very low.

### 4.4.3 *Life expectancy*

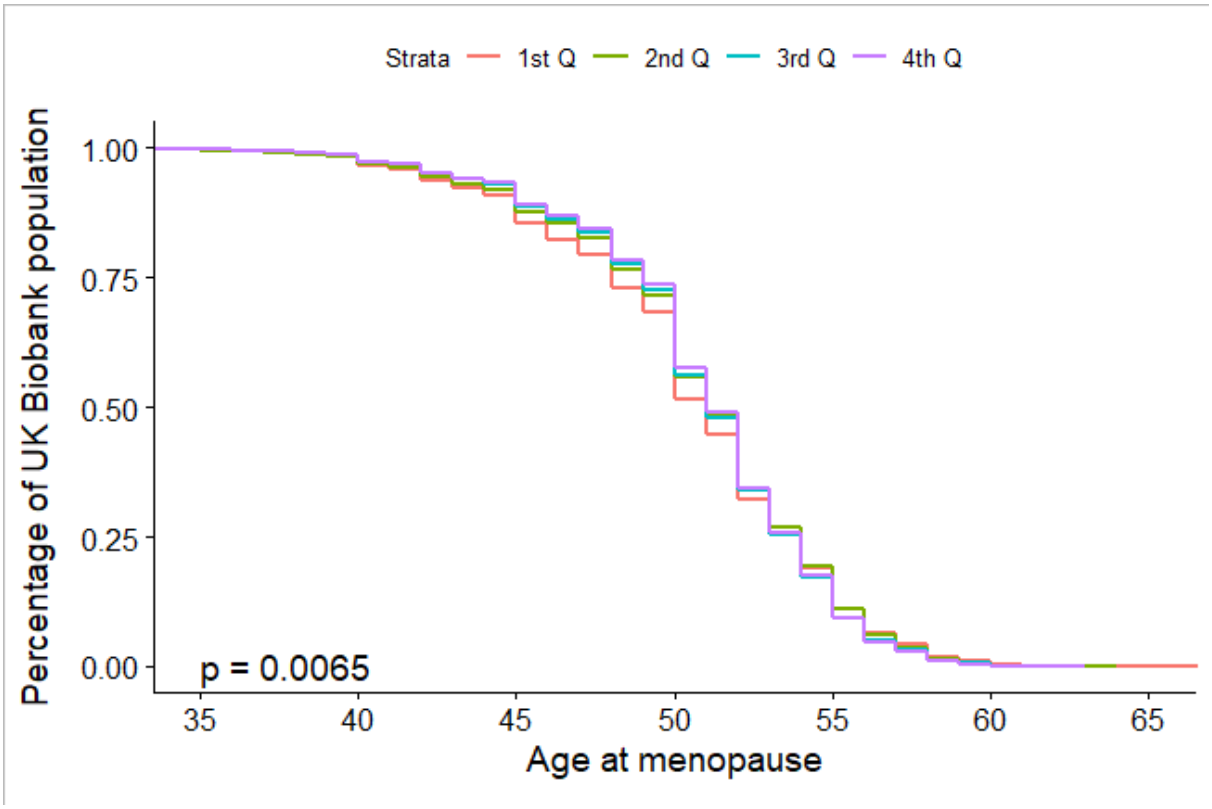


*Figure 4.11: Kaplan-Meier survival curve showing distribution of age at menopause by quartile of life expectancy estimates within the UK Biobank.*

Unadjusted Kaplan-Meier models for age at menopause stratified by life expectancy estimates shows age at menopause is also different when stratified by life expectancy estimates (Figure 4.11). The first quartile refers to all participants with life expectancy estimates below 84.98, with the second quartile containing estimates between 84.99 and 85.65, the third between 85.66 and 86.04, and the fourth for all values above 86.05. As shown in Figure 4.11, those in the lower quartile of life expectancy estimates reach menopause earlier than the other quartiles, with each successive quartile showing increasingly later ages at menopause.

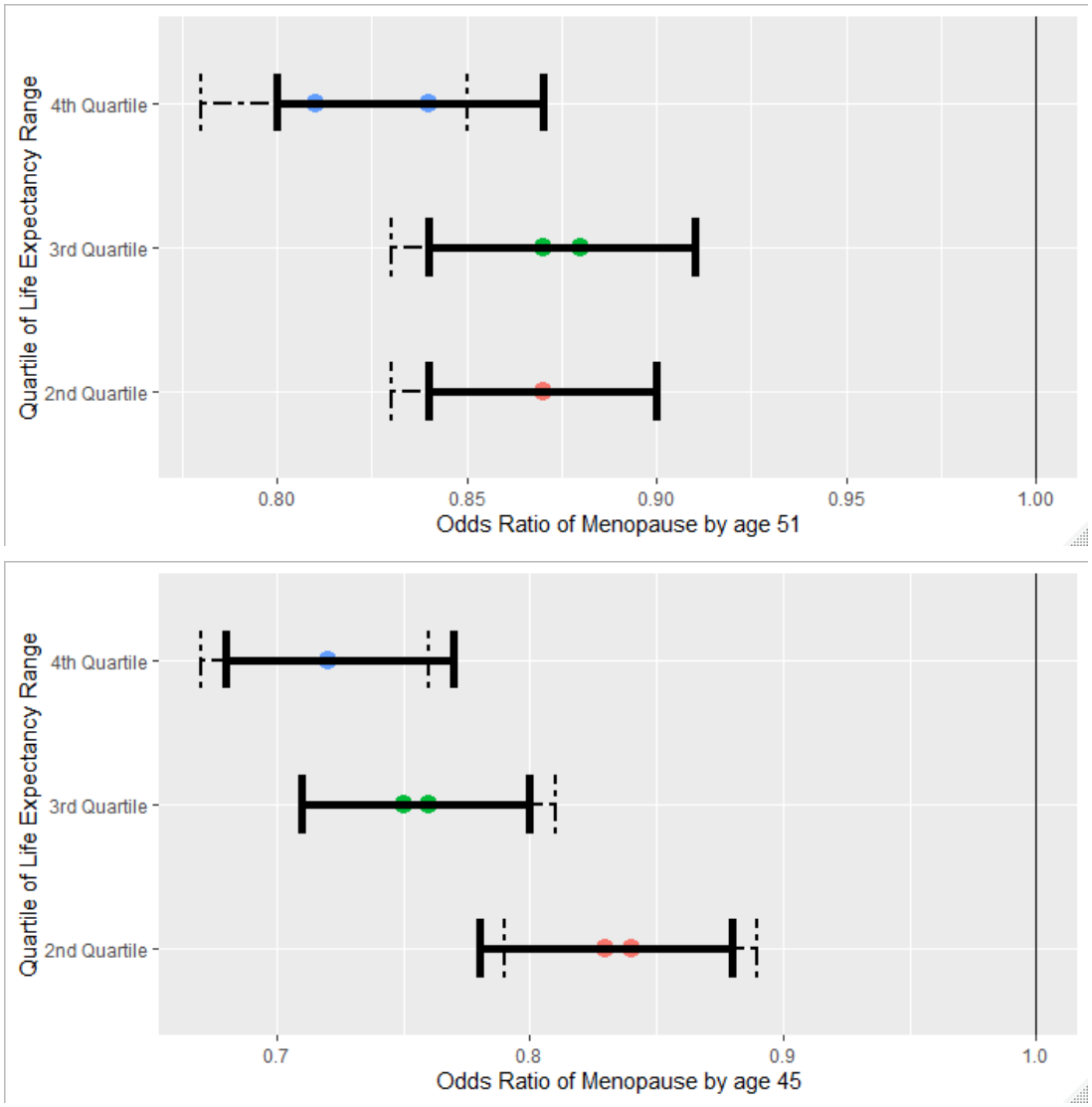


*Figure 4.12: Odds ratios for reaching menopause by age 51 and 45, stratified by quartiles of life expectancy range. Lowest quartile used as reference population. Filled lines show unadjusted ORs, while dotted lines show adjusted ORs.*

Unadjusted logistic regressions stratified by life expectancy quartiles show ORs for menopause by 51 are lower than the reference quartile, with an OR of 0.87 for the 2nd quartile (95%CI 0.84-0.90), 0.88 for the third (95%CI 0.84-0.91), and 0.84 for the fourth (95%CI 0.80-0.87) (Figure 4.12). ORs for menopause by 45 are also lower than the reference quartile, with an OR of 0.83 for the 2nd quartile (95%CI 0.78-0.88), 0.75 for the third (95%CI 0.71-0.80), and 0.84 for the fourth (95%CI 0.68-0.77) (Figure 4.12). Based on these models, participants in the 2nd, 3rd and 4th quartiles for life expectancy estimates showed a later age at menopause than those in the lowest quartile. The patterning of the relationship between age at menopause and life expectancy is more pronounced in the model for menopause by 45, whereby increasing life expectancy quartiles incurred a reduced risk of early menopause amongst participants. Thus, participants who were expected to

live longer based on life expectancy estimates demonstrated a later age at menopause.

As with the temporal and spatial models, the explained variance for both life expectancy models were very low – the percentage explained variance for the unadjusted and adjusted menopause by 51 models was 0.1%, and 0.2% for both menopause by 45 models.

### *4.4.4 Hand grip strength*

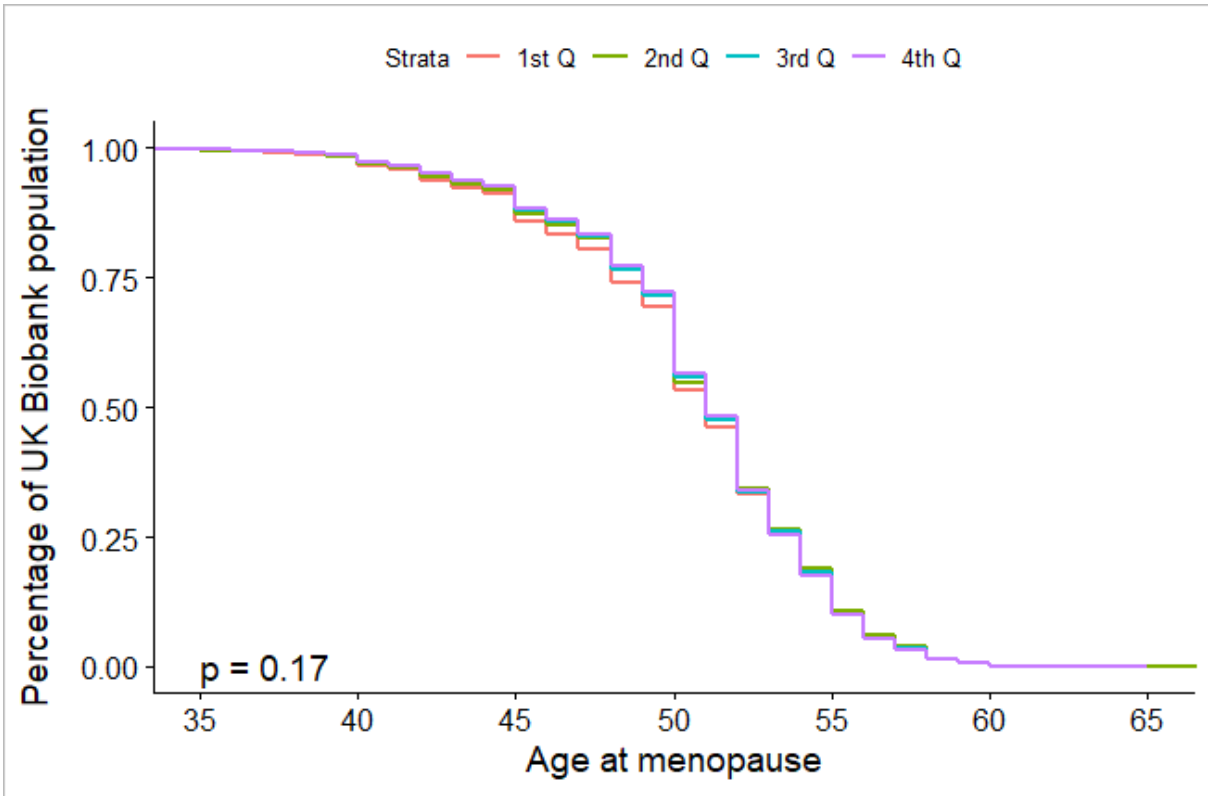


*Figure 4.13: Kaplan-Meier survival curve showing distribution of age at menopause by quartile of hand grip strength within the UK Biobank.*

The unadjusted Kaplan-Meier plot for age at menopause stratified by handgrip strength shows, in contrast to the previous models, that differences in age at menopause between the different groups is more modest (Figure 4.13). Despite this, the figure does indicate that the differences exist in order of grip strength – that the lowest quartile corresponds with earlier ages at menopause which the highest corresponds with later ages at menopause. The first quartile refers to all participants with handgrip measures below 19kg, with the second quartile containing values between 19kg and 22.5kg, the third between 22.5kg and 26kg, and the fourth for all values above 26kg.

In the unadjusted logistic regressions (Figure 4.14) ORs for menopause by 51 and menopause by 45 are all lower compared to the reference quartile - the 2nd quartile shows an OR of 0.95 (95%CI 0.91-0.99), the third showing 0.94 (95%CI 0.90-0.99), and the fourth showing 0.92 (95%CI 0.89-0.97). Thus, the population with lowest grip strength, and by extension the most frail, showed the earliest age at menopause. ORs for menopause by 45 show similar differences to the reference quartile, with an OR of 0.90 for the 2nd quartile (95%CI 0.85-0.96), 0.84 for the third (95%CI 0.79-0.90), and 0.85 for the fourth (95%CI 0.80-0.90). Adjusted logistic regressions maintain a similar pattern in both models but show attenuation of the effect of handgrip strength. This suggests that the known risk factors for age at menopause may be partly responsible for the differences between groups present in the unadjusted model.

As with the previous models, percentage explained variance remains very low. The unadjusted and adjusted menopause by 51 models were <0.1% and 0.8%. For the unadjusted and adjusted menopause by 45 models the percentage explained variances were 0.3% and 1.4% respectively.

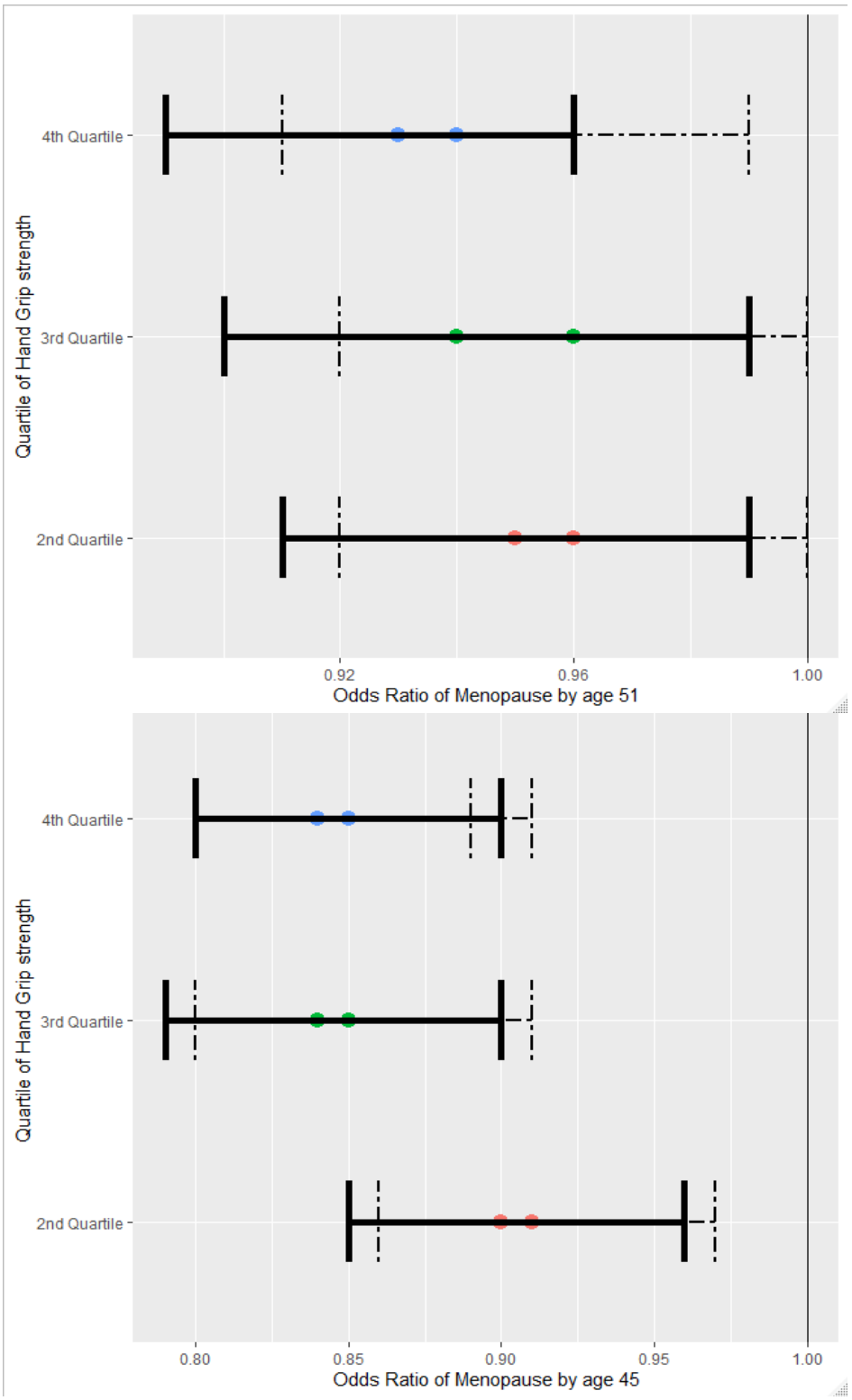


*Figure 4.14: Odds ratios for reaching menopause by age 51 and age 45, stratified by quartiles of hand grip strength. The lowest quartile is used as reference population.*

## 4.5 Discussion

### *4.5.1 Interpretation of results*

In the quantitative arm of this study, I aimed to investigate whether temporal or spatial variation in age at menopause was present within the UK Biobank dataset, and whether, if present, such variation could be explained by known determinants for age at menopause found in previous studies. I also aimed to explore the relationship between menopause timing and measures of ageing more generally, using life expectancy estimates and handgrip measures as auxiliary measures. The results of this component of the study are as follows:

- *Variation in risk of menopause by both age 51 and age 45 exists both temporally and spatially. Even when models are adjusted for known risk factors, these patterns of variation continue to exist.*
- *Later life expectancy is associated with later age at menopause (reduced risk of reaching menopause by age 51 and age 45).*
- *Higher measures of hand grip strength are associated with later age at menopause (reduced risk of reaching menopause by age 51 and age 45)*

In consideration of the above, there is support for my theory that similar mechanisms underpin the duration of both reproductive and actual lifespans (Fraser et al., 2020). These results support the hypothesis that variation in age at menopause may emerge as a result of varied somatic capital. This fits with the previous epidemiological studies into age at menopause already conducted, where lower socioeconomic status both early and later in life has an association with earlier age at menopause (Ruth et al., 2016, Duarte et al., 2014, Mishra et al., 2007, Hardy and Kuh, 2005, Gold et al., 2001, Schoenaker et al., 2014). This also supports epidemiological studies which show earlier ages at menopause are associated with higher rates of cardiovascular disease, non-reproductive cancers and all-cause mortality (Forman et al., 2013, Schoenaker et al., 2014). Approaching age at menopause from the perspective of somatic capital provides a unifying framework for these different findings, whereby menopause becomes situated in the overall ageing process. This can have important theoretical implications for studies into the relationship between timing of menopause and overall ageing. Much biomedical and clinical research into this relationship makes an assumption of directionality within this relationship, often regarding

menopause as the *cause* of accelerated ageing and disease outcomes (Fraser et al., 2020). Rather, the relationship between timing of menopause and health and mortality outcomes later in life may both originate from the influence of somatic capital, and ecological interactions between the individual and socioeconomic environment throughout the life course.

While the results produced from this analysis are promising in their support of the hypotheses explored, they must also be explored in their limitations. The models for temporal, spatial, life expectancy and handgrip strength were only able to account for <1% of variation in timing of age at menopause. Additionally, the degree to which timing of menopause may vary across these dimensions may only be a matter of months – it is worthwhile considering if this is a meaningful margin of variation in a clinical, public health, or indeed experiential context. Also to be considered is the collinearity of variables and how they were derived – the location-based variables (such as indices of multiple deprivation, life expectancy estimates, geographic location) indeed may demonstrate collinearity by merit of being derived from the same metrics of difference. In particular, the use of life expectancy measures is inextricably linked to area-based measures, particularly when the only readily available measures of life expectancy were those made at age 65. This measurement places too much emphasis on the explanatory power of recent areas of residence, and neglects the personal history of an individual, as well as the overall demographics of the area. A future area of research may include testing the association between life expectancy at birth and age at natural menopause. This measurement would provide a better fit, theoretically, with the above hypotheses and could permit consideration of migration across the lifetime.

Furthermore, UK Biobank has a number of limitations as a dataset for use in the exploration of age at menopause. I will explore these limitations in greater detail in the following section, how they shaped this quantitative study, and how these may be emblematic of larger conceptual limitations to the study of women's health, and ecological approaches to health, found within the public health sciences.

## 4.6 UK Biobank and its limitations

Further epistemological considerations must be made in the case of secondary quantitative analysis – whereby the statistical analysis is conducted on data

collected by other sources. In the case of this research project, the quantitative data analysis is conducted with the UK Biobank dataset, an ageing cohort study of men and women aged 40-69 years recruited between 2006-2011, from across Scotland, England and Wales (Fry et al., 2017). Just as statistical methods in epidemiology and public health shape the scope and dimensions of knowledge production, so does the data set also impose its own set of limitations on the analysis. Science and technology scholars such as Latour and Callon argue that the dataset itself should be considered as an actant in the practice of knowledge production, as the dataset shapes analysis through what variables are measured and therefore available to the researcher (Dussauge et al., 2015). Analysis therefore is constrained by what variables are included in the dataset – and therefore which variables have been deemed as valuable to the team behind the dataset (Dussauge et al., 2015).

When assessing the suitability of variables in secondary quantitative analysis, we must also consider the decisions made in how these variables were chosen, how they were measured, and the purported use of these variables to research. My assessment of the variables available in the UK Biobank dataset through these metrics highlights which measurements were considered valuable by those composing the dataset. Value in this context also represents the suitability of variables for research endeavours the data collectors consider to be important (Dussauge et al., 2015). In short, datasets such as the UK Biobank contain variables which the organisers have deemed to be suitable for health-related research.

As outlined in the introduction to this chapter, the UK Biobank is a reputable and widely used dataset within the disciplines of epidemiology and public health, due to its considerable population size and wide range of questionnaire, biomarker and imaging data (Fry et al., 2017). Additionally, compared to ageing cohort datasets explored in earlier chapters, the UK Biobank collected some data on age at menopause, which is not consistently included in the remit of other ageing cohort studies (Fraser et al., 2020). It was intended that incorporating the use of UK Biobank data into the research presented in this thesis would be of considerable value to the quantitative study of variation in menopause experience within academic and wider healthcare contexts. However, owing to the conceptual boundaries of quantitative data analysis outlined above, there are considerable limitations to the use of the UK Biobank dataset in this research

project. Many of these limitations relate to the variables in the UK Biobank, as well as their mode of collection.

While UK Biobank did collect data on age at menopause, namely timing of the final menstrual period, it is important to recognise this is the only facet of menopause experience that is measured, along with HRT usage. There are no experiential variables relating to menopause available for quantitative analysis, aside from those relating to timing. Furthermore, while age at menopause was collected over all 4 waves of UK Biobank data collection, the response rates are highest from the initial wave of data collection. As the youngest members of the population were younger than the mean age at menopause within the UK (51), age at menopause has not been captured for a considerable proportion of the population as they had not yet reached menopause during the initial wave of data collection. This has considerable implications for measuring secular trends in age at menopause, as ages for younger members of the cohort would be biased towards those who experienced an earlier menopause. I encountered these limitations to the age at menopause data during the explorative portion of my analysis, and this shaped my methodology during the hypothesis testing. Owing to these constraints, analysis was limited to 83% of the UK Biobank female population.

Ecological variables

The second focus of this quantitative analysis was to explore the effect of ecological variables on age at menopause. The variables relating to socioeconomic status, lifestyle and early life history collected by UK Biobank were particularly salient to the analysis, both as explanatory variables and covariates to be controlled for.

Relating to exploratory variables, the spatial distribution of participants was of particular interest to my research question. However, the inclusion in the analysis of participant's location highlighted several limitations regarding Biobank recruitment. As shown in Figure 4.15, the geographical range of UK Biobank participants is clustered around the assessment centres, in predominantly urban areas (Biobank, 2012). In addition to this over-representation of urban populations, there are significant areas of the UK which are not represented in the sample such as Northern Ireland, the East of England, and areas of Scotland outside Glasgow and Edinburgh. Furthermore, later waves of data collection are limited to those

who were able to travel to the imaging centres of Newcastle upon Tyne, Stockport, Reading and Bristol, limiting the geographic distribution of participants further.

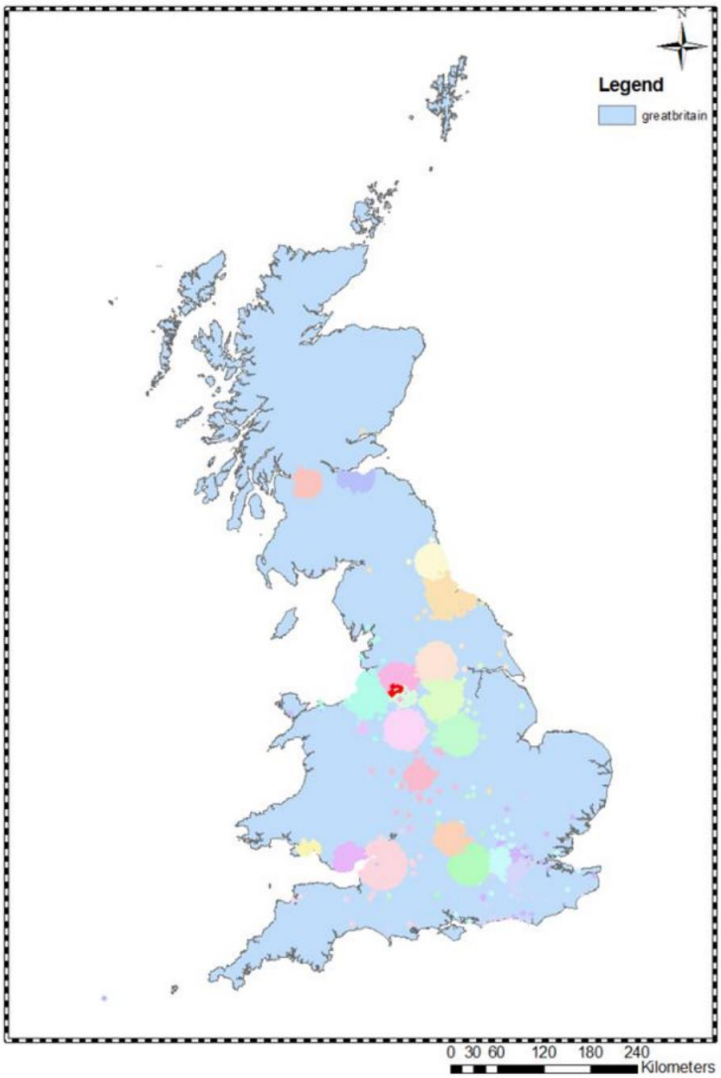


*Figure 4.15: Spatial distribution of participants in the UK Biobank, taken from 'Deriving the Grid Co-Ordinates' (UK Biobank, 2012).*

Socioeconomic status in both early and later life has also previously been linked to age at menopause. Socioeconomic status is measured through Townsend Deprivation Index in the UK Biobank. The Townsend Deprivation Index itself is an area-based measure of economic and social deprivation (Havard et al., 2008) – as such, it relates to the area where the participant lives, rather than based on the participant themselves. The UK Biobank does hold other measures of socioeconomic status relating to qualifications, employment status and housing, but these were not chosen when I was making variable selections when applying for access and it was not possible to add to the dataset after it has been issued without making an additional data request. In all circumstances, it is worthwhile

questioning whether a quantitative measurement can meaningfully represent the lived experience of socioeconomic status, and how it may interact with health and disease (Trostle, 2005). The translation of ecological facets, such as socioeconomic status and other components of the environment into numerical variables is an emerging area of interest in STS, particularly in relation to biosocial approaches to human health (Penkler, 2022). Such quantitative interrogation requires "capturing phenomena and behaviours that comprise a multitude of contributing factors with possibly emergent properties that are difficult to experimentally control" (Penkler, 2022). Given that this reductionist approach is integral to quantitative research, deep consideration is required when interpreting results to make sure conclusions are not overreaching, and accept the impact of residual, unmeasured confounders.

I consider one such area in my analysis to be the role of early life environment in variation in age at menopause. As outlined in Chapter 3, early life environment may impact rates of both somatic and reproductive ageing, and prior research has identified a link between early life environment and age at natural menopause (Ruth et al., 2016). Within UK Biobank early life environment was measured by categorical variables relating to various experiences of abuse and affection early in life during later waves of the questionnaire. Given this later inclusion of early life environment in the data collection, response rates were much lower than other variables. In early fully-adjusted models I included early life characteristics, but removed them for later models due to the subsequent small size of the analytical sample with all values present. As such, the impact of these features of early life environment are unaccounted for in this analysis.

Reproductive variables

Also salient to this analysis are the variables measuring reproductive life history. I gave the reproductive variables considerable attention both due to the previously found associations between reproductive history and age at menopause and the theory I explored in Chapter 2. I was able to include known reproductive covariates into the fully adjusted models as parity and age at menarche were measured at baseline for all female participants. However, I had to abandon my research into the relationship between age at menopause and reproductive life history due to the unsuitability of the variables present in the UK Biobank for this analysis.

In Chapter 2, I suggested a possible relationship between the timing of menopause and cumulative number of menstrual cycles experienced during the reproductive life history. The role of exposure to cyclical menstruation have previously been studied in relation to its impact of developing breast cancer (Chavez-MacGregor et al., 2005, Clavel-Chapelon and Grp, 2002, Menon et al., 1999) and cardiovascular disease risk (Atsma et al., 2008). Lifetime exposure to cyclical menstruation can be approached in two manners: the lifetime duration of menstrual activity (LMA) and lifetime number of menstrual cycles (LMC) (Rautalahti et al., 1993, Olsson and Olsson, 2020). LMA has been calculated previously by age of menopause minus age of menarche, with:

- *9 months subtracted for each pregnancy (Chavez-MacGregor et al., 2005, Atsma et al., 2008, Barreto et al., 2009), 28 weeks subtracted for each stillborn (or duration of pregnancy if data is available) (Chavez-MacGregor et al., 2005)*
- *12 weeks for any miscarriage or abortion (Chavez-MacGregor et al., 2005, Barreto et al., 2009)*
- *6 weeks (Chavez-MacGregor et al., 2005), 6 months (Rautalahti et al., 1993), or reported duration (Barreto et al., 2009) subtracted for each period of breastfeeding*

Lifetime number of menstrual cycles takes the LMA and multiplies by 365, and then divides by length of menstrual cycles (Rautalahti et al., 1993), if data are available for cycle length (Clavel-Chapelon and Grp, 2002), or 28 days if it is not. For some studies, the duration of OC usage has also been subtracted from the LMA, and replaced by OC use duration x 28 to emulate the false bleeds produced by OC (Chavez-MacGregor et al., 2005).

Studies into the link between LMA and LMC have found that a high number of cycles before first full-term pregnancy, and high LMA is associated with an increased risk of breast cancer (Chavez-MacGregor et al., 2005, Rautalahti et al., 1993), but not with survival outcomes in breast cancer (Menon et al., 1999) or risk prediction in cardiovascular disease (Atsma et al., 2008). However, the role of LMA and LMC have not been investigated yet in whether they play a role in influencing age at natural menopause.

Table 4.7 below outlines the variables required to calculate LMA and LMCs, and whether they were present in the UK Biobank:

| **Feature of reproductive life history** | **Present in UK Biobank** | **Absent in UK Biobank** |
|---|---|---|
| Menarche: | Age at menarche | |
| Menstrual Cycle length: | Menstrual cycle length at time of assessment (if not menopausal) | Menstrual cycle length throughout life |
| Parity: | Parity | Age at each birth |
| | Number of miscarriages, stillbirths, terminations | Multiple births |
| | Age at first birth | Ever breastfed |
| | Age at last birth | Duration of breastfeeding |
| Contraceptive usage: | Age first used OCs | Type of oral contraceptive used |
| | Age last used OCs | Duration of LARC usage |
| | | Contraceptive starting/stopping during use |

*Table 4.7: Reproductive life history variables, and their presence/absence in the UK Biobank*

Analysis into the relationship between age at menopause and reproductive life history was therefore considerably hampered by the reproductive variables collected in the UK Biobank. While age at menarche, menopause, first birth and last birth are all collected, there are no ages of additional pregnancies recorded. Additionally, questions relating to contraceptive usage are confined to oral contraceptives (and thus not including long-acting reversible contraceptives) and there is no collection of data relating to breastfeeding. Variables on cycle length were limited to those who answered as still having periods and relate to the immediate time of data collection rather than retrospectively. Given the unsuitability of the UK Biobank data to the research question, this avenue of analysis was abandoned due to the considerable assumptions that were required in the calculation of LMA and LMC of the analytical sample.

### *4.6.1 Wider issues relating to quantitative approaches to women's health*

While I could approach the above limitations of the UK Biobank as purely assessing its suitability to address my research question, I will argue that the above limitations are not exclusive the UK Biobank. Rather, they highlight that the UK

Biobank, the variables it collects, and the data it holds, should be considered as a product of the biomedical system of knowledge production which holds hegemonic status within the public health systems (Gabbay, 1999). As outlined in the previous chapter, quantitative data analysis in public health is shaped through the central tenets of biomedicine, creating a focus on population-level health patterns and emulating positivistic research theories and practices from the natural sciences (Davis-Floyd, 2003, Gordon, 1988, Kaufert, 1988, Canguilhem et al., 1978). In this context, I argue that the UK Biobank, and the limitations I have identified, are emblematic of the biomedical framework under which the UK Biobank was formed, and functions under.

As outlined previously, contrary to the assumption that data sets and data itself is a passive actor in the research process, data are not inert and work to perpetuate the decision processes that were made when the data were collected (Desai et al., 2017, Dussauge et al., 2015). In this context, we can consider that the poor data availability in the UK Biobank – especially relating to female reproductive life history and menopause - is an outcome of how biomedicine approaches women's health. As discussed in Chapter 2, biomedicine has a propensity to conceptualise the male body as the ideal standard of health (Grosz, 1994). As the female reproductive system deviates from the male body, it is both inherently pathologised (Davis-Floyd, 2003) and othered from the rest of the body (Kaufert, 1988) – the female body is conceptualised as being the same as that of the male, with the added influence of the female reproductive system. This conceptualisation is so widespread that it is only recently that biomedical research has begun to include female participants, having previously been systematically excluded so as to 'control' for the effect of the reproductive cycle on physiological processes (Johnson and et al., 2014).

In many ways, the UK Biobank can be seen as perpetuating the same assumptions. Variables pertaining to the female reproductive system, such as those outlined in Table 4.7 do not provide meaningful data on the participants' reproductive life histories so as to allow its inclusion in larger health research. The data collected for menopause is also significantly limited due to the low response rate amongst the youngest members of the cohort. Indeed, it is also significant that only data on age at menopause and HRT usage is collected – data on other facets of menopause experience, such as symptoms, are not collected in any capacity

within UK Biobank. Given these shortcomings, I argue that the UK Biobank perpetuates the pathologisation and reductionism of female reproductive health, in that it does not permit a considerable portion of sex-specific phenotypic features to be included in studies of female health. Patterns of health and disease continue to be treated the same in male and female bodies, and thus, relationships between health outcomes and the female reproductive system are unable to be identified. This perpetuates the measurement trap present in women's health research – that the lack of data is both the cause and effect of a continuing knowledge gap (Graham, 1998, Graham and Campbell, 1992).

# 5 Chapter 5: Biocultural approaches to menopause experience – Methods and findings

## 5.1 Introduction

Approaching menopause experience from an ecological perspective requires reflection on how aspects of menopause experience vary and are influenced by the environment in which one lives. In this chapter, I aim to explore both breadth and diversity in menopause experience, and how such variation may stem from ecological interactions. I use 'ecology' as the term to describe the external environment in which individuals exist on a micro (e.g., household), meso (e.g. regional) and macro (e.g. nation-state) level (Wiley and Allen, 2013, Banwell et al., 2013). Not only does an ecological approach take account of the environment, but it also considers the bidirectional relationship between the person and the environment and, in this case, specifically how the experience of menopause interacts dynamically with their environment. As outlined in previous chapters, with this study of menopause experience I aimed to expand understanding of how menopause varies beyond the facets, explored in earlier Chapters, which are of traditional public health interest.

Data production for this component of my research took the initial form of face-to-face interviews but changed to an online qualitative survey in response to the emerging Covid-19 pandemic. During the initial qualitative data collection stage described below, my research focused on understanding whether differences in cultural and environmental factors - such as socio-economic status and employment – can influence menopause experience and to explain diversity therein. As outlined in the introduction, differences in menopausal symptom experience have been recognised across cultures, in a way which suggests that menopausal experience extends beyond somatic experience of symptoms into a complex biosocial process (Sievert, 2006, Sievert, 2014b, Lock, 1993). Broadly, the ethnographic study of menopause experiences has previously studied variation at the level of ethnic group (Sievert, 2006, Sievert, 2014b, Lock, 1993). While the traditional biomedical approach may ascribe this variation to physiological differences between populations, an anthropological approach more so considers

this variation in an ecological context – as the outcome of the interaction between person, culture, and environment.

My initial qualitative exploration was conducted in the Glasgow population through semi-structured paired and group interviews. Recruitment of participants was focused on sampling from the most deprived, mid-deprived, and the least-deprived areas of Glasgow, as indicated by the Scottish Index of Multiple Deprivation (Scottish Government, 2020). I explore in more detail below this phase of data collection and key learning from it which was taken forward into the next phase of the study.

As I was beginning fieldwork, a novel environment began to emerge as a result of the Covid-19 pandemic and subsequent UK government-mandated lockdown measures. I therefore decided to adapt the qualitative component of my research to capture not only the breadth of menopause experience outside of the lockdown context, but also the participants' experiences of menopause during a pandemic. Doing so would allow me to address how the ecological context of a pandemic may shape menopause experience, and in doing so to capitalise on the opportunity to understand the impact of this newly emerging context. Continuing to utilise the concept of ecological interactions, I approached the pandemic and lockdown measures as producing a novel ecological environment with which everyone was now interacting. This approach was influenced by Lock and Kaufert's concept of *local biologies* (Lock and Kaufert, 2001), which conceptualises variations in health as being a result of a constant flux in interaction between individuals and their environment. Aspects of the lockdown environment in which I was most interested included the unprecedented governmental regulation and discipline of social contact and free movement, as well as disruption to everyday practices of work, leisure, social contact, and access to provisions. The locus of ecological interest to me therefore changed from socioeconomic status to the restrictions imposed in the novel lockdown environment.

The analysis presented in this chapter outlines the findings from a thematic analysis of the online questionnaire, which I subsequently designed to generate data on this novel environment. This analysis focuses on both the breadth of menopause experience participants described, as well as the role of their lived environments in shaping this experience. This qualitative exploration speaks to

the quantitative component of the study by extending an ecological approach to diversity in menopause experience beyond age at menopause. An integrative analysis and discussion of the qualitative results will be presented in Chapter 6, which considers the results from a biocultural perspective.

## 5.2 Initial research design: Group and paired interviews

My initial qualitative research question centred on documenting whether breadth in menopause experience varied across socioeconomic strata. Using the definition of culture as a set of shared beliefs, values, and customs of a population and not in specific relation to ethnicity, I aimed to extend the study of variation into the cultural impacts of existing within different socioeconomic strata. My approach is grounded in Bourdieu's concept of *habitus*, whereby the grouping of lifestyles socially can manifest in cultural differences between socioeconomic and ethnic groups, even within a small geographical population (Bennett, 2009, Bourdieu and Nice, 1977). In particular, I was interested in how ideas and expectations of what menopause experience is or might be seen as could pattern with differences in menopause experience across socioeconomic strata. Drawing further from Bourdieu, my approach was designed to explore how the role of education, information sharing and lived experience of others may shape expectations of menopause (Bennett, 2009, Bourdieu and Nice, 1977).

The original aim of my qualitative study was to identify themes in lived experiences of pre-, peri- and post-menopausal women within geographic locations designated as 1st, 5th and 10th deciles as per the Scottish Index of Multiple Deprivations (SIMD) (Scottish Government, 2020). While broad generalisability is not an aim of qualitative research, this approach was designed to produce a 'maximum variation' sample, that is, one which would include participants from different socioeconomic strata (Martin, 1987).

My first data production took place in Glasgow as grouped and individual interviews. I chose Glasgow as the locus of this study as it has huge variability in socioeconomic status over a relatively small geographical area, and therefore had potential to offer an interesting example of how culturally mediated variation in menopause experience might manifest even within a population which is relatively homogenous in other ecological traits, such as geographical location and meso-level structures. Given the potentially sensitive nature of discussing menopause

experience, another consideration was to aim to recruit groups of participants who already knew each other socially, such as friends, co-workers and members of the same social club. Conducting discussion with participants who were already known to each other was intended to increase participant's comfort.

### *5.2.1 Ethical considerations*

Given the personal nature of some questions surrounding menopause and reproductive life history, the comfort of all participants was prioritised before, during and after the recruitment and data collection period. Ethical considerations for the development interviews related to ensuring the comfort and safety of participants throughout the data production process, as well as data protection measures to ensure their responses were securely stored prior to pseudonymisation and analysis. All participants were required to give written consent before interviews and data were pseudonymised in the course of transcription by myself. Participant's understanding of consent was clarified verbally before the interviews commenced. This included emphasising verbally the right for participants to withdraw at any point. In the event that participants became distressed or upset, they would be given the opportunity to step out of the group or leave early. Directions for support and advice on topics related to those brought up during discussions were provided at the end of the session. Ethical approval was sought from the Medical, Veterinary and Life Sciences College prior to data collection.

I focused on approaching pre-formed social groups for recruitment, given the benefits of having pre-acquainted individuals in a focus group leading to a comfortable environment for sharing experiences relating to menopause. This presented the ethical issue of ensuring confidentiality amongst those who already knew each other. The importance of confidentiality in the context of data collection was emphasised at the beginning of the focus group. The so-called 'Chatham House rule' – where anyone who comes to a meeting is free to use information from the discussion but is not allowed to reveal who made any comment – was highlighted prior to the discussion.

### *5.2.2 Data production process*

I collected demographic data at the beginning of each interview, by distributing a short questionnaire which asked for the first 4 digits of the participant's postcode,

self-identified social class, profession, and ethnicity. I used the 3-class model of working class, intermediate class, and professional-executive class due to the familiarity and recognition of many in the UK with this class system (Bennett, 2009). The first 4 digits of their postcode were collected in order to identify SIMD as a relatively 'objective' measure of SES. Postcode data, self-identified socioeconomic status and self-identified ethnic background were to be used as both descriptors of the participants, as well as to give an overview the demographic characteristics of the sample.

Participation was open to anyone who self-identified as undergoing or having undergone menopause. Gendered language in recruitment was avoided to make sampling inclusive to transgendered experiences of menopause, although transgendered and non-binary people were not expressly invited to participate. I targeted locations through a combined approach of identifying areas in Greater Glasgow which fit the relevant SIMD criteria, and where pre-formed social groups met regularly. In February 2020, I approached the following different social groups over the course of recruitment: a) a choir in a higher-SIMD area; b) a hobby group in a lower-SIMD area; and c) a fitness class in a mid-SIMD area. This initial recruitment strategy generated one paired interview (area a), and one focus group (area b), which were conducted in the same buildings where these groups would normally meet. Additionally, I undertook convenience sampling to recruit additional participants through email invitations sent out within the University of Glasgow. The latter was particularly successful, with six interviews and two focus groups being held on university premises. This success may have arisen, in part, due to recruitment communications being sent out through Athena SWAN email lists. Athena SWAN is a framework for measuring and supporting workplace changes in tertiary education which are intended to promote equality (SWAN, 2015). Participants recruited from these lists may have been more engaged with equality activities than participants recruited outwith the University. Indeed, participation in the focus groups resulted in several participants establishing Athena SWAN working groups in their own departments within the University. In all but one focus group, participants were already friends or co-workers with other participants. Overall, 17 participants were recruited and interviewed: eight self-identified as working class, four identified as middle class, and five identified as executive/upper class. Focus group composition, socioeconomic status and

occupation for development interviews are outlined in Appendix 1: Development interview participants.

The interviews lasted between 30 minutes and two hours, and were audio recorded for transcription. Prior to starting the digital recording, consent forms and participant information sheets were distributed. I ensured that all consent forms were completed and any initial questions from participants were answered before commencing data production.

A flexible, semi-structured topic guide was developed based on the literature review presented in Chapter 1. The topic guide covered: initial introductions; asking participants to situate themselves within the menopause transition, and to describe their experiences (so far); comparisons of their experience with what they expected; and discussion of sources information about menopause which they had used. I also asked participants at the end of the discussion if they had anything they wished to add, or if there was any specific aspect of menopause they believed should be researched in future.

Audio data were collected using an encrypted recording device. I transcribed and pseudonymised the data and NVivo qualitative analysis software (QSR International Pty Ltd, 2020) was used to support data management and coding.

### *5.2.3 Analysis of the development interviews*

I undertook an inductive thematic analysis set out by Braun & Clarke (2006, 2020), which draws on the ontological positioning of critical realism outlined in Chapter 2. This process of data analysis centres the researcher in the analysis process, recognising that the output of analysis is co-produced by both the content of the data and the theoretical background of the researcher. As I have a medical anthropology background, the themes identified in the data are likely to be influenced by my understanding of that discipline and familiarity with interpretive and critical medical anthropological literature.

Initial codes were generated based on experiences outlined in the data, and whether they related to the body, social context (such as relationships with family and friends), or interactions with wider social structures such as healthcare or workplaces. These distinctions were informed by Scheper-Hughes and Lock's (1987) concept of the *mindful body*, (Scheper-Hughes and Lock, 1987) whereby the body can be conceptualised as the 'body self', the 'social body' and the 'body politic'.

Within these groupings, experiences were coded based on what they described (e.g. symptoms, medical actions, conversations) and emotional responses towards them (e.g. positive, negative, loss, control).

However, by the time I was conducting this analysis, I changed direction in my research question and overall approach, as a response to the emerging Covid-19 pandemic, as I explain below. At this point I made the decisions to use these data to instead develop a qualitative survey as the primary means of data production. I therefore took the decision not to look in depth at any differences in experiences patterned by socioeconomic status in the interview data, in favour of a more specific focus on different components of individual experiences of menopause in this emerging ecological context.

### *5.2.4 Covid impact and subsequent adaptations*

Recruitment and data collection started in February 2020, with the last group interview held on the 18th February. At this time, the coronavirus pandemic was beginning to emerge in the UK. Given government recommendations to socially distance, and the subsequent lockdown measures announced on the 23rd March, qualitative recruitment was halted indefinitely in March 2020. The novel circumstances of the lockdown environment meant there was a lack of clarity as to what forms of research would be acceptable, ethical, and feasible in the coming months. In response to this changing research environment, I sought amendments to my institutional ethics approval which would allow me to carry out interviews remotely, as well as to distribute an online questionnaire to capture menopause experience during the pandemic and lockdown specifically.

However, I was also conscious that potential participants may be dealing with additional anxieties as a result of constraints on social contact and the pandemic more broadly. I thus opted to build on learning from the qualitative interviews which I initially conducted, to produce an online qualitative survey. While a significant shift in study design, this change allowed me to capture valuable data in greater breadth than a smaller-scale interview study, while also capturing some of the rich detail available through qualitative methods as I explore in more detail below. Through this qualitative survey, I aimed to produce data which could capture the outcome of this synergistic relationship between the lockdown environment and menopause experience, as a point of comparison with the 'usual'

environment. Given the uncertainty of how long lockdown measures would exist, I considered the qualitative survey as being ideal for capturing lockdown experiences in a relatively short space of time.

## 5.3 A revised study design: the online qualitative survey

In order to explore any contrast of menopause experience during lockdown with experience prior to the lockdown environment as fully as possible, the survey was split into two sections: menopause experience prior to the pandemic lockdown, and changes to menopause experience during lockdown. Furthermore, the data collected from my previous qualitative study were used to shape the questions and prompts included in the questionnaire.

I chose to collect data through an online qualitative survey for several reasons, primarily practical. These included increased accessibility for participants who may not be able to dedicate time, for example, to an online video interview (Braun et al., 2020). Furthermore, given that lockdown measures meant the majority of respondents would be at home, potentially with little privacy from anyone with whom they shared a home, the survey minimised the necessity for participants finding a private space (Terry and Braun, 2017), such as they would need to answer questions verbally over Zoom. At that time, video calls had also been subject to 'Zoom-bombing' where third parties had infiltrated calls for nefarious reasons, creating additional privacy concerns for this approach to data collection.

Online qualitative surveys have previously been used to document lived experience, particularly for establishing a baseline of knowledge on an area which may be understudied (Terry and Braun, 2017). The qualitative survey approach generates a different type of data than qualitative interviews: typically responses are more condensed, and substitute the rich contextual detail which can be produced in interview contexts with precision and concision in responses (Braun et al., 2020). It was certainly the case that responses to my survey questions were briefer and more concise than in some of the development interview data. Many responses were often descriptive answers to questions outlining specifics of their experience, more so than reflections on or feelings about the experience, which were more clearly evident in the first phase of qualitative work.

The survey comprised the following sections: demographic questions; menopause experiences prior to the pandemic; experiences in lockdown; what might be

termed a ‘public and patient involvement’ (PPI) section (namely asking for views on areas for further research); and signposting to the same information sources available to the interview participants (see Appendix VIII.ii). As with the interviews, demographic questions asked for the first four digits of the participant’s postcode, self-identified socioeconomic status, ethnicity, profession and whether they were considered a key worker. Demographic data were used to contextualise participants in the process of thematic analysis, and in the writing up of results.

Drawing on the results of the development work (outlined below in section 5.4), specific questions were formulated to cover aspects of menopause experience, such as: impacts of symptoms; actions taken to address symptoms; information or support-seeking: and discussion of menopause with others. Prompts were also added into the questions to cover areas of experience brought up in the initial data collection, and to emulate in the online format researcher guidance which might be offered for answering questions during in-person data collection (Braun et al., 2020). These questions are included in Appendix VIII.iii.

One important consideration for question generation was to ensure language was accessible to those responding to questions. There has been much criticism of pathologisation of menopause (Lock, 1993). Nevertheless, at present, menopausal experience is typically framed in everyday life in a highly medicalised way - that is, with reference to ‘symptoms’. Hence, while some of the language used in the questionnaire could be viewed as perpetuating the medicalisation of menopause (which I critique in Chapter 6), I included common terms for symptom in the wording of questions. Furthermore, the questions around symptoms were separated into those which were physical (i.e. experientially related to the body) and mental (i.e. experientially related to the mind). While the Cartesian mind/body dualism is heavily problematised within medical anthropological approaches to health (for example see (Bendelow and Williams, 1998)), popular discourse again still tends to treat both as distinct entities. As such, I opted to utilise this categorisation as a heuristic in data production, and go on to address some of the limitations of this in Chapter 6. Moreover, it was of particular importance to highlight to participants that I was interested in both physical and metal/emotional symptoms as the latter continue to be less well-recognised relating to menopause. Symptoms of menopause widely recognised in biomedicine

tend to remain limited to hot flushes, night sweats and genitourinary symptoms (this is expanded on in Chapter 6). I had a particular interest in documenting the range of menopause experience relating to both the body and the mind, and therefore aimed to balance accessibility of language, and to highlight my interest in a broad field of experiences.

The questionnaire was hosted on JISC, and included a consent form, completion of which was required to advance to the questions. Participants were given the option to provide an email address in order to receive a copy of the findings once the study was completed. The questionnaire was open to responses between 12th June 2020 and 27th July 2020. As with the development interviews described above, participation was open to anyone who self-identified as undergoing or having undergone menopause, providing they lived in the UK during the 2020 lockdown measures.

I initially publicised the questionnaire through Twitter and Facebook, as a practical means to capture a potentially diverse sample of respondents. The questionnaire was distributed around Twitter mainly by other menopause and women's health researchers, and menopause advocacy groups. On Facebook, I targeted groups relating to menopause as well as local neighbourhood/community groups. This was to help the questionnaire also reach those who did not actively participate in menopause-related social media groups. Additional distribution was supported by the *Menopause Matters* magazine, which advertised the questionnaire on their online forums and social media accounts. the breadth of responses received through these online distribution methods supports the benefits of online qualitative surveys as outlined by Terry & Braun (2017), namely that sampling extended beyond those who are less likely to be recruited during more traditional qualitative data collection.

### *5.3.1 Qualitative survey analysis*

The online questionnaire format of data collection generated two key considerations in my approach to data management and analysis: how to manage the volume of responses, and how to categorise the content of those responses. Overall, 377 participants responded to the survey, a volume which was not anticipated, and is extremely large for a qualitative survey. Practical

considerations therefore needed to be made regarding the scope of the study, and options for analysis.

As such, analysis of the qualitative survey data required a slightly different approach to that used with the interview data. As with my development interviews, I utilised a thematic analysis approach to code and interpret the survey data (Braun and Clarke, 2020, Braun and Clarke, 2006). As with the development interviews, I used NVivo 12 software to perform coding, and coded responses based on description of experiences (e.g., symptoms, actions, discussions) as well as which experiential realm they related to (e.g., self, social, workplace, medical interaction). As I was working with such a large dataset, I utilised the demographic characteristics of my population to explore whether coding frequencies varied across different socioeconomic strata. Using the matrix tool in NVivo 12 (QSR International Pty Ltd, 2020), I was able to visualise coding frequencies by self-reported socioeconomic status. I did not identify any considerable differences in experiences among these groups, and so decided not to pursue this analytical approach further.

My analysis of survey responses drew on Braun & Clarke's (2020) review of the literature on online qualitative surveys, in that I took the view that shorter responses need not be considered as lacking in detail *per se*, but rather as providing a more concise and focussed response than may have been given verbally in an interview (Terry and Braun, 2017). Furthermore, the 'open response' design of qualitative survey questions also allowed insight into participants' sense-making of the question and their responses (Terry and Braun, 2017). Thus, analytical focus was placed during coding on identifying participant-specified detail on the range of menopause experience, as well as commonalities therein. As thematic analysis allows a more reflexive approach to coding than other inductive methods like Grounded Theory and Interpretive Phenomenological Analysis (Braun and Clarke, 2020), and is able to be conducted with different levels of detail, this approach allowed a greater breadth of experiences to be captured relating to the novel research context of Covid (Braun and Clarke, 2020). Another pragmatic analytical decision relating to the large volume of data was to analyse responses to thematic groups of questions, rather than across all responses for each individual. Again following Braun and Clarke (2020), this approach allowed me to generate themes relating to specific experiential dimensions of menopause experience across this

large dataset, building upon my literature review and the development interviews. These themes are presented further in this chapter. A conceptually informed analysis, drawing on a biocultural perspective on health, is presented in Chapter 6.

In practice, my process of analysis was thus: Looking at the level of the question response I would identify descriptions of the menopause experience, and code them as these descriptors. For responses where the participants' opinions were given, I would code these relating to whether they were positive, negative or neutral. A copy of my codebook can be found in Appendix VIII.iv.

## 5.4 Development interview findings

In initial analysis of the development interviews, I identified three key areas pertaining to menopause experience, which were then carried forward to guide the focus and structure of the questionnaire. These themes, summarised below, related to: 'menopause and the self', 'social aspects of menopause', and 'actions taken in response to menopause'.

### *5.4.1 Menopause and the self*

Participants in the development interviews described many aspects of their menopause experience relating to the impact of personal symptom experience, ageing, and overall health on their sense of self. In several cases, there was an emphasis on the cognitive and mental symptoms as being more impactful than perhaps the more physical symptoms.

> *I3: Yes, I've had terrible mood swings. I think the insecurity that comes along with now brain fog but whether or not that's associated with the lack of sleep, the sleep deprivation. Then you suffer from anxiety because you know you're not yourself […]*
>
> *AF: And that anxiety, the inability to concentrate, tiredness…*
>
> *I3: It's actually, it's quite embarrassing I would say for me, it's embarrassing. It gives me an insecurity that I never had before. (Middle Class, Admin)*

Participants also described drawing on the responses of others to interpret their own experiences during the focus group. For some, it was not until others had

described their symptoms that they recognised their own experiences as menopause related.

> *FG3: "There was a woman in my group who was talking about she had left her husband, all packed her bags and ready to leave her husband four or five times. And to me it was a real lightbulb moment where I thought "Wow I'm not alone, I'm not going crazy"" (Middle Class, Academic)*

Particularly in relation to cognitive and mental symptoms, participants described feeling reassured through recognising that their symptoms stemmed from menopause. Feelings such as 'not recognising myself' often accompanied cognitive and mental changes, but attributing such changes to menopause helped to restore a sense and recognition of self.

> *FG2: "…so now when I'm feeling that, looking for an excuse to be angry at somebody or something I can recognise it as something, it's not actually something wrong with me and I'm not actually angry, it's out of my control." (Executive/Upper Class, Academic)*

Based on these responses in the development interviews, I decided it was important to include specific questions and prompts relating to the mental health aspects of menopause experience. I felt this suggested that explicit statement of menopause-related symptoms that were not commonly raised in the interviews - such as those related to mental and emotional health - would be especially important, given the emphasis participants placed on not recognising their own experiences as menopause-related until framed as such by others. The idea foregrounded in the interviews of 'not recognising' oneself during menopause also further emphasised the impact of menopause on the self in a way which extended beyond symptom experience, to a wider sense of recognising (or not recognising) the self.

### *5.4.2 Social aspects of menopause*

Social aspects of menopause experience was another factor identified relating to menopause experience. Of note were experiences of navigating family and work during menopause, and participants' discussion of menopause with other people.

Participants described who they had discussions with about their menopause experience, and the content of these discussions. Participants had discussed menopause with (typically female) family members such as sisters, mothers and cousins – sometimes to learn what they might expect for their own experience based on those related to them. An interesting dimension to this, highlighting the potential value of such discussion, was a perceived loss of experiential knowledge/lived experience when participants did not have living older female relatives.

> *FG4: "My aunt died when I was 21 and my mother died when I was 39 so at neither of those times was I thinking about discussing menopausal symptoms. My father's sister I wasn't close enough to speak to about it" (Executive/Upper, Doctor)*

Participants discussed menopause with friends, co-workers, and acquaintances of similar ages, talking about their experiences, what worked for them and general commiseration about menopause, which was framed in broadly negative terms. In some cases, participants described giving advice to younger women on what to expect and treatment options.

> *FG4: "Like at my yoga class next week, my yoga teacher was asking us all about different symptoms and she thought she was going through the menopause early and what should she do, what did we think and all the rest of it… and also she was just taking bits of advice, whether she should take HRT because she has some family history of breast cancer… We attempted to discourage her [AF: As a group?] Yes." (Executive/Upper, Doctor)*

Differing perspectives were given by participants around using menopause as an explanation for symptoms or behaviour, to themselves and others. One participant described a conversation with her immediate family relating to menopause and her behaviour, with a hope that her daughter could contextualise any future behaviour in relation to the participant's menopausal transition.

> *I1: "My daughter commented about an argument we had and I burst into tears, and I think she was really quite surprised by that, and my husband was able to say "well you know mum's going through her menopause and that's what's making her a bit*

*emotional". So hopefully that a bit helpful to her to understand why I might have been a bit irrational." (Working Class, Admin)*

Some participants felt discouraged from communicating their experience, relating to the stigma associated with menopause - compared to other facets of reproductive life - affecting other peoples' perceptions of them.

*I3: "I feel very, very vulnerable. I don't like talking about it too much because, it's not – nobody really talks about it. It's acceptable for women that have had babies to talk about baby brain, and it's the same – I'm sure it's the same sort of fog that comes over them. That's ok, that seems acceptable but it doesn't really seem acceptable for women of a certain age that's going through all of that." (Middle Class, Admin)*

Participants also spoke about work, including the difficulties of working through menopause, and whether menopause was discussed in the workplace. Symptoms such as tiredness, fatigue, heavy bleeding, and cognitive impairments were described both as causing difficulties working, as well as causing some participants to question their ability to work.

*I3: "I feel quite vulnerable if I open up and I tell people, because they'll be analysing everything I do and saying "Is that right what she's done?" [AF: Do you think that it would be, it would put you at a disadvantage, and that people might second guess?] I do, yep." (Middle Class, Admin)*

Based on the above responses, it became clear that menopause experiences were not solely related to symptom experience, but also the context in which symptoms were being experienced. The home and the workplace both were locations where menopause experience had interacted with day-to-day functions and activities, and where participants felt the impacts of this interaction most profoundly. Furthermore, for those I interviewed communication around menopause was said to be important to overall experience, as a mode through which advice and support could be sought. Communication made an impact both on its presence and its absence. As such, questions for the survey were developed to specifically ask about the impact of menopause symptoms in personal, family, work, and social

life. Questions were also formulated to ask about who, if anyone, participants discussed menopause with and where they sought information from.

Actions taken in response to menopause

Many discussions in the initial interviews and focus groups centred on the actions participants had taken to alleviate symptoms. Such treatments include seeking medical advice and treatment, like HRT and surgical treatment for fibroids associated with hormone imbalances. Other actions taken include lifestyle changes, such as increasing exercise and improving diet to not only improve symptoms but to improve overall health as well.

> *I3: "I am trying to exhaust myself through sport, to get asleep if I'm being honest with you. I've actually, I've got a personal trainer. Now, it's a luxury but this is part of my lifestyle, this is to help. This is doing the right exercises that will actually help with my sleep pattern and help with the function of my body." (Middle Class, Admin)*

As important to menopause experience overall were the efforts that participants made to try and alleviate any negative impacts from their symptoms. Beyond hormone replacement therapy, many non-pharmaceutical actions were taken during menopause such as dietary changes and increasing exercise. As such, a survey question was designed to ask about any actions they had taken to alleviate the impact of their symptoms. Within the question, a prompt noted that actions could include medical interventions such as HRT; non-clinical interventions like herbal remedies; and lifestyle changes such as exercise and diet changes.

Based on my analysis of these interviews, the results of this initial data analysis gave an indication of how significant factors in menopause experience extended beyond the self, and into how menopause was communicated and also managed by participants. Thus, I sought to incorporate these factors in the online survey given their importance to the participants in the initial data production.

## 5.5 Qualitative survey findings

The following section outlines my thematic analysis of the qualitative survey data. The findings are organised by general experiences of menopause (that is, those which were not COVID-19-related), and those which were derived from the COVID-19-specific questions of the survey. Within the non-COVID-19 experience category, the themes are also grouped here into three categories: those relating to symptom experience and self-positioning within the menopause transition; those which relate to the impact of menopause; and those concerning the discussion of menopause. An additional theme was also identified relating to COVID-19 experiences, which explores the role of the lockdown environment in shaping menopause experience. While I aim to present my findings as they relate to the content of responses, in some cases I use coding frequency as a way to obtain an overview of how frequent specific aspects of menopause experience were mentioned by participants.

### *5.5.1 Demographic characteristics*

377 participants responded to the survey in full and were included in the analysis. The median age of respondents was 51, with a range of ages from 31 to 71 (Figure 5.1). 27% of respondents lived in the West of Scotland, with a further 10% living in the East of Scotland (Figure 5.2). 53% of participants came from England, with the highest number of English participants coming from Greater London. 3% of participants were Welsh, and 1% were from Northern Ireland. 129 (34%) considered themselves working class, 169 (45%) identified as middle class, and 76 (20%) identified as professional/executive class.

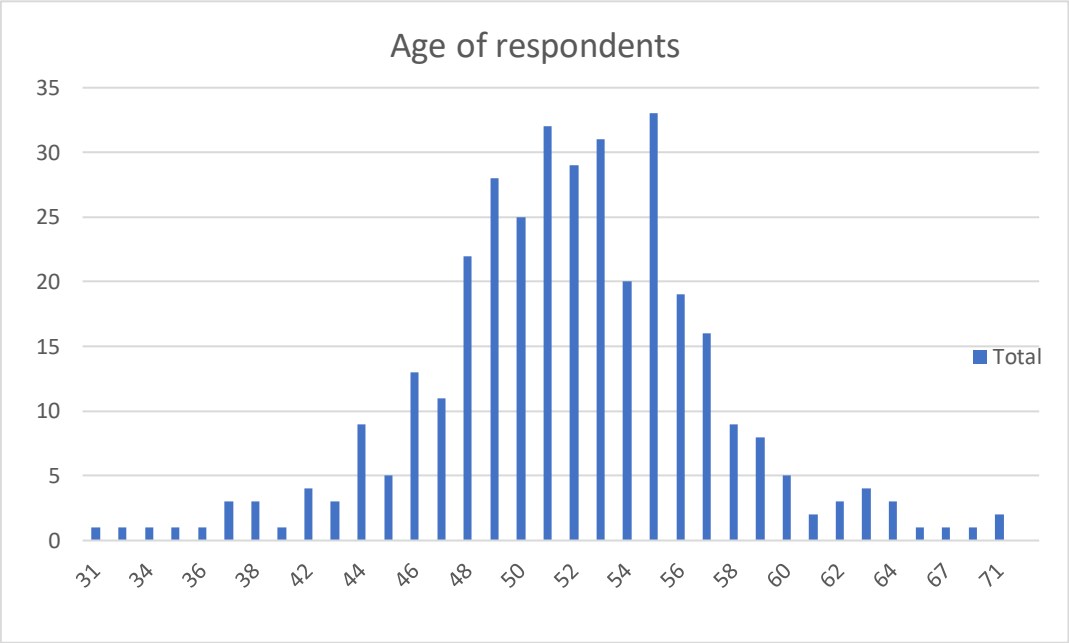


*Figure 5.1: Distribution of age of respondents*

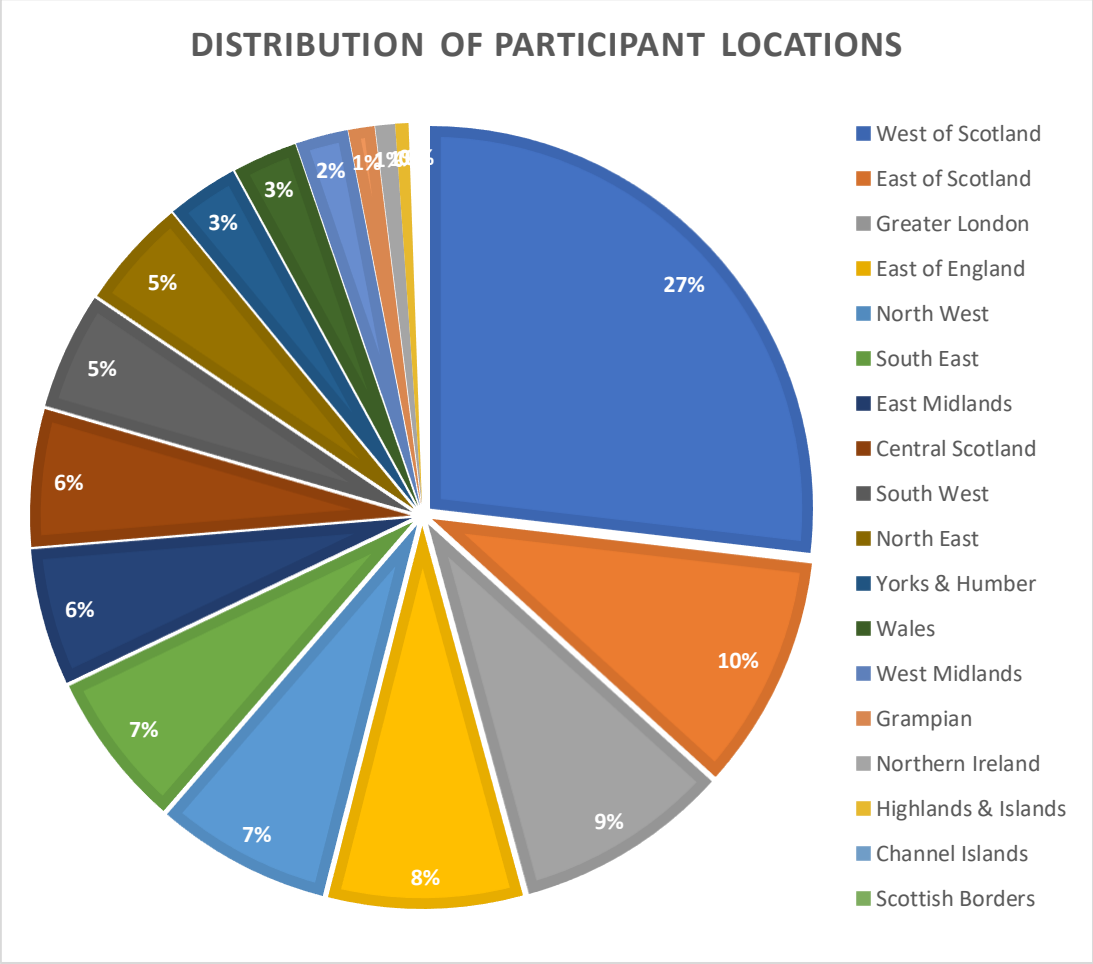


*Figure 5.2 Distribution of location of participants*

### 5.5.2 *General experiences I: Symptom experience and self-positioning in the menopause transition*

This section presents three themes identified in response to questions on symptom experience, and self-positioning in the menopause transition.

Theme: Self-positioning in the transition is primarily comprised of symptom presence and bleeding experience

Following the initial demographic questions, the questionnaire began with several questions designed to elicit participants' own conceptualisations of the menopause transition and their location in it. Although this was designed to be as open as possible, the character of a qualitative survey meant prompts were provided as appropriate, and it should be recognised that this may have shaped the language participants felt was appropriate. Regarding the transition, the prompt was as follows:

> *"This can include information such as: still having periods; still having symptoms; no longer having periods but having symptoms; no bleeding due to contraceptives (Mirena coil, implant, oral contraceptives) and experiencing symptoms"*

Most participants defined their transition primarily in relation to bleeding or other physical 'symptoms'.

Most participants chose to define their position in the menopause transition based on the extent to which symptoms broadly were present, absent, ceased, or had not occurred in the first place.

> *"Been peri-menopausal for around 6 years. Irregular periods/spotting, still having symptoms, worsened over last five months." (South-East England)*

In addition to symptom presence, the next most commonly reported sign of the menopause transition related to bleeding status. Participants' menstrual cycle was referenced in relation to bleeding regularity, contraceptive amenorrhoea, bleeding due to HRT use, or if they had stopped bleeding completely.

> *"No longer having periods (last one almost 7 years ago)" (56, South-East England)*

> *"Peri, still having periods but since the outset of pandemic very irregular (since January have had 3 periods). Previously very regular except when my father died 2 years ago and I missed a couple." (48, West of Scotland)*

Many responses included a combination of bleeding and symptom presence, meaning self-positioning in the menopause transition was often constituted by symptom and bleeding status combined. Interestingly, in a considerable number of responses to the specific question on self-positioning where respondents stated they were still bleeding, there was no mention in the same response about symptom presence. This is despite other symptoms being described in responses to later questions. This suggests those participants may have attributed greater significance to bleeding in their self-positioning, perhaps indicating an earlier position in the menopause transition where bleeding and symptoms more typically co-exist. This stands in contrast to responses which did outline symptom presence, as most responses would contain reference to both symptoms and bleeding.

Some descriptions of transition positioning referenced the impact of hormonal contraception on bleeding, with symptoms or a clinical diagnosis of peri-menopause typically cited in the response to explain their positioning.

> *"No periods, have Mirena. Had Mirena coils for at least 17 years so not had periods all that time. Initially it was my choice for contraception, it's now used in conjunction with oestrogen gel for symptoms. I have no idea when or if my periods stopped" (54, Yorkshire & The Humber)*

In some cases, the absence of bleeding either due to contraceptive amenorrhoea or hysterectomy caused participants to doubt whether they were still in the menopause transition, or if they were in fact post-menopausal. This echoes the positioning, noted above, whereby participant's recognition of changes to bleeding has importance alongside symptoms in general in their self-positioning within the menopausal transition.

> *"I suspect I am peri-menopausal, status based on symptoms experienced but unknown due to hysterectomy aged 47" (51, Northern Ireland)*

In one case, a medical condition unrelated to menopause resulted in additional difficulties for the participant identifying their position in the menopause transition.

> *"Have mirena coil so blood test required as not had periods with coil. Blood test and vaginal ultrasound confirmed possibly in last quarter of peri-menopause. Nearly there! Not realise I was in menopause as symptoms very similar to under active thyroid fluctuations and as I have underactive thyroid and not periods due to coil, I have no idea when I started menopause process" (53, Grampian)*

The difficulties this participant had in identifying whether they were in fact menopausal highlights the significance of symptoms and bleeding as points of reference for identifying menopausal status.

<u>Theme: Menopause experience encompasses a wide range of symptoms</u>

Responses were analysed together to two questions on symptom experience: one relating to 'any symptoms' and another to 'any cognitive or emotional changes' (see Appendix VIII.iii). The separation of physical symptoms from mental/emotional changes was based on learning from the development work described in earlier in the chapter, where participants typically outlined physical changes when asked about symptom experience, rather than any mental changes. The two separate questions aimed to capture responses from participants who may not have linked mental changes with their physical symptoms or with menopause. For physical symptoms and mental changes respectively, the following prompts were included:

> *'physical symptoms such as tiredness, hot flushes and night sweats, genital or urinary discomfort, trouble sleeping, skin irritation etc'; and 'difficulty concentrating or thinking; 'brain fog'; low moods; irrational anger etc'.*

A considerable volume of responses spoke directly to these prompts, with answers stating "*all of the above*", "*all the ones you mention in your example answer*", or "*pretty much all of these*". One such response highlighted the impact of such prompts in increasing recognisability of their own symptoms:

> *"Now that I read those examples, I think I did have some of those symptoms (memory, concentration, depression, and low tolerance to certain sounds, oh - and crippling social anxiety) I thought I was just going mad!"*

Of note here is the sheer range of symptoms outlined, which impacted almost every aspect of bodily function. Categories of all symptoms mentioned are outlined in Figure 5.3, organised in relation to their coding frequencies, that is, how commonly they appeared across the dataset. Also noteworthy is the relative balance between physical and mental symptoms.

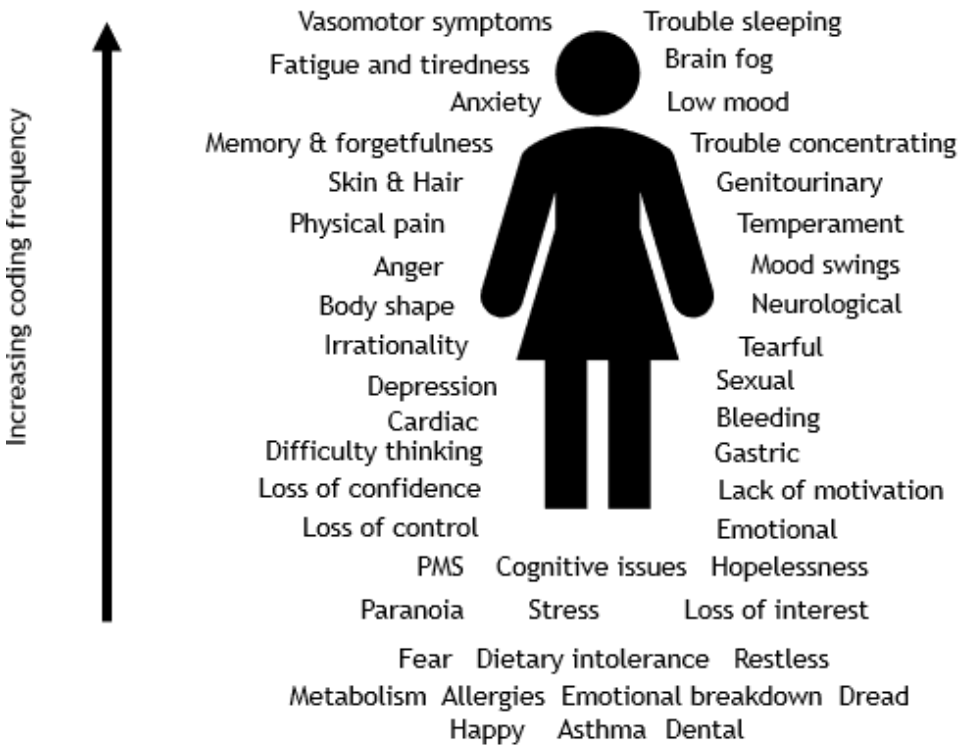


*Figure 5.3 Range of menopause symptoms and relative coding frequency*

It was very rare for individuals to report experiencing only one symptom related to menopause. Vasomotor symptoms (hot flushes and night sweats) were commonly reported alongside others such as trouble sleeping, fatigue and anxiety. Many respondents thus reported experiencing both physical and mental symptoms, which were sometimes described as interdependent.

> *"The hot flushes have been constant for 9 years. I have approximately 8-10 a day and also through the night. I wake up on average 3 times a night with hot flushes and find it difficult to get back to sleep afterwards." (55, West of Scotland)*

Brain fog was commonly reported alongside low mood, anxiety, anger, and trouble concentrating. This supports the view that symptoms also cluster both cognitively and emotionally. Trouble sleeping in particular was invoked as exacerbating other symptoms, supporting a view that symptoms were not experienced independently but in interaction with each other. Menopause symptom experience may therefore be best considered as both the range of symptoms, but also as the interaction amongst these, and the resultant effect on the individual.

> *"Not sleeping leading to exhaustion. Muddled thinking. Temper tantrums. Unable to control emotions. Constant crying with bouts of irrational howling. Palpitations and feelings of something bad going to happen - on edge. Total lack of libido to the point of frigidity. Depression as a result. Change of character. Not being me. Teeth coming loose. (57, Yorkshire & the Humber)*

### *5.5.3 General experiences II: Impacts of menopause*

Participants were invited to share ways in which they felt their symptoms had interacted with their daily (personal, work, social) life, and about any actions they had taken to manage their menopause symptoms, such as HRT, herbal remedies, or lifestyle changes (see Appendix VIII.iii)

The following themes were identified in response to this group of questions.

Theme: Menopause is disruptive

When recounting impacts of menopausal symptoms, many participants gave details of how their menopause experience had disrupted various aspects of their lives. As such, symptom experience was not limited to the person, but also infringed on participant's abilities to navigate their everyday lives. Responses often specified which areas of life participants felt symptoms to be impacting. The impact on work was the most frequently noted area, followed by participants' personal, daily, and social life.

**Workplace**

Disruption in the workplace was described in relation to the daily experience of working during menopause, the consequences of working during menopause, and larger changes to employment that occurred during menopause. Daily interactions noted by participants based around cognitive symptoms included worrying about not being able to do their job; not feeling in control of their work; getting

frustrated from making mistakes at work; losing confidence in their work; and getting emotional over their workload.

> *"Impacts quite severely on my working life as I have lost confidence in my abilities, particularly in relation to acquiring new skills" (55, Central Scotland)*

Some participants noted their symptoms got in the way of their duties, such as where irritation and anxiety affected those in management positions; being unable to focus on training after being redeployed; being unable to handle other's perceived incompetence; and taking longer to complete their work.

> *"Don't feel as in control of work, find it exhausting to keep recapping that I haven't forgotten to do something" (54, East of Scotland)*

Those who noted the consequences of working with their menopausal symptoms described disruption as relating directly to their symptoms. One participant experiencing heavy bleeding also mentioned the constant interruptions caused by having to take many toilet breaks, as well as the embarrassment of having to excuse themselves to go to the bathroom in front of male colleagues. Another disclosed that they fell asleep at work. The larger disruptions to employment mentioned by some participants revolve around changes to their work patterns, taking time off, and leaving the workplace.

> *"I chose to take voluntary redundancy as my stress levels and severe menopause symptoms whilst working full time were causing workplace conflict and I was signed off work for several weeks and couldn't face going back." (57, North-West England)*

Several participants noted the challenges of holding down a full-time job, and that they had reduced their hours due to working through menopause. Others stated taking time off work due to cognitive and emotional symptoms, going on medical leave, and taking voluntary redundancy.

> *"Acute anxiety was at its height during work leading me to decide to leave the world of work at the age of 52 ... I had a great career" (58,South-East England)*

One participant stated that she was losing out financially by taking days off work due to her symptoms.

> *"Hugely impacted my life. In work have quit jobs I previously enjoyed as have no patience with members of public […] I'm trying to set up a business selling locally grown flowers and had to put it hold this year. Feelings of intense overwhelm and anxiety had to take days off work, losing out financially […] The tiredness and sore joints make my physical job as a gardener/florist hard going, have had to step back from it this year." (44, East Midlands)*

Participants reported further significant work-related decisions such as taking retirement due to symptoms. One participant experienced disciplinary procedures relating to menopause symptoms that had affected their workplace behaviour, while another believed that their cognitive symptoms had led to unsuccessful job interviews. In one case, the participant expressed regret over leaving their job for medical reasons, as she didn't realise at the time that this was menopause related.

> *"[I] left my job […] mainly due to anxiety and extreme fatigue. [If I'd] realised that this was caused by menopause I would not have given up my job" (54, Highlands)*

Disruption to work life comprised of the interaction between menopause-related symptoms and the responsibilities and demands of the workplace. As such, the impact of menopause symptoms becomes context dependent, both between different jobs and within different parts of the participants' lives.

**Home and personal life**

Similar to impacts on workplace interactions, participants referenced disruptions in their home life, relating to their symptoms. Participants described feeling "irritable" towards, and "snapping" at, their family; having no energy to play with their children; being too tired to enjoy the company of their family; becoming obsessed over their family's safety; and trying not to wake young children during night visits to the bathroom.

> *"Yes. I'm the driven one, the powerhouse, and some days I'm just not able to sustain things and lack energy. I feel so tired I can*

*barely walk. If I've arranged things but then I've not got the ability to do them, that causes issues at home. I've tried explaining to my partner what it's like and why I can't do things but there is no understanding of my situation, I'm made to feel like I'm a nuisance." (53, London)*

Disruptions to partner relationships were described in specific relation to symptoms affecting intimacy and sex. Low libido particularly affected relationships with partners, with vaginal atrophy, genitourinary discomfort and hot flushes also reducing sexual contact with partners.

*"Moods have big impact on daily family life. Loss of sex drive has been a very big issue in my marriage as we always had a really good sex life and my husband has a high sex drive." (South-West England)*

Outside of intimate relationships, participants saw practical disruptions to sharing beds with their partners due to both being restless in bed and overheating from hot flushes. One participant noted her partner had moved into another bedroom as his sleep was being disturbed by her insomnia. Partners were also subject to irritability and shortness of temper from participants, leading to arguments with their partners, and feelings of anger towards their partner while at home. Larger changes to family life and dynamics disclosed by participants include having to negotiate their relationship with their partner, irreparable damage being done to relationships with family members, and marriages being strained, almost breaking down, and ending during menopause.

*"My husband of 32 years has left our home due to my mood swings and violent outbursts" (53, North-West England)*

Personal life disruptions also related to interruptions to everyday routine. Responses related to either the impact of interrupted sleep on the participants' days, or on the added difficulties of performing daily tasks while experiencing symptoms.

Difficulty sleeping was most frequently cited by participants as causing disruption to their everyday lives. Interruptions to sleep came from several different factors – feeling restless, anxious, and irritated; skin irritations; and heavy bleeding were

all given as examples of how sleep was disturbed. The knock-on effect of poor sleep affected participants in several ways, such as being unable to get out of bed in the morning, having low energy and poor functioning throughout the day, and falling asleep in the evening.

> *"Affected sleep, made me more irritable, more difficult to carry out daily tasks when so much discomfort. Affected work and home life." (51, South-East England)*

Non-sleep related interruptions to daily life relate to other symptoms interfering with regular activity. Interruptions from physical symptoms include feeling discomfort from flushes in public places; painful joints affecting mobility and exercise routine; and discomfort from genitourinary itching, urinary frequency, and digestive issues causing anxiety about leaving home.

> *"The toilet problem (urinary urge incontinence) is only bad if I drink a cup of tea and then go out so I have to ensure I only drink tea when I'm at home. If I am going out early, I may drink tea later after I get back. It curtails freedom a bit." (52, London)*

Mental symptoms caused similar interruptions, with participants noting anxiety over driving; feeling unable to leave the house apart from going to work; and needing to take downtime to manage their mood.

> *"My symptoms really affect my everyday life some days I literally have to drag myself out of bed, I don't socialize any more as once I've finished work all I want to do is go home and put my pyjamas on. I can no longer drive out of my comfort zone which is just in and around my hometown due to the anxiety" (51, South-East England)*

> *"I completely stopped leaving the house other than to go to work 3 days a week. I made a joke of it but it upset me to see my world shrinking." (57, West of Scotland)*

**Socialising**

Disruptions to socialising were either intrinsic (i.e.. relating to the participant and their symptoms) or extrinsic (i.e.. relating to their interaction with other people). Intrinsically, menopause caused some participants to stop feeling sociable,

"taking away from the good stuff", and often cancelling plans due to low mood or anxiety. Due to physical symptoms, participants found further barriers in being unable to drink alcohol, feeling embarrassed socially due to weight gain, fear of flushing when around others, and not wanting to explain menopausal behaviours to others in a social setting.

> *"Yes. Stopped socialising before lockdown to avoid anxiety. Became more isolated for fear of having to explain behaviour that 'wasn't me'. Avoided alcohol for over a year." (52, Wales)*

Extrinsic factors relate to the participants' tolerance of, or interest in others. Responses demonstrating this include participants lacking interest in social interactions, feeling unable to tolerate anyone, and having to force themselves to take interest in others. As a consequence, participants had noted they had fallen out with people as they could not be bothered arguing, lost their tempers with friends, been isolated from friendship groups and become totally withdrawn from friends.

> *"Hugely significant, I lost it with one friend and was isolated by our friendship group. I have done irreparable damage to the relationship with my son who got the worst of me at that time" (53, Central Scotland)*

<u>Theme: Menopause is uncomfortable</u>

Related to the disruption from menopause is the theme of discomfort coming from the impact of menopausal symptoms. This is differentiated from disruption in that it relates to how participants felt as a result of their symptoms, including from the impact on their lives. Generally, discomfort was discussed in relation to how specific symptoms made them feel, but also the impact of experiencing symptoms on their wider being.

Flushes and night sweats were described as 'horrible', 'bothersome', 'annoying' and 'uncomfortable in any context'. One participant stated that they would feel faint whenever they had flushes or sweats. Another participant was particularly bothered by them when they were also feeling anxious or wearing PPE. As such, vasomotor symptoms produced discomfort both from the physical sensation of

flushing or sweats, and in contexts where temperature fluctuations and sweat are unwelcome.

> *"Night sweats where I wake up soaked and hot flushes. One min I'm freezing, the next I'm on fire. It's hard when you share a bed!" (31, South-East England)*

> *"Flushes all day long glasses steam up and face goes red. Sometimes it's that bad I have to leave a class or meeting to dry off as water running down my face" (56, West of Scotland)*

Symptoms involving urination, bleeding and genitourinary discomfort were regularly described as uncomfortable. Bleeding caused participants to flood through menstrual products, was very difficult to manage, and was sometimes so heavy they had to sit on towels to protect furniture. Participants felt embarrassment, pain, and discomfort from urinary incontinence to the extent that some became antisocial. Genital pain and itching caused discomfort and bother both during day-to-day life and in intimate relationships. Everyday tasks such as travelling and using the bathroom triggered genitourinary pain, while routine medical examinations like smear tests were "agony". Genital pain also caused discomfort when participants were being intimate with their partners. Sexual intercourse was often avoided "in case it is too sore", because "it's too painful", and as a result of low libido.

> *"I have found it impossible to get the genital itching under control and that decreases comfort and confidence going out places." (52, West of Scotland)*

> *"I find my issues with vaginal atrophy, dryness, pain and labia cuts, soreness and friction distressing" (57, Wales)*

As well as discomfort from specific symptoms, the overall experience of menopausal symptoms compounded the discomfort and distress felt by some participants. For some there would be no respite from discomfort as they were "affected almost constantly with one symptom or another". Symptoms would overwhelm some participants, to the extent "life was hardly worth living before HRT", with others being "devastated".

*"It's so horrible, every day is hard. Wake up feeling "why am I here"?" (54, West of Scotland)*

Discomfort also stemmed from changes to self-image felt by some participants. Menopause had stripped them of "feeling like a woman", feeling desirable, and caused some to "feel like I've lost it".

*"I feel less feminine due to losing female body shape and certainly become invisible in general as an older woman. I suffer from huge bouts of sadness" (57, East of Scotland)*

Menopause was also source of a loss of personhood for some. Participants were "stop[ped] from being who you are", had a feeling of going mad, and a loss of self-worth. In some responses, participants noted that they did not recognise the person they are becoming during their menopause.

*"I wasn't like this before. They all make me crazy cos it's not me!" (48, Yorkshire and the Humber)*

<u>Theme: Women seek treatments that are biomedical, non-medical, or both</u>

When asked to note which actions they had taken to alleviate their symptoms, participants responded with a huge range of interventions. A distinct theme was apparent therein: that symptom relief came from both medical and non-medical interventions, and that both were not mutually exclusive to the participants.

The most frequently mentioned action given by participants was taking hormone replacement therapy (HRT). Some participants gave further details on their HRT regimes, which included combined therapies (oestrogen + progesterone), oestrogen-only therapies with hormonal coils, localised oestrogen, and testosterone therapies. Many participants also offered their experience with HRT even if they were not taking it. Interestingly, justifications for not taking HRT were more forthcoming in responses than reasons for taking HRT.

*"2 rounds of HRT. The side effects were worse than the debilitating hot flushes" (49, North-East England)*

*"I have not taken HRT partly because of my mother's experience with it and partly because I had a very off-putting experience when I reached out to my GP after struggling with symptoms for over a year" (56, South-East England)*

Beyond HRT, other biomedical interventions prescribed by medical professionals were described in responses. Antidepressants and anxiety medication were prescribed to help poor mental health and hot flushes, with varying degrees of success. Several participants noted they were seeking HRT after finding conventional treatments unsuccessful. Other prescribed medications were given to treat specific conditions such as sleeping aids for insomnia, pain relief for heavy bleeding, and steroid creams for vulvovaginal discomfort.

Outside of medical interventions, many participants noted trying to manage their symptoms through lifestyle changes. The most commonly cited action by participants (second only to taking HRT) was exercising to manage symptoms. Specifically, exercises helped participants to remain fit, manage body shape and manage symptoms like joint pain, poor mental health, and sleeplessness.

> *"Exercise has massively helped the anxiety so that's my medicine for that." (43, South-East England)*

> *"I am trying to eat more healthily and have found increasing my exercise levels improves my mood and sleep. Recently ran out of herbal medicines and routine slipped and felt much worse." (50, Wales)*

Alongside exercise, dietary changes, nutritional supplements, and alternative therapies were also frequently cited by participants as lifestyle changes made to try and manage their menopausal symptoms. Changes to diet occurred for many reasons: healthy eating, weight management, reducing alcohol, caffeine, and spicy foods, and increasing water, soya, and oily fish consumption.

> *"If I eat less sugar/ less carbs then hotness and sleeplessness definitely improve." (48, West of Scotland)*

> *"Have tried a few dietary changes including trying to improve diet to become more nutritious and trying to include beneficial foods." (51, West of Scotland)*

> *"I've adopted a vegetarian lifestyle. I take vit B, cod liver oil capsules and sage capsules. I try to walk 3 to 5 miles a day. I've cut down on alcohol, really notice a difference in flushing if I've had more than one glass of wine." (51, East of Scotland)*

Justifications behind dietary changes evoke the perceived importance of participants following a healthy lifestyle to try and keep menopause symptoms under control. Specific triggers for symptoms such as caffeine, alcohol and spicy food are also subject to dietary control but were not as frequently cited by participants as catalysts for dietary change.

Herbal remedies and alternative therapies were also popular amongst respondents. Similar to exercise and dietary changes, participants noted specific herbal remedies they were taking to help manage symptoms.

> *"Wasn't really happy trying herbal things as never sure what's in them. Had one of those magnets for a short time but not convinced of benefit" (57, West of Scotland)*

> *"Sea buckthorn has helped dry eyes etc, evening primrose has helped breast pain and magnesium has helped with sleep and anxiety." (48, Northern Ireland)*

Other lifestyle adjustments made by participants covered self-care activities and hobbies. Many took up self-care strategies and hobbies during their menopause experience, but continuation of activities they participated in pre-menopause also provided support to manage symptoms. Self-care strategies include colouring, meditation and mindfulness, looking after pets, reiki, alone time, and being surrounded by family. Hobbies listed by participants include life drawing, being part of a choir, gardening, cooking, reading and volunteering for community and church groups.

> *"I've always been fit, eaten well and don't over drink alcohol or caffeine so I already did many of the recommended self-help steps. I have made sure I get 30 mins alone every day - especially in lockdown - to make sure I don't overboil with my temper. I also try to breathe 10 times before ranting at anyone but this doesn't always happen" (50, South-East England)*

> *"Exercise has been hugely beneficial, as has yoga & mindfulness/meditation. Escaping to the garden early in the morning as I wake so early, to dig & weed has saved my life!" (53, South-East England)*

With the co-occurrence of biomedical treatments and lifestyle changes in most participant's responses, the question is raised of what the impetus to take multiple actions by so many is. One such cause may be that many participants view their menopause experience beyond a medical event, and that a change to everyday practices is necessary to accommodate menopausal changes. Indeed, many responses refer to the need for "continued healthy lifestyle measures" in order to mitigate any symptoms from menopause. As such, these responses may point towards participants considering their actions to need to be both curative (i.e.. HRT) and preventative (to maintain health) in order to support themselves during menopause.

However, the many different avenues taken to seek relief from symptoms may also be indicative of the lack of treatment choice available to participants – particularly from mainstream medicine. Biomedical advice and treatments were sometimes considered unsatisfactory for the following reasons: being given advice which was perceived as poor or unacceptable (such as losing weight); doctors perceived as unwilling to prescribe HRT; and participants having to advocate for receiving and continuing HRT treatment.

> *"I have spoken to my doctor and gynaecologist about the fact that it has gone on so long. They dismiss it and tell me I just have to deal with it" (55, West of Scotland)*

> *"GPs have no idea, except from proposing HRT, which as we know is a hit and miss exercise" (55, East of England)*

Furthermore, aside from HRT there were very few alternative biomedical treatments available to participants. The range of lifestyle actions taken by participants may partly stem from lack of options for symptom relief. This specific facet of the menopause experience also portrays the considerable economic cost of managing symptoms, given the large range of options participants described trialling and using.

> *"Herbal teas. Exercise. Diet (I eat healthily anyway however). Anything that would 'help' as there's simply not enough evidence of what's the best thing to do out there!" (55, South-East England)*

*"I've tried lots... Follow Michael Mosley advice on diet and sleep (Mediterranean style, low carb, low sugar, healthy fats etc.), no caffeine after midday, minimal alcohol, supplements (star flower oil, omega 3, magnesium glycinate, b complex, curcumin, vit D, menapol (herbal), Exercise (walking 4 times week, Pilates, and Qi Gong every day). I'm having Hypnotherapy each week and I'm on a waiting list for CBT. I am also awaiting advice from an Obs And Gynae Consultant as to whether I can have HRT with my family history of breast cancer (mum and Aunty) and grandma had ovarian cancer." (52, Yorkshire and the Humber)*

### *5.5.4 General experiences II: Discussing menopause*

Participants were invited to share who, if anyone, they discussed menopause with as well as where they sought information from about menopause. Discussions around menopause generally centred around two different aims – those seeking support and understanding and those to disclose how menopause was impacting the participant's lives.

**Theme: Discussions don't happen with everyone**

Participants described having discussed menopause with friends, their partner, work colleagues, family, and children to seek support around their experience. Quite often, participants noted perceived successes and failures around seeking support through discussion. I explored this data through a lens of facilitators and barriers to discussion of menopause, with a view to both foregrounding its significance to participants' experiences, and to understanding discussion as a form of social support.

Participants described a range of facilitators of discussion. By and large, the most successful discussions for participants were those had with others who were also going through or had gone through menopause. Mothers, friends, sisters, and colleagues provided support by sharing information with participants and empathising with the experience of going through menopause.

*"My sister as she is experiencing similar symptoms. Friends my own age who are empathic and understand" (57, Wales)*

*"I have one friend who has been a godsend through all of this. She is slightly older & has been there ahead of me, so we laugh together about how hideous it is, that is a huge help" (53, London)*

Within the family, conversations with partners, children and parents varied regarding levels of comfort and details discussed. Many participants reported open discussions with their partners, who had been understanding, some having researched menopause themselves and helping to monitor and manage the participant's symptoms.

Another facilitator to note is the context of discussions reported. In particular, several participants working in healthcare settings described their work context as allowing menopause to be a common topic of discussion. This was both attributed to working with other women who were of a similar age, and also treating female patients.

*"Mainly within the workplace as this is common subject that we assist female patients with" (47, West of Scotland)*

As important as facilitators to conversation around menopause were the barriers perceived by the participants. Just as similarities in age, sex and experience facilitated discussions around menopause, differences in age, sex and experience were cited as preventing participants from having discussions.

Lack of empathy from partners was a significant barrier to discussion which impacted participants. Some felt discouraged when talking about menopause around their partners, as their response to conversation was to offset the topic with humour, they were "not that sympathetic", uninterested, or unsure how to respond.

*"My partner avoids physical contact saying I am 'too hot to hug' and so I tend not to talk about it at home" ( North-West England)*

*"I don't find my husband knows what to say and so it's not very helpful" (52, London)*

Discussion of menopause with partners also made some participants feel "unattractive". In a few instances, participants noted that after discussing with partners, many household problems were attributed by the partner to menopause, even when they were unrelated.

*“Partner attributed every problem we had to it even when it was his fault!” (57, Yorkshire and the Humber)*

*“My partner is kind but he really doesn't understand. Almost as if because "it's that" it is not real/should be dismissed. Would never talk to my kids about it. They are just getting their heads around sex and reproduction - it's too much” (47, Central Scotland)*

When children were also part of the household, respondents mentioned similar reactions to conversations where their “kids are completely uninterested”.

Conversations in the workplace were often halted when co-workers were much younger, the topic was laughed off by colleagues, or when it made participants feel embarrassed. Some also felt that disclosing their menopausal status would “put [them] at a disadvantage in keeping [their] job”, especially in relation to younger colleagues.

*“Reluctant to speak with colleagues as it is laughed off (which is sad considering I work in the ‘caring’ profession).” (53, Grampian)*

*“I don't tell work as my boss is a moron and he is much younger” (50, South-East England)*

In contrast to the support many received from others who were experiencing, or had experienced menopause, some found little empathy from their discussions with other women. A few participants noted that their mothers did not feel comfortable discussing their own menopause or offered little support.

*“Have stopped talking to mum because she thinks I'm just not trying hard enough or it's in my head” (48, North-West England)*

*“Not much with other women as there is an attitude of stop whinging and get on with it.” (53, South-East England)*

Other barriers explicitly mentioned include wanting to avoid “annoying anyone”, and a fear of being judged for ‘making a big deal out of it’ – especially by other women. Several respondents noted that they considered their menopause a private matter, especially in relation to their symptoms. Others mentioned that they were concerned about disclosing their menopausal status to others, as they did not want to be labelled as menopausal or mad.

> *"No one wants to talk about it, and I'm the mad bat banging on about her menopause. Makes people uncomfortable." (46, Scottish Borders)*

Theme: Discussion benefits in family, social and workplace contexts

While much discussion around menopause centred around seeking guidance, support and empathy, participants also noted conversations initiated around menopause with the specific goal of disclosing their menopausal status. This occurred most commonly in order to make those they spent the most time around aware of their symptoms and how they were affected.

In the household, some participants talked to their children about menopause to explain their symptoms or behaviour in the house. Similar to partners, reaction from children ranges from supportive to indifference. Furthermore, menopause was sometimes discussed in the workplace by participants as a way to explain the impact of their symptoms, or for explaining when they may need some extra assistance to complete their work duties.

> *"I did discuss my symptoms with work colleagues, important as you are working 12 hour shifts alongside them. Important they know and understand what you are experiencing" (59, Central Scotland)*

> *"At work I do explain if I forget names or have a hot flush in meetings" (57,South-East England)*

Beyond disclosing menopause in relation to their own symptoms, other participants described taking on an element of menopause advocacy, in order to challenge stigma and to make others aware of the often seemingly hidden realities of menopause. This was in some cases done by participants talking with their male and female children in order to make them aware of menopause and its potential impacts.

> *"I do talk to my daughter as I don't want her to find it such a shock when it happens to her in thirty years' time" (53, North-East England)*

> *"I talk to my young son as I want him to understand it's a normal life stage for women" (50, South-West England)*

Related disclosure of menopause status in the workplace had allowed several participants to facilitate a return to work, as well as opening up discourse around menopause in the workplace policies.

> *"Asked my manager to consider a policy on menopause in the workplace. This was agreed by our management team but not yet in place" (51, South-East England)*

Throughout this section, the breadth of impact of menopause experience on participants' lives is exposed. It is clearly evident that menopause is considered to impact work, home, and social lives. Furthermore, the extent to which participants felt they were able to discuss their experience has also been shown, with specific focus on the barriers and bridges to discussion. The role that environmental and ecological context plays in influencing menopause experience will be explored further in Chapter 6, as are ways in which these ecological influences are compounded by participants' abilities to discuss their experiences with others. In the next section, the role of the environment will be outlined further as I explore the impact of the lockdown context on menopause experience.

### *5.5.5 Menopause experiences in a pandemic context*

In this section I will address my findings specifically relating to changes in menopause experience in the context of COVID-19. I present one theme here which posits that changes to menopause experience largely stemmed from the environment, rather than as a result of differences in symptom severity or emergence. The impact of the environment can be attributed to specific changes in the lockdown context such as changes to working, caring and restriction of activities.

Theme: changes in experience stemmed from changes in environment, rather than changes in symptoms

Menopause experience in the Covid-19 lockdown context was questioned in relation to both symptom changes, and the experience of living in the lockdown measures during menopause. Relating to symptom experience, many women did not report feeling any changes.

*"I can't say the lockdown has made any difference to my experience. It's going to happen, irrespective of a global pandemic or not. I suppose if I were still suffering with anxiety or other mental health problems, it would impact on me more" (51, London)*

*"I've not noticed any specific changes" (41, East of Scotland)*

Of those who did, the most frequently reported changes were experiencing poorer mental health, and feeling much more anxious and depressed during the lockdown period. Additionally, more frequent low moods and mood swings were reported, as well as respondents being more irritated and feeling angry than normal.

*"Yes, I was affected. Extreme worry, anxiety, very deep depression, mood swings... It wasn't pretty..." (37, South-East England)*

*"Yes. It's got a lot worse. Stuck at home with work furloughed. 4 adults. Argument city! Mental health is suffering greatly" (52, North-West England)*

*"As I'm a key worker I have to say it was very scary and the anxiety levels skyrocketed and to be honest it still is. This COVID-19 is really getting some of us menopausal ladies down" (51, South-West England)*

Further changes included poor quality of sleep, tiredness and fatigue, and changes in their body shape, such as putting on weight and losing muscle mass. Indeed, several participants noted an increased frequency of hot flushes and night sweats.

*"Insomnia a lot worse. Was getting 5 to 6 hours. Past few months 2 to 3 hours each night. Dread nights. A lot more emotional. Healthy eating went out window and drank more alcohol during first month of lock down which didn't help symptoms. Now not getting night sweats since going back to healthy eating and minimal alcohol. Anxiety and brain fog a lot worse." (52, Yorkshire and the Humber)*

It is important to note here that some participants also specified that, while they indeed felt worse during lockdown, they were not able to say specifically whether these were symptoms of menopause or that they were feeling worse because of the general situation.

> *"It's hard to tell. Because the whole experience is variable. Periods have been all over the place - 33 days, 44, then 28/28. My anxiety levels are much worse than before and my irritability is not helped by being trapped at home solely responsible for the kids all day with huge work pressures on top." (44, West of Scotland)*

> *"Being at home during this exceptional period has enabled me to rest more and eat regularly and I am also taking supplements to boost my immune system so I wonder if this is having an impact on the symptoms I'm experiencing. I have noticed weight gain - not sure to what extent this is related to the menopause or the Covid pandemic and have remained active throughout walking regularly and playing tennis. I notice my sleep pattern is disrupted but again, not sure to what extent this is due to anxiety caused by the current circumstances or my health and it does worry me." (49, London)*

**Symptom management during lockdown**

Several participants noted a reduced access to primary healthcare during the lockdown measures, disrupting their efforts to seek therapeutic symptom management. Additional barriers to treatment came along with the continued shortage of HRT in the UK, which had been ongoing since December 2019. While many reported that HRT was helping them cope during the lockdown, they also often reported difficulties in accessing their usual type of HRT, or being given alternative forms which did not suit them as well. This contributed to added anxiety over whether they would have continued access throughout the remainder of lockdown.

> *"I found it more difficult arranging getting my HRT prescription renewed. Having a phone call with any GP is not the same as going to see the GP I trust. I had to almost beg for my prescription to*

*be renewed. The ongoing HRT shortage has also caused stress in that I've had to change to a different drug. Overall, I'm coping but lack of normal healthcare adds to COVID anxiety" (46, London)*

*"Hot flushes are worse because I took the decision to stop HRT when I had to attend the breast clinic for suspected lump. Due to lockdown, I couldn't be sure any treatment would be carried out if necessary so stopped HRT to reduce any prospect of harm. In the event, no breast treatment was required but I decided not to restart HRT just in case. Have been unable so far to discuss with doctor." (58, West of Scotland)*

**Coping with symptoms**

Discussions about the interaction between lockdown environment and menopause experience largely revolved around participant's ability to cope with the combination of both menopause and lockdown. When asked how the participants felt during day-to-day lockdown life, respondents replied mainly with feeling lonely or isolated, being more aware of symptoms because of fewer distractions, and feeling a lack of motivation. Many responded that they felt they had no choice but to cope during lockdown, and that they just had to get on with it.

*"Much more aware of hot flashes and night sweats I'm not sure if there are more or I am just more aware. Tiredness but this could be because I'm at home and am having less exercise. Feel like I would like my adult children to live somewhere else" (56, London)*

*"Mostly had to cope as there has been no other options" (51, West of Scotland)*

*"I feel isolated from my friends who I see a lot of usually. It's clear my social life is a main support mechanism which has been removed. My kids are bored and needy." (52, West of Scotland)*

However, in addition to the more negative experiences of lockdown, women also responded with positive aspects of their life at home. Some participants noted that they found themselves enjoying the slower, more relaxed pace of life and reduced social contact that lockdown brought and also found themselves with more time to relax. Other women noted that they had more of an opportunity to

rest or to catch up on lost sleep during the day, allowing them to feel better than before lockdown.

> *"The anger issues have been less due to not being in contact with many people. The lack of sleep hasn't been as upsetting because I can have a snooze midday if needed" (55, West of Scotland)*

> *"In some ways it's been helpful, being at home more makes bladder issues more manageable. Also, if sleep deprived, working from home is easier. I've also started work earlier and finished earlier as concentration levels so much better earlier in the day." (53, West Midlands)*

The very warm weather which occurred at several points during the lockdown also presented issues. The heat was mentioned on several occasions in reference to how it impacted the comfort of respondents and caused more pronounced hot flushes. Women who experience hot flushes also reported that staying at home allowed them to make themselves more comfortable by wearing lighter clothes, being able to cool off outside or in the bathroom, and being less self-conscious about flushing in front of other people.

> *"Yes. Less tired as saving nearly 2 hours driving time each day as working from home, so more energy for gardening and sewing etc. which is enjoyable. Can wear more relaxed, loose clothes and take them off if I get hot!" (53, South-East England)*

> *"Staying home makes it easier to cope as can regulate my room, clothing, environment to adjust accordingly. Going out in public is the issue and so following guidelines to stay home suits me during menopause" ( North-West England)*

However, while flushing may have been more comfortable at home, direct COVID-19-related measures like temperature checks, queues for shopping and mask wearing impacted women who had flushes outside of the house. Some women worried that having a flush may be seen as a symptom of coronavirus by others while out in public or produce a higher temperature at temperature checks. Mask wearing was also mentioned as being a factor in overheating.

*"Yes, I can cope. Although wearing a mask makes me overheat" (64, West of Scotland)*

*"I am more worried as I have to stand in a queue for periods of time and I always have a flush which makes me look sweaty and uncomfortable, this has raised a few eyebrows and I see people stepping further away, whispering to their shopping partner and even had one lady leave the queue, so I feel I have to explain I'm having a flush and do not have a fever, it will pass soon. This brings on anxiety about shopping or going out in public, I am concerned that with the temperature being taken in some places prior to admission I'll not be allowed in if having a flush or will be removed if I start to fan myself to cool down and feel more comfortable. I feel embarrassed and self-conscious." (North-West England)*

**Menopause, work and lockdown**

Aside from home life, working conditions changed dramatically during lockdown measures. As workplaces were closed during the lockdown, respondents were either not working or furloughed, working from home, or were key workers.

Key workers, in particular the healthcare sector, reported the main difference to working during lockdown was they felt too hot in PPE they had to wear during the whole day. Otherwise, they mostly reported that their work was impacted in the same way by symptoms of tiredness, brain fog, loss of confidence and pain in joints as before lockdown. Anxiety and tiredness were also increased, usually in response to rapidly changing working guidelines, and the stress of working on the front line of care and service provision.

*"I am working as a doctor. I think flushing worse at work especially with PPE" (53, West of Scotland)*

*"Key worker. Anxiety heightened with working during COVID-19 at height of pandemic" (51, South of Scotland)*

When participants were working from home – especially if they had not previously – considerable benefits were reported in relation to menopause. The most

common benefit reported was being able to adjust the workday better, being able to start at more convenient times and take more breaks. Some reported this was particularly beneficial as they could start work later in order to catch up on lost sleep, and that they could break up their workday to help deal with symptom impact on work. Others also reported being able to deal with symptoms include wearing comfier clothes, taking more breaks, and using fans for hot flushes. Using the bathroom at home was more comfortable, helping to reduce anxiety around bladder issues and heavy bleeding. Participants could also work through fatigue and mood changes easier than in the regular workplace where they would be surrounded by co-workers.

> *"Yes, working from home. Not affected so much as have more flexibility to work around symptoms. As I'm at home I'm able to regulate the room temperature without impacting colleagues. I can dress very casually and more comfortably. Also work earlier or later, have started work at 5am as I couldn't sleep, but bonus was to finish at lunchtime" (54, East of Scotland)*

> *"Work wise it has been easier working from home - e.g. I can put towels etc on chairs in case of period leaks and I can take breaks, sit in garden for 5 minutes if I become anxious" (48, North-West England)*

**Managing menopause and caring responsibilities during lockdown**

A significant change for many participants during lockdown was the requirement to care for family members who may be shielding or avoiding public places. While not all participants experienced additional caring responsibilities during lockdown, those who reported caring for family and friends noted the impact of menopause on their abilities. For those who were impacted by menopause, the main difficulties reported were caused by low mood, irritability, mood swings, tiredness, and fatigue.

> *"I have four children, 2 dogs and a husband who works away from home Monday - Friday so a lot of balls to juggle. Joint pain and lack of sleep significantly impact my ability to fulfil all my responsibilities." (48, East of Scotland)*

*"Being a wife, mother and granny. Feel weak at times due to flushes and exhaustion" (49, North-West England)*

Caring, especially for shielding and vulnerable family and friends, was reported as being stressful and causing some added anxiety to respondents, who also described experiencing lower tolerance and patience. This sometimes led to feeling guilt about how their ability to care for their children or parents was being affected by menopause, and the general stress of lockdown.

*"I look after my grandchildren while my daughter goes to work as a key worker, I found I am less patient, when they misbehave. When normally nothing would bother me take everything in my stride with them." (54, East of England)*

*"My dad was shielded having to shop for him and support him emotionally. Lack of energy, mood swings and poor patience makes me feel guilty I'm not supporting him enough." (44, East Midlands)*

In comparison to changes in menopause symptoms, it was largely changes to the environment which produced either improved or worsened menopause experience. Of particular note is that some features of the lockdown environment, such as working from home, were much more accommodating to those going through menopause, while other features interacted negatively, such as key workers in healthcare and caring responsibilities.

## 5.6 Discussion and conclusion

Throughout this Chapter, I have presented thematic analysis of the menopause experiences documented in the data produced through my qualitative research. This analysis highlighted both the range of physiological variation in menopause experience, and the ways in which menopause experiences are compounded and modified by the environment, including interactions with others in the home, workplace and other social contexts. I expand on these findings in Chapter 6, by considering these experiences through a biocultural lens, in order to understand in greater depth, the effect of ecological facets in influencing menopause experience.

### *5.6.1 Discussion of methodological strengths and limitations*

As noted previously in this chapter, I employed an online qualitative survey in response to the context in which I was conducting the research. Doing so enabled me to gather a large breadth of qualitative data during a unique ecological context, without requiring face to face contact with participants. The use of an online qualitative survey, and the subsequent volume of data produced arguably falls under the term 'big qual', an emerging approach to qualitative data which can utilise datasets comprising at least 100 participants (Brower et al., 2019). 'Big qual' approaches were employed by other researchers during the COVID-19 pandemic and associated restrictions, given that the limits to in-person contact necessitated innovative approaches to data production (Jamieson et al., 2020). I find considerable parallels between my experience of utilising 'big qual' in this portion of my research, and the experience reported by other researchers. Namely, these include production of a dataset of much larger volume than more traditional qualitative approaches, and use of a less conventional approach to analysis (Jamieson et al., 2020). Echoing these similar approaches, I found that the online qualitative survey was effective in enabling rapid data production from a large number of participants in a relatively short amount of time (Jamieson et al., 2020, Brower et al., 2019), producing a maximum variation sample from respondents throughout the UK. These data were produced during the ecological conditions in which I was interested (i.e. UK lockdown measures) where a rapid approach was necessitated by the unclear nature of how long the lockdown measures would persist in their current form.

This approach to data production presented several considerations around data analysis, however, which shaped the ultimate output of this research project. The first consideration was how to analyse a large quantity of qualitative data within the capabilities of one researcher and timeframe of a PhD project. The analytical technique I employed approached the responses of each question, rather than the responses of each individual. That is, my coding technique identified the breadth of responses to each question rather than to identify a narrative within each participant's response. This is in line with my interest in an explanatory approach to the interaction between menopause experience and the novel, emerging context of lockdown. With this approach, drawing/interpreting connections between responses to each question is more limited than may be present in more

conventional qualitative methodologies. Furthermore, the analysis of breadth - an approach employed effectively in earlier 'big qual' studies (Brower et al., 2019) - also employed more of a 'quantitative' approach to describing patterns and trends in coding. However, this approach allowed me to establish a 'big picture' of a novel phenomenon, incorporating the increased scope that larger data sets can offer with the detail of phenomena that qualitative approaches provide.

A second consideration is that the rapid mode of data production did not facilitate the reflexive process that to questions and prompts from the researcher than are employed in more conventional methodologies. Given the time constraints on this data production, resulting from the uncertainties over the duration of the initial 2020 UK COVID-19 lockdown measures, I did not distribute an initial pilot questionnaire. Thus, the qualitative survey did not benefit from a reflexive adjustment to the questions based on initial feedback (Brower et al., 2019).

While I recognise these limitations, these considerations are also referenced in the 'breadth and depth' method in the emerging field of big qual research (Davidson et al., 2019). Such methods employ initial explorative approaches in order to identify areas of interest, including the use of 'data mining' techniques, to map the breadth of a 'big qual' dataset (Davidson et al., 2019). Following this, smaller samples of the dataset may be selected to undergo a deeper analysis based on the prior findings. These areas of interest may also be a focus for subsequent surveys, or indeed more traditional modes of qualitative data production. In this context, my research could be viewed as encompassing key groundwork in this field, in its identification of the breadth of themes. Further research utilising the survey dataset, while outside the scope of this PhD project, could build upon the breadth of themes identified, in order to explore these issues in greater depth as they evolve and their longer-term significance becomes more apparent.

# 6 Chapter 6: Biocultural approaches to menopause experience – analysis

## 6.1 Introduction

This chapter considers the findings from the qualitative analysis in the context of wider literature on health and disease. Utilising the biocultural triad of disease, illness, and sickness, I will explore how the menopause experiences which participants described varied across different experiential facets both prior to, and during COVID-19. In examining 'menopause as disease', I draw on evolutionary literature to explore how we may better understand the vast range of menopause symptoms documented in these data. To explore 'menopause as illness', I use Bury's concept of 'biographical disruption' (Bury, 1982) to show similarities between participants' experiences of menopause and wider literature on chronic illness. When considering 'menopause as a sickness', I consider feminist approaches to disability (Garland-Thomson, 2002) to expand on how environments seldom accommodate participant's menopause experiences. When looking at menopause experience during COVID-19, I argue that the environmental context of menopause makes a greater contribution to changes in participants' menopause experiences than physiological changes to menopausal symptoms.

As outlined in Chapter 1, I will approach the findings from my qualitative analysis from a biocultural perspective. While taking a biocultural approach has no set definition or theoretical framework (Wiley and Cullin, 2016), within anthropological settings a biocultural approach broadly refers to the recognition of the bidirectional relationship between human biology and culture (Wiley and Cullin, 2016). As such, a biocultural approach to menopause experience will incorporate not only 'biological' factors in variation, such as genetic, physiological and anatomical changes, but also facets of culture which both impact, and are impacted by menopause.

To help situate my analysis of menopause through this lens, it is important that I clarify my position on the implicit pathologisation which permeates much menopause discourse (Lock, 1993), by which I mean that menopause is regarded as a pathological state. This stands at odds with menopause as a ubiquitous feature of the female ageing process. Hence, while I frame menopause in terms of 'disease', 'illness' and 'sickness', my intention is to recognise that the (largely

negative) bodily experiences described in Chapter 5 emerge as a result of physiological changes that have occurred in the female reproductive system, rather than suggesting that the peri-menopausal phase itself is a state of disease *per se*. The requirement for this clarification foregrounds the linguistic challenges of appropriately labelling changes to the body over the life course in a way which recognises a physiological alteration without inherently assuming the change is pathological. This challenge is not limited to menopause, with other features of the life course such as puberty, pregnancy and somatic ageing facing similar issues.

As outlined in Chapter 2, this tendency to pathologise the menopausal transition stems from the central tenets of biomedicine which pathologise deviation from a supposed 'normal' function (Canguilhem et al., 1978). This issue of the normal versus the pathological can be seen as particularly acute in relation to women's health, given that the biomedical basis for 'normality' is grounded in masculine embodiment. As a counter to this, some feminist social science disciplines reject a biological basis for gendered experiential differences (Wilson, 2015). However, I view this position as problematic since the physiological changes associated with menopause produce tangible, experiential corporeal changes, and that recognition of these changes is required to study how plasticity can shape variation in symptom experience. This approach is in line with the ontological positioning of critical realism which I outlined in Section 2.4.

## 6.2 Menopause experiences prior to COVID-19

### *6.2.1 Menopause as disease*

Following the biocultural triad, disease refers to a physiological alteration within the body which impairs function in some manner (Wiley and Allen, 2013). In the context of menopause, this maps onto the dysregulation of the menstrual cycle during the perimenopausal period as depletion of oocytes prevents the menstrual cycle from functioning as usual (Sarris et al., 2009).

As explored in the results presented in Chapter 5, many participants used the physical characteristics of menopause as a way to position themselves in the menopause transition. Irregular or stopped periods combined with menopause symptoms coproduced positionality within the menopausal transition for participants. The reliance on physiological changes for signposting the menopause transition poses interesting situations when both symptoms and bleeding are

absent. Although prevalence of vasomotor symptoms and sleep disturbances amongst perimenopausal women is as high as 75% and 40-60% respectively (Monteleone et al., 2018), there are some who do not experience any symptoms during peri-menopause. Furthermore, 59% of women in England aged 45+ using contraception use some form of long-acting reversible contraception (Digital, 2021), which can produce amenorrhoea through normal usage. The levonorgestrel releasing intra-uterine system (the hormonal coil) has a 20–80% chance of producing amenorrhoea, and is the form of contraception with the highest continuation rates in women aged 39–48 (Currie, 2019). As such, it should be recognised that cases can emerge where women may not experience either symptoms or bleeding changes. Given the reliance on physiological markers in medical conversations surrounding menopause within the UK, care must be taken to acknowledge the potential absence of these markers in order to be inclusive in the breadth of menopause experience.

Evident in the qualitative survey data presented in the preceding chapter is that self-reported symptoms relating to menopause are not restricted to the most commonly recognised symptoms in biomedicine, namely hot flushes and night sweats, genitourinary symptoms, and cognitive symptoms such as 'brain fog'. Rather, these data suggested that physiological manifestations of menopause extended into: energy levels; mental health; neurological changes; changes to skin, hair and body shape; cardiac health; gastric health and dietary intolerances; metabolism; and immune reactions (as seen in Figure 5.3, p.133). Also evident from the survey data was the co-occurrence of menopause symptoms, that is, symptoms were commonly reported in clusters. As shown in my analysis of these data, the physiological changes associated with menopause were not restricted to the few most commonly reported and did not tend to appear in only one form. I suggest our understanding of variation in menopause experience therefore extends to the possibility of physiological changes affecting all areas of the body, and that clusters of symptoms can vary from person to person.

The prominence of such symptoms in biomedical approaches to menopause is evident in the focus placed upon them in the UK's *National Institute for Health and Care Excellence* Menopause clinical guidelines (NCC-WCH, 2015). These guidelines include no other symptoms in the literature searches and meta-analyses they present. These findings from my analysis stand somewhat at odds with the

biomedical basis for understanding symptoms of menopause: a set of assumptions which positions vasomotor symptoms and genitourinary irritation as the most 'significant' elements of menopause experience. The pre-eminence given to these symptoms in biomedicine can arguably be seen to stem from its social construction, namely the tendency towards reductionism of organ systems within the body. Reductionism is fundamental to the biomedical view of health, and postulates that nature, society and the body are discrete entities of life and that all systems within each can be reduced to the pure level of natural law (Davis-Floyd, 2003). Within the 'atom' of the body, subsequent reductionism occurs to distinguish separate factors of the body and health from one another, such as the separation of the reproductive system from other systems like the immune, cardiac, pulmonary, and neurological systems. This reinforces the idea that all organs and bodily systems are autonomous units within the body, and which operate as discrete entities inside the same space. Such an assumption inhibits the study and recognition of interactions between the physiological systems of the body, such as the reproductive system during menopause. Indeed, in many ways patriarchal approaches to the female body already recognise an inextricable link between the female reproductive system and women's social, sexual and biological role (Grosz, 1994), but in a way which reduces interactions with the reproductive system to producing babies and causing hysteria (Grosz, 1994). Rather, I call for a need to reconfigure our understanding of the symbiosis between the reproductive system and other bodily systems in a way which accommodates a whole-body view of the physiological impact of menopause.

My findings – particularly the wide ranges of symptoms, and their clustering - support a more holistic approach to interaction between bodily systems, such as that purported by an evolutionary approach to health. As explored in Chapter 3, an evolutionary approach to health is one that conceptualises health as a means to an end of reproductive success, due to the role that natural selection plays in the evolution of physiological functions (Stearns, 2012). As such, all systems within the body are inherently linked to reproductive function – a contrary position to the biomedical view of reductionist systems existing discretely. The vast range of symptoms associated with menopause – and by extension the dysregulation and cessation of reproductive function – may therefore result from this inextricable interaction between the female reproductive system and other body functions.

The impact of the reproductive system and the menstrual cycle on non-reproductive health is beginning to be explored (see (Alvergne and Högqvist Tabor, 2018)), but the study of menopausal symptoms as a result of these interactions is lacking.

### *6.2.2 Menopause as illness*

As outlined in the thesis introduction, illness as an approach concerns how physiological changes can manifest experientially within the individual (Wiley and Allen, 2013), thus extending the study of menopause variation into the phenomenological components of experiencing menopause. Distinct from disease, illness involves ways in which the individual 'makes sense' of the physiological changes they are experiencing (Kleinman, 1988), as well as their perceptions of somatic sensations (Nichter, 2008) and how they manage and communicate what they are feeling (Young, 1982). In respect to menopause, this conceptualisation extends beyond the presence of menopause symptoms into how these symptoms are felt and make individuals feel. As I explain below, *menopause as illness* relates to how treatment and changes are made in response to menopausal symptoms, as those going through menopause shape actions around seeking therapeutic interventions.

The themes of 'menopause is disruptive' and 'menopause is uncomfortable', which I set out in Chapter 5, echo existing sociological literature on the biographical disruption caused by chronic disease (Bury, 1982). Menopause as biographical disruption has recently been explored in specific relation to menopause narratives (de Salis et al., 2018), and the findings from my qualitative survey support de Salis's findings. Bury's notion of biographical disruption refers to the various forms of disruption to lived experience that occur through the unfolding of chronic illness (Bury, 1982). These changes largely fall into three categories: the recognition of bodily changes, and uncertainty caused by the emergence of disease symptoms; the ways in which the patients make sense of their new circumstances in relation to their larger life plans; and the mobilisation of resources to manage their new and changing circumstances (Bury, 1982).

Initial comparisons can be made between peri-menopause and chronic illnesses as defined by Bury, in that both share being long-lasting or permanent changes in a person's life (Bury, 1991). Significant to many experiences of menopause noted

by survey participants was the element of discomfort introduced by menopause and its symptoms. The disruptive effect of symptoms permeated home, work and social life. Coping with symptoms such as hot flushes, heavy bleeding and genitourinary discomfort introduced new circumstances which participants became aware of, experienced, and therefore needed to accommodate in their daily lives. As such, the survey data showed similarities to the newfound attentiveness to novel somatic sensations present in biographical disruption (Bury, 1982). This increasing attentiveness also parallels concepts of the 'dys-appearing' body in relation to pain and chronic illness (Bendelow and Williams, 1998), whereby bodily dysfunction brings the body to the fore of attentiveness when the body is usually only marginally present in everyday life. Corporeal experiences of menopause repositions the body as a central aspect of experience (Bendelow and Williams, 1998), around which reconfiguration of everyday life must occur.

This reconfiguration of everyday life - as well as of larger biographical trajectories, as seen in the chronic illness literature - was clearly indicated in the survey data. Throughout the 'menopause is disruptive' theme, the data highlighted ways in which work, home and social life were disrupted by the somatic sensations of menopause. This echoes the consequences of chronic illness, whereby those with chronic illness first start identifying areas of disruption, which leads to exploration of management strategies to mitigate the impact of illness (Bury, 1991). While there were no explicit references to duration of menopause experience in the survey data, I find there is an implicit uncertainty in reference to how menopause will impact larger life trajectories, similar to that found in chronic illness (Bury, 1982). Considerations around timing of symptoms, or how long menopause symptoms would continue for did not feature in many responses. As such, many management strategies for menopause consider menopause in both the short and the long term. Biomedical interventions such as HRT were framed as more immediate solutions to symptoms, while changes to diet and exercise were framed as maintaining or improving health in the long term. The co-existence of both suggests participants were unable to assess how long they may be affected by their menopausal symptoms. Furthermore, as seen at several points in the analysis in Chapter 5, more significant shifts in work and relationship trajectories were described by participants as resulting from menopause, including career changes,

taking early retirement, breakdowns of relationships with families, friends and significant others.

Inextricably linked to the disruptive impact of menopause symptoms were the measures survey participants outlined having taken to manage their symptoms and, by extension, the impact of their symptoms on their wider life. Again, sociological interrogation of chronic illness can shed helpful light on interpreting these actions. Bury suggests a need to differentiate between ways in which people 'cope', have 'strategies' and have 'styles' (Bury, 1991). Coping becomes the process through which individuals learn how to tolerate or put up with the realities of their illnesses, or peri-menopause experience (Bury, 1991). Survey data highlighted strategies employed by participants, that is to say, the actions taken in the face of somatic changes (Bury, 1991). Strategies identified by Bury include "the skillful manipulation of social settings and appearances to minimise the impact of illness on interaction", attempts to "mobilise resources to advantage", and the "setting of realistic goals in order to maintain everyday life" (Bury, 1991). Many of the actions outlined in the survey data mirror these strategies. Primary care was described as a resource drawn on to receive HRT; diet, exercise and self-care strategies were incorporated into everyday routines; and daily actions were carefully planned, or even curtailed in order to mitigate the disruptive impact of symptoms. Further parallels between Bury's strategies and my survey data include the need to frame strategic actions in the context of choice and constraint (Bury, 1991). 'Strategy' as a term holds connotations of measured actions which maximise an output, especially within the neoliberal model of the individual as the informed consumer (Collier and Ong, 2005, Mol, 2008). However, Bury strongly notes that strategies for chronic illness must very much be considered within the context, and that strategies are shaped by the options available to the individual (Bury, 1991). The survey data strongly reflected this, as indeed many participants note an element of pragmatism in their strategic actions for managing menopause. Many described feeling dissatisfaction and frustration with the care received from healthcare professionals when seeking HRT and other medical interventions to help with menopause symptoms. Others who were unable or unwilling to take HRT felt constrained in other therapeutic options available to them. That a significant proportion of participants outlined making lifestyle changes in order to manage menopause symptoms may also reflect a dearth of therapeutic interventions

available. While it may indeed be the case that participants situate their menopause experience within their wider health and wellbeing, these strategic actions could also result from limited choice.

One further area of similarity between Bury's biographical disruption and experiences of menopause as illness is the restructuring of personal relationships to source advice and support from others (Bury, 1991). Social support can come from close family and friends, as well as from others going through similar experiences (Bury, 1991). The importance of social relationships in sourcing both support and sympathy is evident in participant responses – participants noted their most beneficial discussions to be with others who shared a similar experience. Talking with others sharing the same experience can also help to maintain hope and reinforce a sense of the future (Bury, 1991) – as such, the importance of social support extended beyond sourcing information, and helps recentre personhood in the context of biographical disruption (Bury, 1991). As illustrated in the theme 'discussion around menopause', talking about menopause with others not only brought support through sharing strategies, but through empathising with each other's experiences, and bringing them into perspective. The importance of support relationships also becomes clear in their absence. Bury notes that being unable to mobilise social support for chronic illness "may lead to deterioration in the individual's condition" (Bury, 1991). Indeed, in instances in the survey data where participants were unable to discuss their menopause experiences they were left feeling they were annoying others, feeling invalidated, and feeling they were being stereotyped as 'menopausal minnies'.

### *6.2.3 Menopause as sickness*

Examining menopause as sickness involves a more critical view of ways in which the 'sick role' is arguably denied to those going through menopause. Investigating menopause as sickness therefore also encapsulates exploration of why menopause seems to be acceptably framed in contemporary western society as both disease and illness, but not yet as sickness.

Personal narratives around menopause have been examined elsewhere in relation to feminist disability theory (Garland-Thomson, 2002), where menopause is understood as a stigmatised bodily variation at odds with the younger, fertile female body (de Salis et al., 2018). Approaching menopause through the lens of

feminist disability theory allows the paradox of menopause as sickness to be explored. In this paradoxical framing, the bodily variation of menopause is othered, but also not afforded the accommodations of sickness. As a concept, feminist disability theory views disability as problematic due to a system which does not accommodate different kinds of bodily variation (Garland-Thomson, 2002). As such, the limitations encountered by a disabled body do not stem from physiological differences, but from the inability of the environment to meet that body's needs (Garland-Thomson, 2002).

The cultural construction of menopause posits the menopausal body as 'deficient' (Lock, 1993), 'risky' (Harding, 1997) and 'struggling' (de Salis et al., 2018) - standing at odds with biomedical ideals of normal body functionality (Wiley and Cullin, 2020). Nevertheless, as my survey analysis illustrates, participants outlined very few socially accepted accommodations for menopausal bodies. By way of comparison with other workplace accommodations relating to female reproductive health, the right to maternity leave has been included in UK legislation since 1975 (UK Parliament, 1975). The impact of menopause in the workplace, however, has only recently become of interest to the UK Government. While a report on the effects of menopause on women's economic participation in the UK was released in 2017 (Beck et al., 2020), there has been little movement to make any national legislation surrounding menopause accommodations.

While 'menopause as disruption' has been viewed through the lens of illness, it can also be interrogated from a sickness perspective, where the bodily variation of menopause is not accommodated in contemporary western environments. As explored in the theme 'menopause as disruption', menopause was disruptive to participant's work, home and social lives. Often, disruptions during the workday originated from symptoms interfering with participants' abilities to complete actions as they were previously able to. The expectations from both the workplace, and indeed from the participants themselves, of what work could be done were incompatible with the work participants were able to carry out in reality. Similarly, disruptions in the home and personal lives comprised participants being unable to fulfil what they considered as their caregiving responsibilities and role in familial relationships. At the same time, the survey data did not suggest that any allowances were being made within these environments. Workloads remained the same, financial obligations continued, and household responsibilities were not

eased by others. Discussions around menopause were often noted as unsuccessful around those who could not relate experientially. Family members, partners and co-workers were amongst those participants disclosed with whom they could not, or would not, discuss menopause. As such, participants were dissuaded from sharing the difficulties they experienced in a way which could facilitate change in the household or workplace. This indicates that the majority of environments – from micro-level (such as households and interpersonal relationships) to macro-level (including governmental support and legislation) – do not afford any leniencies to women during menopause. In this way, menopausal women are not afforded the opportunity to adopt a sick role, and the subsequent support this may offer them.

A further dimension to the sick role is that, within a contemporary western context, legitimacy of sickness is often only secured through biomedical recognition (Wiley and Allen, 2013). A diagnosis from medical professionals, and accompanying therapeutic intervention is often required in order to substantiate the reality that 'something is wrong' (Wiley and Allen, 2013). The results presented in the previous chapter relating to the timing and treatment of menopause, highlighted that women often referenced medical diagnosis and prescription of HRT as a way to validate their menopausal status. Furthermore, participants who did not take HRT often included justifications for not doing so, suggesting they considered there was a need to explain why they had not taken up 'conventional' treatment. The perceived requirement for menopause to be legitimised through medical recognition adds a further dimension to the many survey responses which outlined dissatisfaction with medical treatments. This points to a dearth of treatments as not only hindering women's ability to manage menopausal symptoms, but also to legitimately be considered (or indeed consider themselves) 'unwell'.

## 6.3 Covid lockdown and local biologies

In this thesis I have taken the broad position that symptom experience is co-produced by interactions between the biological and the social. The term 'local biologies' was introduced by Lock & Kaufert in their studies of variation in menopause symptoms between North American and Japanese populations (Lock and Kaufert, 2001). 'Local biologies' refers to the observed differences in menopause symptom experience, which were hypothesised to stem from the different cultural environments (Lock and Kaufert, 2001, Gibbon, 2017). Lock and

Kaufert argue that regional and culturally specific understandings of menopause shape the experience of menopause to the extent that it is impossible to maintain a marked division between the biological body and its social context (Lock and Kaufert, 2001). Documentation of symptom experience therefore captures a cross-section of the synergistic relationship between culture, society and bodies which are kept in constant flux (Lock and Kaufert, 2001).

It is in this context I consider the role of local biologies as they relate to changes to menopause experience during the 2020 Covid-19 lockdown presented in the previous chapter. As I explore below, these changes highlighted interactions between the body and the novel lockdown environment, characterised by restriction of movement, reconfigured social interactions and heightened awareness of health. As above, I present these in relation to the triadic concepts of disease, sickness and illness, and draw on both biological and social scientific literatures as relevant to the discussion.

### *6.3.1 Changes relating to menopause as disease*

In Chapter 5 I suggested that changes during lockdown which related to the conceptualisation of *menopause as disease* related mostly to symptom presence, that is, whether or not symptoms were experienced at that time. Overall, no broad patterns of changes to menopause symptoms themselves as experienced during lockdown were identified.

What I did identify, however, was that the most frequently reported changes related to poorer mental health. Participants noted perceived increases in anxiety and depression, frequency of low moods, mood swings, anger, and irritability. This survey has highlighted a possible future area of exploration as the relationship between changes in mental health-related symptoms and psychosomatic stress responses to lockdown. While research into the health effects of the pandemic lockdown measures is still ongoing, increases in associated stress has already been documented (Bates et al., 2021, Kwong et al., 2021). This may be explained by the fact that psychosocial responses to stress cause activation of the sympathetic nervous system, redirecting energy towards skeletal muscles and reconfiguring central nervous system function to increase sensory awareness and alertness (Gluckman et al., 2009). Chronic activation of the stress response, in response to uncertainty such as that produced during the Covid-19 pandemic results in immune

deficiency, cognitive impairment, impaired growth and psychological maladjustments (Flinn, 2006). Chronic low-grade inflammation is also triggered in response to continuous stressors (Raison and Miller, 2013), with elevation of inflammation markers found to be higher amongst those experiencing depression (Iwata et al., 2013). As such, the increased stress levels associated with the lockdown environment may compound menopausal symptoms relating to mental health through pathways like chronic low-grade inflammation. It is important to note here, however, that changes to mental health experienced during the first pandemic lockdown may not have necessarily been related solely to menopause. Indeed, many participants noted in their responses that they were unable to disentangle which corporeal experiences were due to menopause, or due to the general pandemic environment.

A further area of interest relating to physiological changes during lockdown is that relating to changes in menstruation. While not frequently noted by survey participants, some respondents did observe changes to their periods during lockdown, such as periods stopping or restarting after a pause (see Chapter 5.5.5). While potential interactions between coronavirus disease (Covid-19) itself, lockdown, and menstruation are the subject of ongoing research, several potential loci of interaction have been noted (Sharp et al., 2021). In addition to other effects noted above, psychosocial stress is known to produce infrequent or absent menstruation (Sharp et al., 2021). Furthermore, the menstrual cycle can be impacted by immune responses to COVID-19 infections, with exacerbation of premenstrual syndrome associated with infection (Sharp et al., 2021). Given the relative absence of changes in symptoms documented in this survey, I consider that a physiological response to the lockdown environment may not have been a considerable factor in shaping changes to menopause experience during COVID-19.

### *6.3.2 Changes relating to menopause as illness*

The most apparently impactful changes to menopause experience during the COVID-19 lockdown described in the survey data were those related to personal experiences of menopause. While symptoms themselves were not particularly changing, there were significant changes to symptom management strategies and the environment of experiencing menopause.

As explored earlier in this chapter, a significant experiential facet of chronic illness - and, as I argue of menopause - is the use of strategies to mitigate the impact of symptoms on everyday life (Bury, 1991). The survey data indicate that the novel lockdown environment affected participants' ability to cope with their menopause experience. Through limited access to primary care, alongside a continuing shortage of HRT (Hamoda et al., 2020b), participants reported notable disturbances to their access to HRT. This disruption occurred not only with those already prescribed HRT but also with those who were hoping to start treatment. Additional primary care input was also required at this time for HRT prescription, as shortages had limited access to different forms of HRT (Hamoda et al., 2020a). As such, many participants in my survey who were previously prescribed unavailable forms of HRT were being prescribed alternatives which required adjustment to find a therapeutic regime. In this way, the significant impact of lockdown measures on the procurement of pharmaceutical therapeutic strategies is evident, as is the negative impact on women's ability to manage their symptoms.

Also evident in the survey data was the tangible loss of non-medical strategies for menopause symptom management. As discussed in the previous chapter, exercise was used by a significant proportion of respondents as a way to manage their menopause symptoms. With even outdoor access restricted to one walk a day during the first 2020 Covid lockdown, many forms of exercise became impossible to undertake. In response to this, some participants adapted their exercise regime to include exercise they were able to do outside or in the home. Additional upsets to coping strategies revolved around the restriction of individuals to their homes for the majority of the day – usually with other family members. Participants were now unable to leave the house to engage in other activities and were in close proximity to other family members for extended periods of time, which often hampered efforts to have 'alone time'. Social activities with others outside of the household were also prohibited, curtailing participant's abilities to mobilise social support groups which could previously offer support and practical advice (Bury, 1991). In terms of symptom management strategies (Bury, 1991), the lockdown environment severely limited what was available. As such, participant's strategic management of their illness – which may have been successful outside of the COVID-19 context (Bury, 1991) - were less successful within the COVID-19 context,

producing considerable changes to their experience of menopause during lockdown.

The survey data also suggest that manifestations of menopause-related discomfort were subject to change in the lockdown environment. For those experiencing hot flushes, novel behaviours such as mask-wearing and protective personal equipment (PPE) compounded discomfort from flushing by causing frequent overheating. Furthermore, as fever is a common symptom of Covid infection (Singhal, 2020), body temperature checks were employed to screen those entering shops and other open services. Participants who flushed while out of the home reported becoming self-conscious over the visibility of flushing, as they were concerned it would be flagged up in temperature checks. They were also concerned that observers would misinterpret their flushing as having a fever – especially when those with symptoms were required to self-isolate, with those purported to be breaking rules facing considerable public scrutiny.

While I have primarily focused on negative changes to menopause experience in the preceding sections, it is worth noting that many participants also reported positive changes during lockdown. This particularly related to their increased ability to manipulate the home environment, versus what options were available in workplace. Restrictions on movement outside the home meant many participants were either furloughed or working from home. As such, participants noted that they had newfound freedom to make themselves comfortable during the day which was not previously afforded to them in the workplace. The ability to freely use the bathroom at home, to dress in more comfortable clothes, and not feeling self-conscious around others were all noted as ways the home environment was more accommodating for symptom experience. Particularly beneficial amongst those working from home was the flexibility in timing – participants who experienced poor sleep and tiredness were able to adjust their working around rests and breaks. Where the rigidity of workdays, dress codes and visibility of co-workers were features of the 'normal' workplace, discomfort from menopause symptoms was exacerbated. From the perspective of many survey participants, the home environment as the workplace was much more suited to those experiencing menopause.

### *6.3.3 Changes relating to menopause as sickness*

While changes relating to menopause as illness encompassed both positive and negative aspects, those I have framed as relating to menopause as sickness appeared to be much more negatively impacted by the lockdown environment. This related to increasing responsibilities participants found themselves with, such as additional caring responsibilities for children, and family members who were shielding. These expectations of participants taking on additional responsibilities often disregarded any readjustment of social responsibilities that menopause had afforded participants (Wiley and Allen, 2013). As such, permissions to adopt a sick role with adjusted responsibilities fell to the wayside in light of prioritising support and care for others during lockdown.

This effective rejection of *menopause as sickness* can be seen as having occurred at various societal levels, from locally in the household to a more structural, governmental level. Participants at home with children experienced additional burdens of facilitating schooling from home or needing to do additional housework. Participants with parents and other family members who were required to shield or cautious about entering shops faced the additional responsibilities of collecting food, prescriptions, and other household needs. These responsibilities can be seen as coproduced by both household dynamics (i.e., specific family members assuming or abdicating responsibility to others), and the wider governmental implementation of lockdown measures which did not introduce systems for help with schooling or providing resources for those shielding on a structural basis.

Readjustment of priorities also occurred amongst key workers, whereby there was no accommodation made for menopause symptoms (amongst many other conditions). Those working in healthcare were required to wear additional PPE during shifts, especially when in contact with COVID-19 patients, despite additional discomfort this could bring to participants experiencing flushing.

## 6.4 Conclusion

Throughout this Chapter, I have aimed to conceptualise the breadth of menopause experiences identified in my qualitative data production and analysis into those relating to *menopause as disease, menopause as illness* and *menopause as sickness*. In doing so, I have identified key components of the ecological context which shaped these experiences. In particular, I have shown that notable changes to

menopause experience occurred during the 2020 Covid-19 lockdown measures which largely related to the environmental changes, rather than stemming from a physiological cause. In the Discussion presented in Chapter 7, I take forward these conclusions in order to assess how effectively both the ecological context and menopause experiences were captured through my qualitative research, and to consider how these findings can be utilised in a public health context.

# 7 Chapter 7: Discussion and conclusion

In this chapter, I integrate my findings from both my quantitative and qualitative research components in order to answer the research questions proposed in Chapter 1. These research questions were:

- *Do patterns in age at menopause exist across temporal or spatial distributions in the UK?*
- *Do trends in age at menopause mirror trends in rates of ageing?*
- *What is the breadth of variation in menopause experience within the UK?*
- *What role does the lived environment play in shaping menopause experience?*

In the following sections, I will consider my success in understanding the ecological determinants of variation in menopause experience and the dimensions of menopause itself through my research methods. While the contributions from the quantitative and qualitative research components were originally intended to be equitable in size and scope, the findings from my quantitative research were considerably less extensive compared to those produced during my qualitative research. As such, while I had intended an integrative approach, the degree to which it was possible to do this is much reduced. As a result, I also consider my experience of researching menopause quantitatively, using my qualitative research methods as a point of comparison and triangulation. In the final section of this chapter, I explore the significance of my findings in the current context of this research – where menopause is receiving heightened policy attention within the UK. In doing so, I make recommendations on how this novel attention towards menopause and call for increased research can be approached productively, based on my experience of researching menopause from a public health perspective.

## 7.1 Capturing an ecological approach

Intrinsic to my overarching research aims was being able to capture the ecological context, in order to understand how interactions between the person and the environment could influence variation in menopause experience. As shown in Figure 1.3 (page 33), the ecological context extends from the micro level (e.g. home, work, neighbourhood, friends) to the macro level (e.g., national population, governmental structures, healthcare infrastructure, population level events). The

ecological context also exists along a time axis - in that past events remain influential over current circumstances. This ecological context has been the primary focus of this thesis, along with the documenting of menopause variation from both quantitative and qualitative perspectives. Thus, I am now in a position to integrate findings from both methods of data production and analysis, in order to assess their relative success in capturing significant elements of the ecological context. In doing so, I will present the strengths and limitations of my approaches towards the ecological context in this research project.

As discussed in Chapter 4, I found limited success in encapsulating the ecological context through quantitative methods, due to issues largely stemming from the form of the data offered by the UK Biobank. I was able to generate findings which support the assertion that variation in timing of menopause exists both temporally and spatially throughout the UK Biobank population. I was also able to show a relationship between timing of menopause, life expectancy and handgrip strength as measures of overall rates of ageing supporting the hypothesis that I explored in Chapter 3. Thus, my quantitative analysis did indicate that diversity in age at menopause exists and could be attributed to differences in ecological contexts occurring along spatial, temporal and developmental axes. This supports the evolutionary approach I utilised to generate these hypotheses. However, the degree to which I was able understand the interaction between ecology and timing of menopause was considerably limited. Most restrictive was the impact of what was measured and why in fundamentally shaping the scope of the research I was able to conduct. As discussed in Chapter 4, measures of temporality and spatiality were constrained by the design of the UK Biobank dataset itself. Exploration of other variables of interest - such as those which overlap with previous studies and were therefore included for validation of these results - were also severely limited due to the way in which they were measured. While the quantitative results were promising in suggesting a relationship between timing of menopause and measures of somatic ageing, I am therefore cautious in the degree to which these results are salient in the real world. Given the low explained variance of the life expectancy and handgrip strength models, I doubt that life expectancy and handgrip would be useful real-world indicators of age at menopause in any context outwith epidemiology.

In comparison to the quantitative research, I consider my qualitative research to have been considerably more successful in contributing to an understanding of the ecological context and its interaction with the menopausal body. Referring back to my model of ecology (Figure 1.3, p33), I have been able to identify a multitude of ecological features via this approach. At an individual level, my qualitative methods allowed me to foreground considerable breadth of variation in the physiology of menopause, such as symptoms and signs of menopause, severity and duration of symptoms, and menstrual changes through peri-menopause. Indeed, the data not only described these features, but also how these features of menopause contributed to self-positioning in the menopausal transition. Extending to micro-level interactions, I was also able to identify the ways in which experiences of menopause interacted with families, the workplace, friends and partners. Central to these interactions was not just the presence of menopausal symptoms but, in particular, how these interactions made the participants *feel*. In many cases, these interactions appeared to have had a profound impact on participants and their quality of life.

Furthermore, I was able to explore at the micro-level some of the communication by participants with others, and the relative benefits and setbacks that this communication afforded. Beyond the social interactions documented, I was also able to capture many ways in which the lived environment interacted with participants through their menopause. One significant environmental impact on participants stemmed from the workplace. My analysis suggests that women found it much more difficult to have their menopausal bodies accommodated in ways which mitigated the impact of symptoms on comfort and ability to function. The degree to which the workplace environment impacted participants was made clear by contrast with the lockdown context, where the removal of workplace constraints was presented as significantly improving the menopause experience of many who were now able to work from home.

An area of interest relating to micro-level interactions which influence menopause experience that is present (or, rather, absent) is the interaction between socioeconomic status and menopause experience as disclosed by participants. In contrast to the initial qualitative research which sought to explore variation across socioeconomic strata, the results captured through the qualitative survey did not overtly suggest socioeconomic status or self-identified social class as a

determinant of menopause experience. One area in which personal income could be indirectly linked to menopause experience was through the purchase of remedies, or engagement with therapeutic practices to aid in symptom management. As such, those with a higher disposable income may have better access to therapeutic products or services than those with less disposable income.

Extending towards the meso-level, I was able to capture interactions between participants and larger societal structures during their menopause experience. Perhaps the most significant of these meso-level interactions were those which were described among participants, healthcare systems, and access to therapeutic interventions. The ability for many participants to manage and cope with their menopausal symptoms depended on their ability to seek both medical and non-medical treatment. Access to medical treatments such as HRT was mediated by participants' GPs and their prescribing of, as well as physical access to, the treatments as mediated through pharmacies and drug supply. Beyond primary care therapy, participants also outlined ways in which secondary care services like menopause clinics and consultants were (un)able to be accessed. A significant portion of many documented menopause experiences involved the ways in which participants were able to manage or cope with their symptoms. Just as the micro-level interactions impacted the ways participants felt, so did the power to manage their experience through treatment, therapies and lifestyle adjustments. Again, contrast with the lockdown context foregrounded the impact of this through the removal of access to exercise, hobbies, socialising and medical care. While symptoms themselves did not change in many participants, the inability to control them played a profound role in affecting lived experiences of menopause.

The impacts of macro-level systems were perhaps less explicitly evident in the qualitative results and were not explicitly referenced by participants when documenting their experiences. Despite this, I suggest that many of the grievances participants aired regarding a lack of options in treatment towards menopause, or workplace policies accommodating menopause are emblematic of its systematic exclusion at the level of national policy. In addition to this, internet and global social networks played a role in participant's access to information and support surrounding menopause. This globally facilitated transmission of information in many ways forms a global assemblage of support available to participants, whereby communication is not restricted to those in geographical proximity.

As mentioned above, the relatively small impact that socioeconomic status appeared to play in shaping variation in menopause experience was not anticipated. In both my development interviews and online qualitative survey I stratified participants by their self-identified socioeconomic status to look at any differences in coding but was unable to identify any considerable differences. This could suggest that socioeconomic status may make little difference to the lived experience of menopause in the ways which were captured through my qualitative research. This is also interesting considering my quantitative research was able to identify some form of relationship between menopause and measures of ageing, which is intimately intertwined with deprivation and socioeconomic status. It may also suggest that, just as larger macro-level ecological interactions were not overtly mentioned by participant responses in my qualitative analysis, the interaction between socioeconomic status and menopause experience was also more subtle. Future avenues for research might see more traditional methods of qualitative enquiry used to effectively interrogate the nature of the potentially complex relationship between socioeconomic status and menopause experience, given the potential for greater depth of understanding that such methods can offer.

When considering the quantitative and qualitative methods together, the most considerable conclusion I can draw is how poorly the quantitative analysis was able to explore the role of the environment. Compared to the level of detail present in the qualitative analysis regarding ecological interactions, the quantitative analysis offered very little insight into how ecological interactions produced differences in menopause timing. As alluded to in my discussion of Chapter 4, I consider this to be as a result of the inability to quantify components of the ecological context in a way able to be used in quantitative research. This is a contemporary topic of interest in science and technology studies – there is emerging literature exploring the trade-offs required for researching complexity in health outcomes in an inherently reductionist approach (Penkler, 2022, Latour, 1983, Ackerman et al., 2016). Compared to the level of ecological details present in my qualitative interrogation, the degree to which I could incorporate ecological contexts in the quantitative research was minimal. Indeed, as I explained in Chapter 4 it is worth questioning the degree to which any component of the environment has been meaningfully quantified in the UK Biobank, and even more the inferences that can be drawn about ecological interaction from statistical

analysis. However, it is not worthwhile maintaining too much scepticism about the study of the ecological context in all quantitative methods – as to do so would disregard a very salient research area relating to human health. Rather, there should be greater discussion and transparency over the values which underpin which variables are collected quantitatively, which can illuminate the processes which shape the techniques and virtues of quantifying the ecological (Ackerman et al., 2016).

I consider the qualitative findings, which foreground the importance of ecological interactions, to support this continued avenue of enquiry through quantitative means. The quantitative findings indeed support theoretical assertions that the relationship between earlier menopause and diseases of old age originate from the same life history determinants of health, encompassing somatic capital and life history strategies and the wider socio-cultural determinants of health. Such fall under the emergent discipline of evolutionary public health (Wells et al., 2017), where both proximate and ultimate explanations into patterns of population health and disease are considered within the theoretical framework, as I did through my quantitative analysis (Wells et al., 2017). Evolutionary public health offers an alternative approach to biomedically informed studies into menopause timing, allowing the underlying assumptions surrounding menopause and women's health to be subverted. This approach is not to say that menopause has no adverse impact on the health of ageing females but a more nuanced approach to studying menopause, such as its insertion into large-scale health data collection, would allow any risk factors emerging from menopause to be identified and nuanced, combating the pathologisation of menopause as a whole.

## 7.2 Capturing menopause

The other overarching aim of my thesis was to understand how best to measure menopause, and to assess how menopause might be best captured through both quantitative and qualitative methods. This is not a novel process of interrogation: the definition of what menopause is has been debated previously (Kaufert, 1988). However, a key strength of my approach is that it has put me in the position of being able to integrate knowledge of menopause generated both quantitatively and qualitatively, in order to produce my own conclusion on the subject, which has relevance to public health going forward.

I found the most illuminating approach for understanding menopause in all its experiential form was by asking participants to self-define their positionality within the menopause transition using their own words. My qualitative analysis of these responses highlighted the role that all physiological aspects of the menopause transition (i.e. bleeding and symptoms) as well as therapeutic responses (i.e. HRT usage) were used by many of the participants in self-defining their positionality. Indeed, in cases where one or more of these markers were absent or obscure, such as through contraceptive amenorrhoea or comorbidities, participants felt uncertainty in how to place themselves – despite their continued recognition that they were menopausal. I believe that these results have substantial implications for future epidemiological research into menopause: chiefly that measurement of menopause should not be strictly limited to the cessation of bleeding. Even to extend measurement of menopause variables to age when symptoms start, or age at which bleeding becomes irregular would provide greater insight into menopause as a process. Access to this wider breadth of exploratory variables may make research into menopause more fruitful than it has been previously, perhaps uncovering stronger patterning of the process than age at menopause itself can produce.

This stands out in comparison to my quantitative exploration, where one of the considerable limitations was the way in which menopause data were generated within the UK Biobank. Variables on menopause were limited to those considered epidemiologically salient – that is, easy to measure and holding some value for future studies (Kaufert, 1988). Given biomedicine's propensity towards discrete, objective and reliable measures (Kaufert, 1988), the metric of 'final menstrual period' was the variable collected by the UK Biobank, with the aim to offer a point in time whereby the participant ceases to be reproductive and becomes post-reproductive. However, as I found through the low reporting rates of this variable amongst the younger members of the cohort, the reality of measuring menopause amongst peri-menopausal participants is not as clear cut in practice. The very nature of the peri-menopausal period – that menstrual cycles become dysregulated, symptoms are felt, and that HRT is often used in a therapeutic capacity – does not lend itself to providing an easily identifiable end point for those experiencing menopause and those capturing menopause. To complicate this process further, symptoms and therapeutic use do not immediately cease with

menstrual cycles (Sturdee et al., 2017). I believe that these characteristics of the peri-menopausal period played a considerable role in the low reporting of age at menopause amongst the younger UK Biobank cohort participants – as many would be in the midst of the process, they could not confirm that their menstrual cycle had ceased. This, compounded with the low response rate of later data collection waves produced the absence of datapoints I encountered during my quantitative research. However, this was not an issue in my qualitative data production where ages ranged +/- 20 years each side of 51 and yet participants were all able to position themselves within the menopause transition in their own words.

This is not the only occasion whereby biomedicine ascribes artificially derived end points to features of life which are more ambiguous in nature. Fundamental aspects of life such as the beginning of life and time of death are themselves artificially defined as events within biomedicine. When life begins has critical implications for neonatal care and abortion services, and protections over the embryo, foetus and mother vary considerably cross-culturally (DiGregorio, 2020). Death, as the end of life, has also been subject to re-conceptualisation in the 20th century in response to the development of organ donation technologies and practices. The concept of 'brain death' – where there is no sign of life in the brain, but physiological function is maintained – is a direct response to the advent of organ donation (Lock, 2002). Brain death would be declared in order to protect doctors harvesting organs from homicide, as their actions would result in the physiological death of the donor (Lock, 2002). Given that shared definitions of the fundamental features of life are in constant reinvention within biomedicine is indicative that the process of menopause can undergo the same.

Despite these limitations, I consider my quantitative results to hold practical implications for menopause, particularly in a clinical setting. As discussed in Chapter 1, age at menopause guides both prescription guidelines for contraceptives and HRT. The temporal trend for increasing age at menopause by DOB may require reconsideration of when fertility is assumed to be ceased, in relation to guidelines for when to stop contraception. To assume that all women have reached a natural loss of fertility by 50 or 55 (guidelines for oral contraceptives and progesterone contraceptive systems respectively (FSRH, 2017)) may put those with a later date of birth, or in regions where age at menopause occurs later at risk of ceasing contraceptive usage when they may not have

reached the end of natural fertility. For HRT, risks like venous thromboembolism, cardiovascular disease and breast cancer are considered when advising when, and for how long to prescribe HRT (NCC-WCH, 2015, Hillard et al., 2017). The results of this study indicate that the temporal trend towards a later age at menopause may result in more women taking HRT beyond age 60 – the age used in HRT guidance where there are no increased risks arising from HRT usage.

Age 45 is currently given by the NICE guidelines as the upper limit for validity of testing menopausal status through blood tests due to the reduced validity of hormone levels during peri-menopause as being able to diagnose menopausal status (NCC-WCH, 2015). As cessation of menstrual cycles is the end point of the reproductive cessation process, the variation in risk of menopause both temporally and spatially may indicate differences in rates of reproductive cessation (Fraser et al., 2020). As such, the presence of variation temporally and spatially suggests that clinical guidelines around ages of contraceptive discontinuation and limits to diagnostic tests should be taken into consideration.

I also consider the quantitative findings to challenge a prevailing biomedical assumption that earlier menopause is the cause of adverse health outcomes later in life, rather than being an indicator of underlying processes which can affect both reproductive and actual rates of ageing. By exploring the relationship between age at menopause and other measures of rates of ageing, I suggest a reconsideration of the role menopause plays in the female ageing process. The quantitative findings support a view that risk factors for health and disease that accelerate biological ageing may also contribute to earlier age at menopause rather than menopause itself being the catalyst for biological ageing (Levine et al., 2016). For instance, menopause has been associated with epigenetic processes linked to cellular senescence and ageing when epigenetic biomarkers of methylation are compared to chronological age (Levine et al., 2016) (USA & European populations, n=3110). In this study, there was a suggestion of directionality, with post-menopausal women who had late onset of menopause found to be epigenetically younger than women with early onset menopause. However, taken in context with my quantitative findings, I consider the risk factors that accelerate biological ageing may also contribute to earlier age at menopause rather than menopause itself being the catalyst for biological ageing

(Levine et al., 2016). Such research nuances prevailing assumptions around menopause being the cause or catalyst of poor health and disease in later life.

A further salient point my findings raise is the need to understand the extent to which facets of lived experience were as a result primarily of the physiological process of menopause, and when they were significantly influenced by other features of ageing and ecological interactions. I encountered this particularly when asking about symptom experience during lockdown, where participants stated that they had experienced poorer mental health. Many participants stipulated in their responses that they were unsure if this was directly menopause related, or was more a product of the uncertainty that COVID-19 itself provoked. While this distinction should not downplay the experiences of the participants, it does call into question how many symptoms and experiences are ascribed to menopause but may be influenced by other factors. The qualitative analysis highlighted the significance of other life factors such as relationship, family and work issues as well as stressors like ageing parents and growing children co-occurring with menopause. These features were compounded with menopause in a way where it was impossible for participants to elucidate where the influence of one ended and the other began. I note this, not to enforce boundaries to the menopause experience, but from the recognition that menopause is already inherently pathologised and often considered the cause of negative experiential facets of the female ageing process. Furthermore, as I explored in *menopause as sickness*, despite the substantial impact of menopause to the lived experience it is not afforded the societal recognition of sickness. This facet of the menopause experience outlined by participants – that they were expected to carry on regardless of their menopause – may also have considerable impact on their overall lived experience.

This issue plays into larger questions surrounding the assignation of physiological features of the menopause transition as 'symptoms', and their inherent pathologisation. One further consideration to be made is the extent to which physiological changes are considered signs of menopause, or symptoms of menopause. I explore this in the context of bleeding specifically, as irregularity of bleeding is often considered a symptom of menopause, insomuch as symptoms denote a manifestation of physiological dysregulation and pathology. If we are to consider menopause, and thus the dysregulation and cessation of the menstrual

cycles, as a normal feature of the female ageing process then irregular bleeding becomes a sign of menopause. While some features of menstruation, like heavy bleeding and cramping, often stem from issues of the reproductive system, irregularities in bleeding themselves do not denote an intrinsically pathological origin.

## 7.3 The wider context of this thesis research and results

At the beginning of this research project, menopause was not a major issue of concern in the public conscience or in any policy capacity within the UK. However, while conducting this research project I found there to be a concurrent insurgence of menopause as a topic of interest amongst advocacy groups (such as #MakeMenopauseMatter, Menopause Cafes etc.), increased discussion around 'menopause in the workplace', and through public figures (such as Davina McColl's documentary D*avina: Sex, Myths and the Menopause*). The result of this renewed (or indeed completely new) public interest in menopause has been the specific inclusion of menopause in the Scottish Government's Women's Health Plan (The Scottish Government, 2021), and the UK Government's Women's Health Strategy for England (The UK Government, 2021). The direct goals of these strategies are to "*Ensure women who need it have access to specialist menopause services for advice and support on the diagnosis and management of menopause.*" (The Scottish Government, 2021) and ensure *"every woman has access to the care and support they need during the menopause, and is supported to fulfil their potential through this stage of life"* (The UK Government, 2021).

With this tangible increased interest in menopause, and particularly healthcare provision for menopause within the UK, I argue the findings of this thesis become increasingly pertinent, in particular, in the respect that traditional biomedical modes of knowledge production are inadequate for understanding the breadth of menopause experience and mitigating its negative impact on women's lives. To set up a sufficient coverage of 'specialist menopause services', policymakers will require an understanding of the size and characteristics of their population of interest. However, as demonstrated throughout the quantitative portion of this thesis, considerable barriers exist in the data available to researchers to gain a robust understanding of how menopause is experienced, and when. Indeed, as also demonstrated with the quantitative data analysis, there was insufficient data collected for the younger members of the UK Biobank cohort to measure age at

menopause. Given this population would likely be the population of interest when organising population-level provision of menopause specialists, this dearth of information could hamper the goals of the Scottish and UK Governments. Furthermore, as I found, there are little to no data available which can outline the breadth of menopause support required, such as the range of symptoms which would be seen by menopause specialists. While, undoubtedly, these data will be collected during the running of menopause services, the initial running of the services would not benefit from this understanding of the target population.

Along with menopause healthcare specialists, another area of increased policy-related focus both on a micro- and macro-level is menopause in the workplace. During my research project I was also involved in the collection and analysis of evidence on menopause in the University of Glasgow workplace, with a view to inform menopause in the workplace policies. This, combined with the data I collected on menopause in the workplace in the qualitative portion of this thesis, has given me a greater appreciation for the impact of the workplace environment on ability to work during menopause. As explored in Chapter 6, I consider the environment to be just as influential in menopause experience as symptoms, with many participants outlining the ways in which the work environment permitted or hampered their ability to work. Considering the huge diversity of workplace environments, even within the UK, any menopause in the workplace policies must consider the influence of the specific environment to ensure policies can create a tangible difference to the lived experience of those with menopause.

To return this thesis to the ontological and epistemological questions posed during Chapter 2, the experience I have gained in researching menopause has highlighted multiple ways in which the systems of knowledge production in use in Public Health have contributed to this systematic exclusion of menopause from public health research and practice. Following my research, I now suggest that menopause may be an example of 'undone science' (Frickel et al., 2010, Hudson, 2022), whereby the absence of knowledge on menopause originates from structural, cultural and political processes which place precedence on certain forms of knowledge production over others (Hudson, 2022, Frickel et al., 2010). The result of these systems is a wilful ignorance of menopause (Tuana, 2006). I consider this systemic ignorance around menopause to stem from the conceptual limitations of women's health within biomedicine, as menopause is not the only

facet of the female reproductive system which is being 'wilfully ignored' (Hudson, 2022). Endometriosis, a chronic gynaecological condition of the reproductive system, exhibits similarities with menopause in the dearth of research and clinical treatments available – despite its high prevalence within the female population (Hudson, 2022). In Hudson's critical reflection of endometriosis as 'undone science', she reflects that

> *"Given that the evidence base around [endometriosis] is limited, scientific consensus is lacking, and the long-standing mis- and under-recognition of the condition, attempts to standardize treatment – whilst welcome – remain built on an incomplete foundation, and one which prioritizes 'objective' knowledge." (Hudson, 2022).*

In this statement, I find multiple parallels with menopause which have become evident throughout this research project – particularly the recognition that any future research into menopause will be built upon conceptually limited knowledge if wider approaches to women's health are not accepted within biomedicine. I have found scientific consensus to be lacking in methodological areas such as how to properly define 'natural' menopause in quantitative research, and as such there are no accepted protocols for exclusion criteria to capture natural menopause in epidemiological studies. I attribute the issues with age at menopause data collection amongst younger cohort members of the UK Biobank with a fundamental misunderstanding of the nature of the menopause transition, coupled with inadequate follow-up of questionnaire data due to the precedence of imaging data collection within the dataset. My analysis highlights potential inconsistencies in HRT prescription, the significant impact of GPs as gatekeepers and differences in physical access to HRT depending on its availability. My analysis also highlights that, for those unable or unwilling to take HRT, very few alternatives may exist. Indeed, even the ability to be diagnosed, or recognised as being peri-menopausal was not provided to every participant who sought help from medical professionals – the restriction of diagnostic tests to those under the age of 45, and the confusion of peri-menopausal symptoms with other health conditions prevented the recognition of peri-menopausal status.

Based on the findings presented in this thesis, I argue that menopause has faced similar challenges to those identified by Hudson in relation to endometriosis – that social, cultural, and structural factors together have created an accepted tautology that menopause is difficult for biomedical sciences and clinicians to understand. I argue that the difficulty of measuring, recognising, and treating menopause is not inherent to it being intrinsically unmeasurable, unrecognisable, or untreatable. Rather, this 'difficulty' relates to menopause standing at odds with many of the assumptions which shape the biomedical system of knowledge production and prevent the conceptualisation of menopause in a biomedical space. This process, sometimes referred to as "unknowing", occurs as a result of exclusion and maintenance of boundaries during knowledge production (Geissler, 2013). In the context of health research, the limits of knowledge production are bound in order to 'render a dangerous landscape of disease legible and navigable' (Geissler, 2013), as occurs in the controlling of confounding factors and the establishing of analytical samples. Those factors which are excluded or controlled for are un-known, in that the process of research has rendered them disposable and ancillary to the research subject (Geissler, 2013). Through its systematic exclusion from biomedical research, women's health in general and menopause in particular have been rendered unknowable, and, even when they are the focus of research, are hindered by their incompatibility with the ontological nature of biomedical research. It is the assumption that little else can be known about menopause which is the greatest barrier to its further study, and which limits a greater understanding of menopause to only those who have direct experience.

With this in mind, the goals of the Scottish Government's Women's Health Plan and Women's Health Strategy for England not only propose an increase in research around menopause in order to address their aims but also a complete re-conceptualisation of menopause in a research context. Fortunately, the Women's Health Plan recognises "what needs to change in the system to make health policy, planning, and services more responsive to women's gendered needs" (The Scottish Government, 2021). As such, I hope that the value of this thesis will be seen not just in the insight it offers into the dimensions of variation in menopause experience, but also for its problematisation of current methods of data production around menopause and the constraints they place on the knowledge that is generated.

## 7.4 Conclusion

In the context of considerable knowledge gaps this study has sought to explore the capacity to which menopause experience varies, and to what degree this variation is shaped by the ecological context. By utilising a mixed methods approach, I considered 4 specific research questions:

- *Do patterns in age at menopause exist across temporal or spatial distributions in the UK?*
- *Do trends in age at menopause mirror trends in rates of ageing?*
- *What is the breadth of variation in menopause experience within the UK?*
- *What role does the lived environment play in shaping menopause experience?*

In relation to the first question, I have indeed been able to identify patterns in age at menopause within the UK. I have found a secular trend in age at menopause – that age of FMP increases as date of birth increases, and that timing of menopause has a spatial dimension across regions of the UK. In answering the second question, I have found age at menopause to also be associated with other measures of ageing, namely life expectancy estimates at age 65 and handgrip strength. These results support my hypothesis, informed by evolutionary ecology approaches, which situates timing of menopause within the overall female ageing process.

In answering the third and fourth questions, my qualitative analysis identified multiple facets of menopause experience, as well as how menopause experience amongst participants was co-produced by the interaction between physical manifestations of menopause and the wider environment. Participants would situate themselves in the menopause transition based on bleeding status and symptom presence, with range of symptoms extending beyond those typically associated with menopause in the biomedical paradigm. Menopause impacted the wider lived experience of participants in 2 ways – by disrupting everyday life and by producing discomfort in participants. Disruption and discomfort as a result of menopause were identified in home and personal lives, in a workplace context and socially. In the specific ecological context of the 2020 COVID-19 lockdown, changes to menopause experience did not stem from changes in symptoms but

rather from the novel environment in which participants were living. This variation was also linked to interactions between individuals and the ecological context, indicating that determinants of menopause experience extend beyond symptom experience and absence of bleeding.

Beyond addressing these specific questions, I have maintained a critical and reflexive approach to the methods I have used in this thesis. This has been focused particularly on their ability to capture breadth of diversity in menopause experience, as well as ecological interactions and their role in influencing menopause experience. By utilising both quantitative and qualitative methods I have maximised my ability to address these key considerations. Increasingly evident throughout my thesis was the unsuitability of existing public health datasets and methodologies in capturing menopause in a meaningful way. An over-reliance on timing of final menstrual period as the only quantitative measure of menopause resulted in the UK Biobank conferring significant limitations to my quantitative analysis. Rather than this being an issue of the dataset on its own, I have attributed this to an incompatibility between the conceptualisation of menopause within biomedicine and the actual manifestation of menopause as a lived experience. As highlighted by my qualitative analysis, the experience of menopause extends far beyond the cessation of periods – the somatic manifestation of signs and symptoms are considerably more integral to the menopausal experience. Also evident in my qualitative findings was the key role of ecological context and its interaction with the menopausal body in shaping a considerable component of the menopause experience. In the specific context of the lockdown environment due to COVID-19, changes to menopause experience largely related to the menopausal body navigating the novel ecological context of lockdown rather than due to any physiological changes in signs and symptoms of menopause. To continue with timing of FMP as the only measure of menopause would have been to miss capturing this entire experiential dimension.

With menopause now experiencing considerable public and policy attention, the results of this thesis are key to informing research practice to address this newfound demand for information. In particular, I recommend a reconfiguration of how menopause is measured and quantified, which incorporates other somatic signs of menopause beyond cessation of bleeding. I also recommend that, given its considerable success in addressing my research questions, qualitative

approaches to capturing menopause experience should be foregrounded in public health research. This would allow researchers to obtain a broader view of menopause as an experience, and to ensure that research into menopause expands beyond the conceptually limited scope that it currently inhabits. To do so will not only maximise the insight that such research offers into the dimensions of variation in menopause experience, but also to directly address the considerable problems with current methods of data production around menopause - challenging the constraints these limitations place on knowledge generation.

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# VIII Appendix

## VIII.i Appendix 1: Development interview participants

| Group | Identifier | SES | Occupation |
|---|---|---|---|
| 1 | FG1 | Working | Admin |
| | FG2 | Upper | Academic |
| | FG3 | Middle | Academic |
| 2 | FG4 | Upper | Doctor |
| | FG5 | Upper | Auditor |
| 3 | FG6 | Middle | Estate Agent |
| | FG7 | Working | Admin |
| | FG8 | Working | Nurse |
| | FG9 | Working | Admin |
| | FG10 | Working | Admin |
| | FG11 | Working | Admin |
| | I1 | Upper | Accountant |
| | I2 | Middle | Nurse |
| | I3 | Middle | Admin |
| | I4 | Working | Admin |
| | I5 | Working | Admin |
| | I6 | Upper | Admin |

## VIII.ii Appendix 2: Consent form, demographic questionnaire and participant information sheet

University of Glasgow | College of Medical, Veterinary & Life Sciences

**Participant Identification Number:**

**Project Title:** How do ecological and cultural factors shape diversity in menopause experience?

**Name of Researcher:** Abby Fraser, PhD Public Health candidate

**CONSENT FORM**

| | Please initial |
|---|---|
| I confirm that I have read and understood the Participant Information Sheet version 1.2 dated 18/12/2019. | ☐ |
| I have had the opportunity to think about the information and ask questions, and understand the answers I have been given. | ☐ |
| I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected. | ☐ |
| I confirm that I agree to the way my data will be collected and processed and that data will be stored for up to 10 years in University archiving facilities in accordance with relevant Data Protection policies and regulations. | ☐ |
| I understand that all data and information I provide will be kept confidential and will be seen only by study researchers and regulators whose job it is to check the work of researchers. | ☐ |
| I understand that if I withdraw from the study, my data collected up to that point will be retained and used for the remainder of the study. | ☐ |
| I agree to my interview/focus group being audio-recorded. | ☐ |
| I understand that the recorded interview/focus group will be transcribed word by word and the transcription stored for up to 10 years in University archiving facilities in accordance with Data Protection policies and regulations. | ☐ |
| I understand that my information and things that I say in an interview or focus group may be quoted in reports and articles that are published about the study, but my name or anything else that could tell people who I am will not be revealed. | ☐ |
| I agree to take part in the study | ☐ |

| | | |
|---|---|---|
| Name of participant | Date | Signature |
| Researcher | Date | Signature |

University of Glasgow | College of Medical, Veterinary & Life Sciences

## Participant information sheet

**Study title:** How does menopause experience vary within Glasgow?

*You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information. If you decide to take part in this study, you will be given a copy of this Participant Information Sheet and the signed consent form to keep*

- *What is the purpose of this study?*
    - *The purpose of this study is to collect information about women's menopause experience in Glasgow, and to understand if menopause experience varies across the social class of women experiencing it. This research will be included in the completion of the PhD thesis "How do ecological and cultural factors shape diversity in menopause experience".*
- *Why have I been invited to participate?*
    - *You responded to an advertisement about this research, or have been approached by Abby Fraser, and have been invited to attend a focus group with other women interested in participating this research. If you decide not to take part, you are welcome to leave the focus group. If you decide to take part, you are still free to withdraw at any time and without any given reason.*
- *What will happen to me if I take part?*
    - *Participation in this study requires attending and participating in a focus group convened by Abby Fraser (researcher) which will last for approximately 1 hour. During this time you will be asked to discuss your menopausal experience, and fill out a small questionnaire. Once the focus group has finished you are welcome to discuss with Abby Fraser any questions or issues that have arisen during the discussion.*

- *You may be contacted following the focus group if you are being quoted in the write-up of this research – this is to allow the researcher to ensure her interpretation of the quote is correct.*

- *What are the possible benefits of taking part?*
  - *You will receive no direct benefit from taking part in this study. The information that is collected during this study will be used for the completion of the PhD thesis "How do ecological and cultural factors shape diversity in menopause experience", and give us a better understanding of the experiences of menopausal women in the Glasgow population.*
- *Will my taking part in this study be kept confidential?*
  - *All information which is collected about you, or responses that you provide, during the course of the research will be kept strictly confidential. You will be identified in the research by a name different to your own, and any information about you will have your name and address removed so that you cannot be recognised from it.*
  - *Any data in paper form, such as questionnaires and consent forms, will be stored in locked cabinets in rooms with restricted access at the University of Glasgow. All data in electronic format will be stored on secure password-protected computers. No one outside of the research team will be able to find out your name, or any other information which could identify you.*
- *If I take part, will I be able to later withdraw?*
  - *You can request to withdraw, and have your data excluded from the analysis, at any point during the research process. You do not have to give a reason for withdrawal. This is in accordance with The General Data Protection Regulation (2018).*
- *What will happen to my data?*
  - *All study data will be held in accordance with The General Data Protection Regulation (2018)*
  - *The data will be stored in archiving facilities in line with the University of Glasgow retention policy of up to 10 years. After this period, further retention may be agreed or your data will be*

*securely destroyed in accordance with the relevant standard procedures.*

- *Your data will form part of the study, whose results that will be published in a PhD thesis, as well as expert journals, presentations, and on the internet for other researchers to use. Your name will not appear in any publication.*

- *What will happen to the results of the research study?*
  - *The study results will be published in a PhD thesis, as well as expert journals, presentations, and on the internet for other researchers to use.*
  - *You will receive a plain English copy of the report findings following completion, which will also be made available to the general public.*
- *Contact for further information:*
- *Abby Fraser (PhD Student, Institute of Health and Wellbeing)*
-

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# Participant demographic questionnaire

1. *Please provide your postcode, omitting the last 2 numbers. Eg. G 1 2*

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |

2. *What social class do you identify with?*

-

| | | | | | |
|---|---|---|---|---|---|
| Working Class | | Intermediate (Middle) | | Professional/Executive (Upper) | |

3. *What ethnicity are you?*

_____

4. *Please briefly describe your employment history*

# MENOPAUSE INFORMATION SHEET

Thank you very much for participating in my research into menopause experience – your involvement is greatly appreciated! Here is a list of resources which contain more information on topics which may have been discussed:

Menopause symptoms and medical advice

**menopausematters.co.uk** – This website is founded and run by Dr Heather Currie, a gynaecologist based in Dumfries. It contains information about menopause itself, treatment options including hormone replacement therapy (HRT), menopause and lifestyle, and menopause in the workplace. There are also forums where you can discuss menopause related topics with other users, and take part in surveys.

**theBMS.org.uk/find-a-menopause-specialist** – This is a service run by the British Menopause Society (BMS), which finds the nearest BMS-recognised menopause specialist to you

**womens-health-concern.org** – This is the patient arm of the British Menopause Society, and provide information about gynaecological and sexual health to women of all ages.

**daisynetwork.org** – A charity dedicated to providing information and support to women diagnosed with Premature Ovarian Insufficiency, or Premature Menopause

Menopause in the workplace

The Faculty of Occupational Medicine (fom.ac.uk), the British Menopause Society (BMS, thebms.org.uk) and Unison (unison.org.uk) have all produced guidance on menopause and the workplace, available on their websites. Links to all 3 can also be found on menopausematters.co.uk/menopause_at_work.php

Menopause support

Menopause Café is a charity which organises menopause cafes, a space for people to gather, have tea and cake, and discuss menopause (menopausecafe.net). You can find information about your nearest menopause café on the website, or on their facebook page. There is also a facebook group (Menopause Café) which you can join, and discuss topics with other members.

## VIII.iii Appendix 3: Online survey questions

How old are you?

Please provide your postcode, omitting the last 2 numbers. Eg. G12 8—

Which social class do you identify with most?

What ethnicity are you?

What is your current profession?

Are you considered a key worker during the 2020 Coronavirus lockdown measures?

Do you have any children? If so, please give their age and whether they are currently living with you during the 2020 Coronavirus lockdown measures

Please describe where you are currently in the menopausal transition - This can include information such as: still having periods; still having symptoms; no longer having periods but having symptoms; no bleeding due to contraceptives (Mirena coil, implant, oral contraceptives) and experiencing symptoms

What symptoms, if any, have you experienced during your menopause? - Some examples include: physical symptoms such as tiredness, hot flushes and night sweats, genital or urinary discomfort, trouble sleeping, skin irritation etc.

Have you experienced any cognitive or emotional changes during your menopause? - Some examples include: difficulty concentrating or thinking; 'brain fog'; low moods; irrational anger etc.

Do you find any of your symptoms bothersome? If so, how significantly are you affected by them? - This can be in your personal and family life, your work life, and your social life.

Have you taken any action to alleviate your symptoms? If so, do you find they have helped? If not, why not? - These actions can include medical interventions such as HRT; non-clinical interventions such as herbal remedies; lifestyle changes such as exercise, diet, taking up hobbies etc.

Do you seek out information about your menopause experience from anywhere? - Eg. Medical professionals, social media, magazines/tv shows, family, friends, workmates etc.

Do you generally discuss your menopause experience with anyone? If not, why not? - Eg. With your partner, children, parents & siblings, friends, work colleagues, social media

Have you noticed any changes in your menopause experience since the beginning of the 2020 coronavirus pandemic and UK lockdown measures? - Eg. Physical changes, cognitive or emotional changes

Do you find you are able to cope with your menopause during the 2020 Coronavirus pandemic and UK lockdown measures? If so, how? If not, why not?

If you are still working during lockdown measures (eg. key worker, working from home) do you find your work being affected by your menopause? If so, how? If not, why not?

If you are not working during the lockdown measures, do you find your day-to-day life affected by your menopause? If so, how? If not, why not?

Do you have any care responsibilities towards family/vulnerable persons? If so, do you find these affected by your menopause?

What further information about menopause, or your menopause experience would you like to be available? Is there anything about menopause that your feel like there should be more research into?

Do you have any further thoughts about anything related to your menopause you would like to share?

## VIII.iv Appendix 4: Online survey codebook

| Actions | Discussion |
|---|---|
| All actions in question | Attitude |
| Effectiveness | Avoid discussion on social media |
| Effective | Concerned about repercussions of discussing |
| Not effective | Difficult due to age |
| Partial effectiveness | Difficult to discuss |
| Lifestyle | Don't feel need to discuss |
| Alone time | General discussion |
| Comfort changes | Kept private |
| Diet | More open discussion needed |
| Discussion | Occasional discussion |
| Drinking | Open to discussing |
| Education | Others aren't interested |
| Exercise | Others don't understand |
| Herbal remedy or therapy | Others uncomfortable about discussing |
| Life adjustments | Oversharing |
| Self-care and hobbies | Prefer to not discuss |
| Supplements | Superficial discussion |
| Taking no action | Taboo subject |
| Medical | To justify behaviour |
| HRT | To learn from others experiences |
| Affected by shortages | Try to limit discussion |
| Considering HRT | Unapologetic about discussing |
| Don't want to or unable to take HRT | Location |
| Previously taken HRT | Avoid discussion at home |
| Taking HRT | Menopause Cafe |
| Want to take HRT | Social media |
| Medical opinion | Support group |
| Medical treatment | People |
| Non-HRT medication | Anyone |
| Therapy | Clients |
| Unable to take action | Doctor |
| Unaware of menopause | Don't discuss |
| | Family |
| | Children |

| | |
|---|---|
| | Mum |
| | Partner |
| | Sister |
| | Friends |
| | Other mums |
| | Others going through the same |
| | Others have noticed |
| | Rarely discuss |
| | Therapist |
| | Work colleagues |
| | Work superiors |
| | Unaware of menopause |

| Impact | Information |
|---|---|
| Area | Anywhere |
| Symptoms affect confidence | Difficult to find advice |
| Symptoms affect enjoyment | Don't look for information |
| Symptoms affect everything | Everywhere |
| Symptoms affect personhood | Find information to inform GPs |
| Symptoms affect routine | General discussion |
| Symptoms affect self-image | Information biased towards pharmaceuticals |
| Symptoms affect sociability | Information conflicting |
| Symptoms affect work | Keep up with research |
| Symptoms affecting personal life | Marketing heavy information |
| Effect | Sometimes source information |
| Adding stress | Sought information in the past |
| Affected constantly | Sourcing information |
| All-consuming | Where |
| Annoying | Academic sources |
| Anxiety about health and symptoms | All sources in question |
| Bothered | Books |
| Compounded by stress | Companies |
| Difficulty coping | Media |
| Discomfort from symptoms | Menopause Cafe |
| Embarrasment | Newspapers and magazines |
| Frustration at symptoms | Online |
| Hospitalisation | Articles |
| Impact due to early age | Forums |

| | |
|---|---|
| Internalise impact of symptoms | Internet |
| Learning to cope | Medical professionals online |
| No impact | Online events |
| No motivation | Searches |
| Overwhelming | Social media |
| Positive impact | Videos |
| Reduced through treatment | Websites |
| Sometimes impacted | Podcasts |
| Symptoms add onto other symptoms | Radio |
| Symptoms affect functioning | Reading |
| Symptoms disruptive | TV |
| Symptoms distract from other parts of life | Webinar |
| Try to ignore symptoms | Wellbeing professionals |
| Visibility of symptoms | Work in medical field |
| | Workshops and conferences |
| | Who |
| | Family |
| | Figures |
| | Friends |
| | GP |
| | Medical professionals |
| | Support groups |
| | Work colleagues |

| Menopause status | Symptoms |
|---|---|
| Bleeding | All mental symptoms in question |
| Bleeding being investigated | All physical symptoms in question |
| Contraceptive amenorrhoea | Allergies |
| HRT bleeding | Bleeding |
| Irregular bleeding | Body shape |
| PMT | Cardiac |
| Still bleeding | Cognitive |
| Stopped bleeding | Brain fog |
| HRT | Difficulty thinking |
| Not taking HRT | General cognitive |
| Previously taken HRT | Lack of motivation |
| Taking HRT | Memory and forgetfulness |
| Trying to get HRT | Trouble concentrating |
| Unable to take HRT | Controlled by HRT |

| | |
|---|---|
| Status | Dental |
| Symptoms | Dietary intolerance |
| No symptoms | Emotions and mental health |
| Symptoms present | Anger |
| Symptoms restarted | Anxiety |
| Symptoms sparse | Depression |
| Symptoms stopped | Dread |
| Timing | Emotional |
| Confirmed by testing | Emotional breakdown |
| Iatragenic menopause | Fear |
| Perimenopausal | Happy |
| POI | Hopelessness |
| Post menopause | Irrationality |
| Towards the end | Loss of confidence |
| Unsure of timing | Loss of control |
| | Loss of interest |
| | Low mood |
| | Mood swings |
| | Paranoia |
| | Stress |
| | Tearful |
| | Temperament |
| | Energy |
| | Fatigue and tiredness |
| | Trouble sleeping |
| | Gastric |
| | Genitourinary |
| | Metabolism |
| | Neurological |
| | No changes |
| | No mental symptoms |
| | Physical pain |
| | PMS |
| | Pulmonary |
| | Restless |
| | Sexual |
| | Skin and hair |
| | Unsure if menopause |
| | VMS |

| Caring during lockdown | Day-to-day life |
|---|---|
| Ability | Attitude |
| Caring not easy | Coping strategies |
| Caring takes longer than before | Accept life will be harder during lockdown |
| Difficulty prioritising care | Focus on helping others |
| Emotional impact | Focusing on wellbeing |
| Feeling guilt | Keeping busy |
| Frustrated by lack of time to yourself | Keeping occupied decreases symptoms |
| Getting additional help for caring | Maintaining normality |
| Impacted by emotions | Maintaining routine |
| Impacted by symptoms | Menopause put in perspective |
| Impacted by tiredness | No point in worrying |
| Impacted by work | People need help more than ever now |
| Increased anxiety | Taking each day as it comes |
| Increases tiredness | Taking it slow |
| Interrupting rests | Trying to maintain routine |
| Isolating in order to care | Using tv to cope |
| Needing patience | Negative |
| Not affected by menopause | Affected by friends pregnancies |
| Reduced patience | Burned out |
| Reduced tolerance | Can't be bothered to get dressed |
| Stress for caring | Catastrophising |
| Struggling to cope with caring | Difficult staying positive |
| Try not to be affected by symptoms | Embarrassment |
| Unable to care for self | Feeling flat |
| Worried about caring ability | Feeling helpless |
| Worried about passing on infection | Feeling no-one cares |
| Attitude | Feeling trapped |
| Enjoying caring | Finding it hard to cope |
| Just have to carry on | Frustrated |
| Not able to be affected | Irritated |
| Switch to work mode | Just getting on with it |
| Caring role | Just want life to be easy |
| Being cared for | Just want menopause to end |
| Caring alleviated due to visiting restrictions | Lack of desire |
| Caring at work | Lack of focus |
| Caring for friends | Lack of motivation |
| Caring for other family | Lack of purpose |
| Caring for parents | Lack of resilience |
| Children caring | Life feels ruled by menopause |

| | |
|---|---|
| Home-schooling | Lonely or isolated |
| Looking after family | Loss of control |
| Looking after partner | Loss of freedom |
| Not caring during lockdown | Menopause feels intensified |
| Teenager caring | Missing leaving the house |
| Children learning new responsibilities | Missing normal exercise |
| Experienced bereavement | Missing routine |
| Family needing to shield | More aware of symptoms |
| | Negative outlook |
| | Nightmare |
| | No choice but to cope |
| | No distractions |
| | Not feeling myself |
| | Overwhelmed |
| | Struggling |
| | Trying to cope |
| | Unable to do as much as before |
| | Wanting to hide away |
| | Worried about lockdown easing |
| | Wound up |
| Neutral | |
| | Concerned with keeping safe |
| | Doesn't see menopause as an excuse |
| | Menopause was already part of life |
| | Need to accept more |
| | Not affected |
| Positive | |
| | Appreciating things that make you happy |
| | Being in the present |
| | Being open |
| | Calmer |
| | Enjoying lockdown |
| | Enjoying slower pace of life |
| | Feel better by focusing on others |
| | Feeling better at home |
| | Happiness |
| | Have never felt less stressed |
| | Keeping healthy |
| | Keeping positive |
| | Learning new things |
| | Less stressed |
| | Life feels easier |

| | |
|---|---|
| | Looking to the future |
| | More in tune with body and needs |
| | More relaxed during lockdown |
| | More time to myself |
| | No need to keep up pretenses |

| Day-to-day life contd. | Symptom changes during lockdown |
|---|---|
| Behaviour | Able to cope using HRT |
| Better diet | Ambiguous |
| Create retreat space | Bleeding |
| Exercise | Body shape changes |
| Finding it difficult not to drink | Cardiovascular |
| Fresh air | Cognitive and memory |
| Increased drinking | Emotions |
| Increased exercise | Energy |
| Poorer diet | Gastrointestinal |
| Sorting out house | Hormone fluctuations |
| Trying to avoid stress | Increased stress |
| Unable to exercise as much | Less tired during lockdown |
| Family | Loss of confidence |
| Affected by family member's emotions | Mental health |
| Anxiety about children | Improved mental health |
| Away from partner | Worsened mental health |
| Become closer to family | Neurological |
| Challenging staying with family | No changes |
| Conflict with family | No symptoms before lockdown |
| Enjoying time with family | Physical pain |
| Missing family | Skin |
| More comfortable with symptoms around family | Sociability changes |
| More demands for family life | Strange dreams |
| Partner distant | Symptoms already mild |
| Support from family | Symptoms better |
| Symptoms affected by quarantining with partner | Symptoms mixed with COVID-19 |
| Symptoms affecting partner | Symptoms more consistent |
| Talk about symptoms with family | Symptoms returned |
| Unable to find own space | Symptoms stable |
| Unable to see shielding family | Symptoms worse |
| Uncomfortable living with adult children | Unsure |
| Self | Unsure if menopause or just general situation |
| Ability | VMS |

| | |
|---|---|
| Able to control environment easier | |
| Able to cope during lockdown | |
| Able to eat regularly | |
| Able to manage bladder issues better | |
| Able to wear comfortable clothes | |
| Fewer demands | |
| Less to do | |
| More energy for hobbies | |
| More free time | |
| More time to rest | |
| More time to think | |
| Not functioning well | |
| Unable to cope | |
| Comfort | |
| Bleeding affects comfort | |
| Flushing less intrusive when at home | |
| Frustrated by symptoms | |
| Less impacted by symptoms | |
| More comfortable as not working | |
| More comfortable staying at home | |
| Spending more time in bed | |
| Spending more time nude | |
| Symptoms affected by coffee | |
| Symptoms affected by drinking | |
| Uncomfortable | |
| VMS affecting comfort | |
| Weather affecting symptoms | |
| Direct lockdown impact | |
| Affected by longer waits in shops | |
| Affected by restrictions | |
| Flushes affecting temperature checks | |
| Frustrated by lack of social distancing | |
| Mask causes overheating | |
| Missing shopping | |
| Function | |
| Able to sleep more | |
| Affected by reduced exercise | |
| Affected by symptoms | |
| Falling asleep during the day | |
| Feeling less tired | |
| Lack of concentration | |
| Lack of sleep | |
| Lost coping strategies | |

| | |
|---|---|
| Not coping | |
| Tiredness | |
| No routine | |
| Not too affected | |
| Social | |
| Coping through communication | |
| Difficulty communicating | |
| Enjoying reduced social contact | |
| Find isolating easy | |
| Household arguing | |
| Missing meeting with friends | |
| Missing support groups | |
| Seeking online support | |
| Stressed by constant social contact | |
| No changes during lockdown | |

| Taking action during lockdown | Work during lockdown |
|---|---|
| Communicating with friends | Negative |
| Communicating with god | Affected by emotions at work |
| Communicating with partner | Affected by energy while working |
| Coping by looking after home | Affected by loneliness at home |
| Dealing with symptoms as and when they arise | Affected by memory loss |
| Diet | Can't allow myself to be unwell |
| Healthcare | Difficulty articulating |
| Changed non-HRT medication | Difficulty concentrating |
| Healthcare not affected by lockdown | Difficulty coping with tasks |
| Herbal medications | Drains brain function |
| Medication | Feeling paranoid |
| Medication not being reviewed | Finding WFH oppressive |
| Menopause less of a priority in healthcare | Finding WFH repetitive |
| Non-HRT medication helping | Little motivation |
| Phone counselling | Losing interest in work |
| Received healthcare | Need to mitigate symptom impact on work |
| Self-referred mental health | No confidence |
| Sought medical attention | No patience |
| Treatment interrupted | Overwhelmed by WFH |
| Unable to access healthcare | Poorer work life balance |
| HRT | Procrastinating |
| Anxiety around access to HRT | Unable to notice own needs over work |
| Considered starting HRT | WFH harder |

| | |
|---|---|
| Couldn't cope without HRT | Work directly making symptoms worse |
| Difficulty accessing HRT | Work made difficult by symptoms |
| Difficulty adjusting HRT | Work takes longer |
| Enough HRT supply to last lockdown | Working very difficult |
| Forgetting to take HRT | Positive |
| Had to change HRT type | Able to adjust workday better |
| HRT less effective | Able to adjust workspace to be more comfortable |
| HRT shortages | Able to cope better with work |
| Increased HRT | Able to cope with hormonal changes |
| Regret not starting HRT | Able to cope with HRT |
| Restarted HRT | Able to manage symptoms better |
| Started HRT at beginning of lockdown | Able to take more frequent breaks |
| Stopped taking HRT | Able to use memory prompts |
| Taking HRT normally | Able to work better through emotions at work |
| Wanting to adjust HRT | Able to work better when feeling unwell |
| Would like to restart HRT | Better work life balance |
| Making sure to have time to myself | Embraced working changes |
| More exercise | Enjoyed busyness at work |
| More time to do self-research | Enjoying WFH |
| Not leaving home | Grateful for WFH |
| Received no help prior to lockdown | Less stress at work |
| Seeking help online | More energy for work |
| Seeking online consultation | More professionally focused |
| Self-care | WFH making managing symptoms easier |
| Sleep levels | Work is easier |
| Unable to exercise as much | Work keeping you sane |
| Using puzzles | Anxious about getting back into work |
| Wouldn't ask for help | Anxious about other family member's employment |
| | Busy at work |
| | Feel better working |
| | Feeling better not working |
| | Felt bad not working |
| | Furloughed - can't work |
| | Had to take time off work |
| | Job ended during lockdown |
| | Jobsearching |
| | Key workers |
| | Affected by changing work guidelines |

| | |
|---|---|
| | Impacted by symptoms |
| | Irritated by colleagues |
| | Key worker - caring for others helps own symptoms |
| | Key worker - enjoying coworker contact |
| Key worker - more anxious | |
| | Key worker - new responsibilities |
| | Key worker - overwhelming |
| | Key worker - unable to take breaks |
| | Key worker - work provides normality |
| | Key worker in healthcare is challenging |
| | Key worker job is draining |
| | Key worker unable to work due to shielding |
| | Key worker working away and at home |
| | Key workers - caring for others puts own problems in perspective |
| | Too hot while wearing PPE |
| No difference working | |
| Not affected by menopause | |
| Not working during lockdown | |
| Receiving support from work | |
| Reducing workload | |
| Symptoms affected by uncertainty | |
| Volunteering during lockdown | |
| Working during lockdown not affected | |
| Working longer hours | |
| Workplace | |
| | Decreased physical activity while working during lockdown |
| | Difficult to adjust workplace |
| | Enjoying no commute |
| | Feeling isolated WHF |
| | Less workplace anxiety |
| | Less worries about being exposed to other people |
| | Missing work interactions |
| | More able to adjust workplace |
| | More comfort using bathroom at home |
| | More comfortable working from home |

| | |
|---|---|
| | Poor co-worker relations |
| | Symptoms make working uncomfortable |
| | WFH difficult in busy household |
| | Work made difficult by technology |