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Population-Level Prevalence of Depression and Summary Statistics of Women With at Least a Year Post-Final Menstruation With and Without Hysterectomy

Happiness Kingi
University of Nebraska Medical Center

Capstone Title

Population-level prevalence of depression and summary statistics of women with at least a year post-final menstruation with and without hysterectomy.

Student

Happiness M. Kingi

Master of Public Health with Maternal and Child Health concentration

Capstone Committee

Shannon Maloney, PhD

Melissa Tibbits, PhD

Shinobu Watanabe-Galloway, PhD

Abstract

Background: Depression is associated with estrogen hormonal changes. There are few comparisons studies on the population-level prevalence of depression in women at least a year post final menstruation with and without hysterectomy.

Objectives: 1) To determine the population-level prevalence of depression in women with at least a year post final menstruation with and without hysterectomy and 2) to calculate the summary statistics of women with at least a year post final menstruation with and without hysterectomy

Methods: A population-based cross-sectional design was used. Respondents were female participants of the U.S. National Health and Nutrition Examination Survey (NHANES) 2017-2018. Women at least a year post-final menstruation without a history of hysterectomy had a complete lack of menstruation for 12 months and selected menopause as the cause. Women with at least a year post-final menstruation following hysterectomy had a complete absence of menstruation for 12 months, and hysterectomy was chosen as the cause. Frequencies and percentages were used to analyze depression between the two categories.

Results: Total respondents (N=1,249): women without hysterectomy (n=767) and women with hysterectomy (n=482). The overall prevalence of depression in women with at least a year post final menstruation with or without hysterectomy was 133 per 1,000 population, higher in women with hysterectomy (74/482) than in women without hysterectomy (92/767). Compared to women without hysterectomy, women

with hysterectomy had final menstruation at younger age below 44 years (63% vs. 17%) and used depression medication (23% vs. 13%).

Implications: Findings will help clinicians screen for depression in women who report the absence of menstruation for more than a year.

Chapter 1: Introduction

Research questions

1. What is the overall prevalence of depression in women at least a year post-final menstruation with and without hysterectomy?
2. What is the prevalence of depression in women with at least a year post-final menstruation without hysterectomy and in women with at least a year post-final menstruation following hysterectomy?
3. Are there differences in summary statistics among women with at least a year post-final menstruation without hysterectomy and in women with at least a year post-final menstruation following hysterectomy?

Specific Aims

1. To determine the prevalence of depression in women with at least a year post final menstruation without hysterectomy and women with at least a year post final menstruation following hysterectomy.
2. To calculate the summary statistics of women with at least a year post final menstruation without hysterectomy and in women with at least a year post final menstruation following hysterectomy.

Significance of the Study

The study determined the population-level prevalence of depression in women with at least a year post-final menstruation without hysterectomy and in women with at

least a year post-final menstruation following hysterectomy. It determined the summary statistics of these two groups. The statistics include age, race and ethnicity, education, marital status, live births, income, body mass index, smoking status, alcohol use, age at final menstruation, years post final menstruation, use of female hormones, self-reported general health, access to a mental health professional, and use of depression medication. These findings create awareness of depression in women post-final menstruation without hysterectomy and at least a year post-final menstruation following hysterectomy. The prevalence of depression in these two groups calls for an emphasis on screening for depression, diagnosis, and referral of postmenopausal women to mental health care professionals. Depression among women at least a year post-final menstruation without hysterectomy has not received the needed attention. For instance, U.S. Preventive Services Task Force recommends screening in adults, including pregnant and postpartum people, for depression, but menopause was not identified as a risk (Siu et al., 2016)

Also, this study used the Patient Health Questionnaire (PHQ-9), a tool that can be used to screen depression in postmenopausal women (Almeida et al., 2016)(Wang et al., 2021)(Suarez-García et al., 2021). Importantly, this tool can be in primary care and yearly free Well-Woman Visits (endorsed by the American College of Obstetrics and Gynecologists, ACOG) to screen for depression in premenopausal and perimenopausal postmenopausal women (ACOG Committee Opinion No. 755: Well-Woman Visit.2018).

Chapter 2: Background and Literature Review

Literature Review

Depression is defined as persistent sadness and a lack of interest in previously pleasurable activities. Depression is a global burden, with more than 264 million people affected (Purcell et al., 2020). Depression reduces the quality of one's life and is a burden to an individual and society (Force, 2016). Overall, 1 in 5 adults in North America is affected by depression, with women disproportionately affected (Soares, 2019). A neurocognitive study suggests estrogen hormone is associated with mood changes(Newhouse & Albert, 2015). The ovarian estrogen hormone level fluctuations during premenstrual, pregnancy, postpartum, and menopause provide an insight into the prevalence of depression in women (Georgakis, Skalkidou, et al., 2016)(Newhouse & Albert, 2015). Depression is therefore not uncommon in menopause (Major depression during and after the menopausal transition: Study of Women's Health Across the Nation (SWAN) – Corrigendum.2011)(Vivian-Taylor & Hickey, 2014), except disparities existing in subgroups of women, e.g., by race and ethnicity, timing at different menopause stage, and severity is what makes depression in menopause complex.

In the United States, approximately 1.3 million women routinely become menopausal every year at an average of 51 years of age(Gold, 2011)(Kimberly Peacock & Kari M. Ketvertis., 2021). Menopause diagnosis is made retrospectively after cessation of menstruation for 12 months. Estrogen hormones decline in perimenopause, and its cessation during menopause occurs naturally as women age or after gynecological procedures. To make the diagnosis of naturally occurring menopause or following a

surgical procedure, a clinical symptom (the lack of menstrual period for 12 months) is required, or in the absence of this symptom, a repeated measure of Follicular Stimulating Hormone, FSH ≥ 40 combined with low estradiol (< 20 pg/ml) at least three months after the surgical procedures are required to make a diagnosis(Perlman et al., 2018). Perimenopause, also known as menopausal transition, precedes menopause. Perimenopause may begin in the 30s and 40s while below age 40 years it is referred to as premature, at 40-44 years as early, at 45-55 years as normal, and 55 years and older as late menopause(Roman Lay et al., 2020). Cardinal symptoms during perimenopause are hot flushes and night sweats, also known as menopausal vasomotor symptoms (VMS), which occur in up to 80% of women with a median duration of 7 years during menopause transition and at the median of 4.5 years post-final menstrual period. The course is even longer, over 11 years, among women with VMS in pre-and early menopausal years(Avis et al., 2015). Studies suggested duration and severity of VMS also pose a risk of developing depressive symptoms (Strauss, 2011)(Maki et al., 2018). Therefore, the menopause transition stage remains the vulnerable stage for new or recurrent depressive symptoms/disorders (Willi & Ehlert, 2019). Studies have confirmed this observation; for example, major depressive disorders (MDD) were seen more during perimenopause and early postmenopause (Bromberger et al., 2015)(Georgakis, Thomopoulos, et al., 2016).

Hysterectomy is a common gynecological procedure with around 600,000 procedures each year in the United States(Simms et al., 2020). Major indications for hysterectomy include fibroids, abnormal bleeding, benign ovarian mass, endometriosis, and pelvic organ prolapse(Wright et al., 2013). Findings on cyclical

bleeding following subtotal hysterectomy (uterus removal only) and total hysterectomy (uterus and cervix) have varied with incidence ranging from 0% to 25% higher in subtotal than total hysterectomy and 0% in hysterectomy with bilateral removal of ovaries (Ghomi et al., 2005);(Lethaby et al., 2012)(Aleixo et al., 2019)(Neilson, 2007). Common causes of cyclical bleeding after hysterectomy include endometriosis and remaining endometrium following subtotal hysterectomy(Aleixo et al., 2018)(Ghomi et al., 2005). The risk of depressive symptoms or disorders following hysterectomy varies. A decreased risk of depression was seen in a systematic review and increased risk in longitudinal studies (Maki et al., 2018)(Chou et al., 2015)(Darwish et al., 2013)(Wilson et al., 2018).

Cessation of the ovarian hormone estrogen (identified as the biological vulnerability) and exposure to stress increase vulnerability to depression(Newhouse & Albert, 2015). Early age at perimenopause(Cohen et al., 2006) unemployment, low education, race and ethnicity (i.e., being black or Hispanic), high BMI, being a smoker, self-reported poor health, chronic medical conditions, stressful life events, lack of social support, marital status and prior history of depression (including premenstrual mood disturbance and history of postpartum mood disorders increase menopausal women vulnerability to depression. (Soares, 2019)(Judd et al., 2010)(Llaneza et al., 2011)(Bromberger et al., 2015)(Papazisis et al., 2021). Negative attitudes towards menopause, relationship difficulties with a partner, body image, and physical inactivity also increase vulnerability to depression (Ayers et al., 2009)(Deeks, 2003).

The use of hormonal replacement therapy (HRT) reduces the severity of menopausal symptoms and reduces the risk of cardiovascular diseases, osteoporosis, and cognitive

impairment(The 2017 hormone therapy position statement of The North American Menopause Society.2017). A randomized control trial from 1993-1998 with 2,763 postmenopausal women showed depressive symptoms reduced over time among postmenopausal women assigned to a hormonal group(Hlatky et al., 2002). A recent systematic review indicated some evidence of HRT antidepressant ability with variations depending on menopausal status. Perimenopausal women had a significant depressive symptoms reduction than postmenopausal women(Rubinow et al., 2015). Nonetheless, HRT is neither a primary nor secondary preventive and management option of aforementioned conditions because of the complexity of benefits versus risks(The 2017 hormone therapy position statement of The North American Menopause Society.2017)(Manson et al., 2013)(Marjoribanks et al., 2017). The Benefit-to-risk of HRT is more favorable in women within the first ten years postmenopausal or below 60 years of age than women over 60 years or over ten years postmenopause (The 2017 hormone therapy position statement of The North American Menopause Society.2017). Antidepressants are the first-line management of depression with significant depressive symptoms relief (Posmontier, 2013).

To diagnose depression in all menopausal states, several assessment tools are helpful. These assessment tools vary in the quickness to administer, whether self- or clinician-administered, and their qualitative capacity to determine symptoms of depression from menopausal vasomotor symptoms, VMS. Frequently used tools are Beck Depression Inventory (BDI), Center for Epidemiologic Studies Depression scale (CES-D), The Edinburgh Depression Scale (EDS), General Health Questionnaire (GHQ), Medical Outcomes Study-Depression scale (MOS-D), Patient Health

Questionnaire (PHQ- a self-administered version of the PRIME-MD) Primary Care Evaluation of Mental Disorders (PRIME-MD), and the Structured Clinical Interview for the Diagnosis of DSM-IV Axis I Disorders (SCID) (Willi & Ehlert, 2019)(Clayton & Ninan, 2010).

A menopause-specific mood-disorder scale does not yet exist(Maki et al., 2018). However, PHQ, which is a brief, reliable and valid measurement tool for screening depression, can categorize mood disorders in menopausal women. To assess depression severity, scores of each of the 9 DSM-IV criteria ranging from 0 (not at all) to 3 (nearly every day) as experienced in the past two weeks were marked down, and a total score is calculated. There are multiple cut-offs; 0-4, 5-9, 10-14, 15-19, and 20-27, indicating none to minimal, mild, moderate, moderately severe, and severe depression as shown in Figures 1 and 2(Kroenke et al., 2001). The PHQ-9 has been utilized in previous studies with single cut-off points, either 10,11 or 12(Manea et al., 2012); however, the use of single universal cut-offs can create discrepancies in different settings, i.e., false-negatives in the hospital setting and false positives in primary care(Manea et al., 2012).

Chapter 3: Data and Methods

Sample and Study design

This was a population-based cross-sectional study of respondent women who were interviewed in the 2017-2018 National Health and Nutritional Examination Survey (NHANES).

Data Source

NHANES 2017-2018 population-level data was used to answer the research questions. NHANES collects health and nutrition status information of about 5,000 U.S. adults and children each year through interviews and physical examinations each year. This sample is collected through a complex sampling technique to ensure it is representative of the U.S. population. The data used for this study came from multiple NHANES datasets; demographic, health insurance, reproductive health, mental health-depression screener, smoking, weight history, alcohol use, and medical conditions. Some of the questionnaires on datasets such as reproductive and mental health-depression screeners were asked by trained interviewers at the mobile examination center, using the computer-Assisted Personal Interview (CAPI) system. Other questionnaires, such as alcohol use, were asked in homes by trained interviewers using the computer- CAPI system. For the mental health-depression screener, respondents completed the questionnaire on their own. (*National Health and Nutrition Examination Survey: National Youth Fitness Survey Plan, Operations,*

and Analysis, 2012: Data Evaluation and Methods Research. Vital and Health Statistics Series 2;2014 ASI 4147-2.158; Vital and Health Statistics Series 2, No. 163; DHHS Pub. No. 2014-1363;CS245395.2014).

Comparison groups

Women were categorized as women with at least a year post final menstruation without hysterectomy if they reported a complete absence of menstrual bleeding in the previous 12 months and selected menopause as the reason for the lack of menstrual flow and categorized as women with at least a year post final menstruation with hysterectomy if they reported a complete absence of menstrual bleeding in the previous 12 months and selected hysterectomy as the reason for the lack of menstrual period.

Depression screening and PHQ tool

The outcome of interest in this study is depression. NHANES 2017-2018 mental health-depression screener interviews used the Patient health questionnaire, PHQ-9 criteria; therefore, data for all nine questions to screen for depression and the total score for establishing the depression severity were used (see Tables 1 and 2 in Appendix). Respondents with missing values in the mental depression screener were excluded from the study(n=20). Scores in each of the nine questions range from 0 to 3, 0 being ‘not at all’ and 3 indicating ‘the presence of the symptom nearly every day.’ The total score of 0-4 indicates ‘none to minimal’ 5-9 indicating ‘mild’ 10-14 for ‘moderate’ 15-19 for ‘moderately severe’ and 20-27 for ‘severe.’ A cut point of

10 was used for all analyses: 0-9 indicating ‘no depression’ and 10-27 indicating ‘depression’ (Manea et al., 2012). This study screened only, and therefore, no diagnosis of major depressive disorder (MDD) or other depressive disorders was made. To make a diagnosis of MDD or other depressive disorder, scores of 2 (more than half the days) or 3 (nearly every day) in question 1 “little interest or pleasure in doing things”) and question 2 (feeling down, depressed, or hopeless”) along with further assessment by the clinician are required(Kroenke et al., 2001).

Covariates

All covariates were selected based on previously documented associations between depression in natural menopause and hysterectomy: age, race and ethnicity, education, marital status, body mass index, smoking, age at final menstruation, use of female hormones, self-rated health, hormone therapy use, and antidepressant use(Roman Lay et al., 2020)(Papazisis et al., 2021)(Wilson et al., 2018). Age, race/ethnicity, education, marital status, use of female hormones, self-rated health, hormone therapy uses, and antidepressant use were self-reported during the interview. Marital status was categorized into married or living with partner, widowed, separated or divorced, and single. The age reported at the interview was categorized into ten years intervals. Also, general health was categorized into excellent, good, or fair and poor. Race and ethnicity, and education categories were maintained as extracted from NHANES datasets. Body mass index (BMI) was calculated from self-reported weight (kg) and height (m^2). Age at final menstruation was self-reported following the question: “About how old were you when you had your last menstrual period” The number of years being postmenopausal were calculated from

participants'' self-reported age at interview and age at final menstruation. Participants with missing values on age at final menstrual period (n=43) and less than one-year post final menstrual period (n=4) were excluded. The postmenopausal years were calculated by subtracting the age at interview and final menstrual period, and two categories were formed 0-4 years and >4 years. The decision for these cut-offs is based on the Stages of Reproductive Aging Workshop (STRAW) criteria and VMS duration (Avis et al., 2015; Strauss, 2011; Maki et al., 2018; Soules, 2005).

Self-rated health was assessed by response to the following question: "In general, would you say your health is excellent, very good, good, fair, or poor." Menopausal status was assessed by self-reported bleeding patterns annually, and response to the question: "What is the reason that you have not had a period in the past 12 months, pregnancy, breastfeeding, hysterectomy, menopause/change of life, other."

Use of female hormones was assessed by the following question: "Have you ever used female hormones such as estrogen and progesterone including any forms of female hormones, such as pills, cream, patch, and injectables, but do not include birth control methods or use for infertility." The ratio of family income to the poverty line was used to report the respondents' income. This ratio was extracted directly from NHANES demographic dataset calculated by dividing family income by the poverty guidelines specific to the survey year. If respondents did not provide the total family income, they were asked to report family income as < $20,000 or ≥ $20,000, and the ratio was computed as well to ratio values. The ratio values were then categorized in this study into one of two groups: living below the poverty line (0-4.98) or living at or above poverty (for the ratio of 5 and above). (National Health and Nutrition

Examination Survey: National Youth Fitness Survey Plan, Operations, and Analysis, 2012: Data Evaluation and Methods Research. Vital and Health Statistics Series 2;2014 ASI 4147-2.158; Vital and Health Statistics Series 2, No. 163; DHHS Pub. No. 2014-1363; CS245395.2014)

Statistical methods

The data were analyzed using the Statistical Analysis System (SAS) version 9.4. For the primary objective, a descriptive analysis was performed to explore the sample characteristics. The sample characteristics are described by frequencies and percentages. Age was analyzed as a categorical variable after mean and standard deviation were evaluated. All analyses were stratified into two categories; women with at least a year post-final menstruation without hysterectomy and women with at least a year post-final menstruation following hysterectomy.

Chapter 4: Results

Study sample

A total of 1,249 women were included in this study: 767 (61%) women with at least a year post final menstruation without hysterectomy and 482 (39%) women with at least a year post final menstruation following hysterectomy.

Sample description

Demographic and clinical characteristics are presented in Table 3 (Appendix). The sample included respondents between ages 30-80. All respondents with 80 years and above were recorded as 80-year-old. Many respondents were between 50 to 80 years (93%), non-Hispanic whites and non-Hispanic blacks (63% with the majority being non-Hispanic whites), had lower than college graduate education (68%), half of the respondents were married or living with a partner (51%), had at least one live birth (99.6%), and lived in families with income above poverty (73%). Furthermore, the majority had final menstruation at age 45 years and above (64%) and had at least four years post final menstrual period (84%), were either underweight, overweight, or obese (52%), never smoked or had quit smoking (86%), never drank heavily in the past year (91%) and reported good or fair general health (64%). Fewer women used female (30%), accessed mental health professionals in the past year (11%), and used medication for depression (17%).

Characteristics of Women with at least a year post final menstruation following hysterectomy

Table 4 shows characteristics of women with at least a year post-final menstruation following hysterectomy. Many of women with at least a year post final menstruation following hysterectomy were between 50 to 80 years (89%), non-Hispanic whites and non-Hispanic blacks (71% with the majority being non-Hispanic whites), had less than college graduate education (84%), half of the respondents were married or living with a partner (50%) and had at least one live birth (99.8%). Many women in this category were either underweight, overweight, or obese (52%), never smoked (62%), and never drank heavily in the past year (89%). In addition, women in this category had final menstruation period at ages younger than 44 years (63%), with at least four years post final menstruation (89%), used female hormone (45%), and self-reported good or fair general health (64%). Fewer women accessed mental health professionals in the past year (14%) and used medication for depression (23%).

Characteristics of women with at least a year post final menstruation without hysterectomy without hysterectomy

Table 4 shows characteristics of women with at least a year post-final menstruation without hysterectomy. In women with at least a year post final menstruation without hysterectomy, many were between 50 to 80 (97%), non-Hispanic whites and non-Hispanic blacks (57%), had less than college graduate education (80%), half of the respondents were married or living with a partner (52%) and had at least one live

birth (99%). Many women with at least a year post final menstruation without hysterectomy were either underweight, overweight, or obese (52%), never smoked (66%), and never drank heavily in the past year (92%). Furthermore, women in women with at least a year post final menstruation without hysterectomy attained menopause at age 45 years and above (83%) and had at least four years post final menstruation (81%) and self-reported good or fair general health (61%). Fewer women used female hormone (20%), accessed mental health professionals in the past year (8%), and used medication for depression (13%).

Differences in summary statistics between women with at least a year post final menstruation without hysterectomy and women with hysterectomy.

Table 4 shows characteristics of women final menstruation without hysterectomy and women with at least a year post final menstruation following hysterectomy. Compared to women with at least a year post final menstruation without hysterectomy without hysterectomy, women with at least a year following hysterectomy had younger respondents between age group 30-50 (11% vs. 3%), had more current smokers (17% vs. 12%), overweight and obese were 21% and 14% respectively than in women with at least a year post final menstruation without hysterectomy (19% overweight and 11% obese). More women with at least a year post final menstruation following hysterectomy group drank heavily in the previous year (11% vs. 7%), had final menstruation at ages younger than 44 years (63% vs. 17%), and had at least four years post final menstruation (89% vs. 81%). Use of female hormones was high in this category (45% vs. 20%); more women with at least a year post final menstruation following hysterectomy accessed mental health professionals (11% vs. 8%) and used

depression medication more than women with at least a year post final menstruation without hysterectomy (23% vs. 13%)

Prevalence of depression in women with at least a year post final menstruation with and without hysterectomy

The distribution of depression categories and prevalence of depression in women with at least a year post final menstruation without hysterectomy and in women with at least a year post final menstruation following hysterectomy are shown in Tables 5a and 5b. The study found the majority of respondents, 66%, had none to minimal depression (PHQ score of 0-4), 21% had mild depression (PHQ score of 5-9), 8% had moderate depression (PHQ score of 10-14), 4% had moderate-severe depression (PHQ score of 15-19), and 1.36% had severe depression (PHQ of 20-27). After applying cut-off point 10, the majority of women (87%) had no depression symptoms (PHQ-9 less than 10). According to this analysis, the estimated prevalence of depression in women with at least a year post final menstruation with and without hysterectomy was 133 per 1,000 population.

Prevalence of depression in women with at least a year post final menstruation without hysterectomy and in women with at least a year post final menstruation following hysterectomy.

Table 5b shows the frequencies of depression in depression in women with at least a year post-final menstruation without hysterectomy and in women with at least a year post-final menstruation following hysterectomy. After application of PHQ-9 cut-off point 10, 408 women with at least a year post final menstruation following hysterectomy and 675 women with at least a year post final menstruation without hysterectomy had scores of 0-9 indicating no depression while 74 women with at least a year post final menstruation following hysterectomy and 92 women with at least a year post final menstruation without hysterectomy had scores of 10-27. Therefore, the prevalence of depression was 15% in women with at least a year post final menstruation following hysterectomy (74/482) and 12% in women with at least a year post final menstruation without hysterectomy (92/767).

Discussion

This study analyzed the overall population-level prevalence of women with at least a year post final menstruation with and without hysterectomy and population-prevalence of depression in women with at least a year post final menstruation following hysterectomy and women with at least a year post final menstruation without hysterectomy and summarized the characteristics of these two groups of women. About 1 in 10 women with at least a year post final menstruation with and without hysterectomy had symptoms of depression based on PHQ-9 criteria. The prevalence was higher in women with at least a year post-final menstruation following hysterectomy than women with at least a year post-final menstruation without hysterectomy. And although the difference is slight, our findings may suggest these two categories are important to consider when assessing depression in women

reporting lack of menstrual period for at least twelve months, either in women with at least a year post final menstruation without hysterectomy or in women with at least a year post final menstruation following hysterectomy. Also, previous study findings on the association between depression and hysterectomy have been inconsistent (Wilson et al., 2018)(Chou et al., 2015)(Darwish et al., 2013)(Gibson et al., 2012); our findings support depression is common following hysterectomy

Increasing vulnerability to depression in women with at least a year post final menstruation following hysterectomy compared to women with at least a year post final menstruation without hysterectomy without depression might be explained by the differences in age, age at final menstruation, use of female hormones, use of depression medication, and body mass index. Women with at least a year post final menstruation following hysterectomy category had three times the number of young respondents below 50 years old, had four times the number of those with final menstruation at ages below 44 years, and twice the number of overweight and respondents who reported using depression medication.

Previous studies have pointed out the association between extended exposure to estrogen and decreased risk of depression (Georgakis et al., 2016). A large sample size (63%) had final menstruation below 44 years old, while the majority (83%) in women with at least a year post final menstruation without hysterectomy had final menstruation at age above 45. This clinical characteristic might be the major explanatory factor of the disparities in the depression between the two categories of women with and without hysterectomy. Due to fewer years of exposure to estrogen, women with hysterectomy were more prone to depression than their counterparts. The

high use of depression medication in women with hysterectomy than in women without hysterectomy support that depression was increased in women with hysterectomy.

Regarding the use of hormones in menopause, previous findings indicated some reduction in depression symptoms following the use of hormones in perimenopausal than in postmenopausal women (Rubinow et al., 2015). Female hormonal use was double in women at least a year post final menstruation following hysterectomy than in women with at least a year post final menstruation without hysterectomy. Even though this study cannot confirm menopausal status in women with hysterectomy by the clinical symptom of amenorrhea for 12 months and hormonal levels, the differences in female hormonal use might suggest female hormones were not related to depression.

Strengths and limitations

Our study managed to assess the overall population-level prevalence of depression in women with at least a year post final menstruation with and without hysterectomy postmenopausal, the prevalence of depression in women with at least a year post final menstruation without hysterectomy women, and in women with at least a year post menstruation following hysterectomy as well as describe the summary characteristics of the two categories and discussed the distinctive differences. However, our study had several limitations. First, we did not use sample weights in our analysis. Second, our study lacked respondents' previous history of depression; therefore, we did not

rule out the previous history of depression. Third, we lacked a reference group of either premenopausal, perimenopausal women, women with oophorectomy, so we could not ascertain the difference in prevalence at these different stages of menopause and type of surgical procedures. Fourth, we could not assess validity and rule out possible bias in self-reported characteristics such as weight, height, calculated income ratio, and we lack confirmation on the claim of lack of menstruation being a result of menopause or hysterectomy related. We were not certain whether lack of menopause followed premature ovarian insufficiency, which occurs in 1% of menopausal women <40 years (Georgakis et al., 2016), concurrent natural menopause, or hysterectomy with or without ovary removal. Fifth, using a PHQ-9 cut-off score of 10 with 88% specificity and 88% sensitivity may have introduced false-negative and false-positive cases in the study and excluded respondents with remissions (Manea et al., 2012).

Generalizability

This study contained a heterogeneous sample that pointed out similar observations found in other studies, but we cannot claim generalizability because the study did not use sample weights for data analysis.

Conclusion and implication for further research

The PHQ-9 is an easily accessible tool for screening depression in women with lacking menstrual period for more than twelve months with and without hysterectomy.

Clinicians in primary care and mental health practice settings can use this screening tool to identify women characteristics such as age, age at final menstruation, body mass index, history of heavy drinking, smoking status, number of years passed since final menstruation, etc., to identify those prone to get depression. Overall, our study observed depression in two categories, both with estrogen hormonal changes, and findings show these women lack access to mental healthcare and prescriptions for depression. This finding supports the ongoing open dialogue for mental health promotion in the United States and globally. In the future, epidemiological and clinical studies are needed to understand the causal relationship between depression, menopause, hysterectomy, and related interventions.

Appendix

Table 1. PHQ-9 Question and Options

Over the last two weeks, how often have you been bothered by any of the following problems?

	Not at all	Several days	More than half the days	Nearly everyday
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself or that you are a failure or have let yourself or your family down	0	1	2	3

7. Trouble concentrating on thongs such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed. Or the opposite being so fidgety or restless that you have been. moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself	0	1	2	3
	Add columns	_____ +_____ +_____		

(Healthcare professional: For interpretation of TOTAL,

Please refer to the accompanying scoring card)

10. If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?	Not difficult at all_____ Somewhat difficult_____ Very difficult_____ Extremely difficult_____

*From Kroenke K, Spitzer RL, Psychiatric Annals 2002;32:509-521

Table 2. PHQ-9 scores and Proposed Treatment Actions *

PHQ-9 score	Depression Severity	Proposed Treatment Actions
0-4	None-minimal	None
5-9	Mild	Watchful waiting; repeat PHQ-9 at follow-up
10-14	Moderately	Treatment plan, considering counseling, follow-up, and/or pharmacotherapy
15-19	Moderately Severe	Active treatment with pharmacotherapy and/or psychotherapy
20-27	Severe	Immediate initiation of pharmacotherapy and, if severe impairment or poor response to therapy, expedited referral to a mental health specialist for psychotherapy and/or collaborative management

* From Kroenke K, Spitzer RL, Psychiatric Annals 2002;32:509-521

Table 3. Characteristics of women with at least a year post final menstruation without hysterectomy and women with at least a year post final menstruation following hysterectomy

	Respondents, n (%)
Age group at interview (years)	
30-40	13(1.04)
40-50	66(5.28)
50-60	340(27.22)
60-70	465(37.23)
70-80	365(29.22)
Race/ethnicity	
Mexican- American	143(11.45)
Other Hispanic	126(10.09)
Non-Hispanic White	483(38.67)
Non-Hispanic Black	300(24.02)
Non-Hispanic Asian	149(11.93)
Other race, including multiracial	48(3.84)
Education	
Less than 9th grade	164(13.13)

9-11th grade (including 12th grade with no diploma)	118(9.45)
High school graduate/GED or equivalent	228(18.25)
Some college degree	343(27.46)
College graduate or above	394(31.55)
Marital Status	
Married/Living with partner	641(51.32)
Widowed	239(19.14)
Separated/Divorced	273(21.86)
Never married	95(7.61)
Family income	
Below poverty	334(26.74)
At or above poverty	915(73.26)
Livebirth	
Zero	5(0.45)
One	175(15.71)
Two	364(32.68)

Three or more	570(51.17)
Body mass index	
Underweight	243(19.46)
Normal weight	604(48.36)
Overweight	251(20.10
Obese	151(12.09)
Smoking status	
Never smoked	801(64.18)
Former smokers	271(21.71)
Current smokers	176(14.10)
Heavy drinking in the past year	
Yes	96(9.07)
Age at final menstruation	
Premature (<40years)	274(21.94)
Early (40-44)	175(14.01)
Normal (45-55)	659(52.76)
Late (>55)	141(11.29)

Years post final menstruation	
Four years or less	195(15.61)
Above four years	1054(84.39)
Use of Female hormones	
Yes	369(29.71)
Self-reported general health	
Excellent/ Very good	404(32.35)
Good/Fair	778(62.29)
Poor	67(5.36)
Access to mental health professional in the past year	
Yes	132(10.58)
Use of depression medication	
Yes	208(16.76)

Table 4. Characteristics of women with at least a year post final menstruation and women with at least a year post final menstruation following hysterectomy.

	Women with at least a year post final menstruation following hysterectomy		Women with at least a year post final menstruation without hysterectomy without hysterectomy	
	Number, n=482	%	Number, n=767	%
Mean age at interview(years) (SD)	63.47(11.47)		64.13(8.92)	
Age group at interview (years)				
30-40	13	2.70	-	-
40-50	42	8.71	24	3.13
50-60	111	23.03	229	29.86
60-70	159	32.99	306	39.90
70-80	157	32.57	208	27.12
Race/ethnicity				
Mexican- American	43	8.92	100	13.04
Other Hispanic	41	8.51	85	11.08
Non-Hispanic White	211	43.78	272	35.46

Non-Hispanic Black	133	27.59	167	21.77
Non-Hispanic Asian	34	7.05	115	14.99
Other race, including multiracial	20	4.15	28	3.65
Education				
Less than 9th grade	82	6.64	82	10.72
9-11th grade (including 12th grade with no diploma)	45	9.34	73	9.54
High school graduate/GED or equivalent	32	26.14	196	25.62
Some college degree	126	40.87	217	28.37
College graduate or above	197	17.01	197	25.75
Marital Status				
Married/Living with partner	241	50	400	52.22
Widowed	108	22.41	131	17.10

Separated/Divorced	100	20.75	173	22.58
Never married	33	6.85	62	8.09
Family income				
Below poverty	126	26.14	208	27.12
At or above poverty	356	73.86	559	72.88
Livebirth				
Zero	1	0.23	4	0.59
One	68	15.53	107	15.83
Two	162	36.99	202	29.88
Three or more	207	47.26	363	53.70
Body mass index				
Underweight	77	15.98	166	21.64
Normal weight	233	48.34	371	48.37
Overweight	106	21.99	145	18.90
Obese	66	13.69	85	11.08
Smoking status				
Never smoked	297	61.75	504	65.71
Former smokers	103	21.41	168	21.90

Current smokers	81	16.84	95	12.39
Heavy drinking in the past year				
Yes	46	10.67	50	7.97
Age at final menstruation				
Premature (<40years)	231	47.93	43	5.61
Early (40-44)	90	18.67	85	11.08
Normal (45-55)	145	30.08	514	67.01
Late (>55)	16	3.32	125	16.30
Years post final menstruation				
Four years or less	52	10.79	143	18.64
Above four years	430	89.21	624	81.36
Use of Female hormones				
Yes	214	44.77	155	20.29
Self-reported general health				

Excellent/ Very good	146	30.29	258	33.64
Good/Fair	307	63.69	471	61.41
Poor	29	6.02	38	4.95
Access to mental health professional in the past year				
Yes	67	13.93	65	8.47
Use of depression medication				
Yes	110	23.01	98	12.84

Table 5a. PHQ 9 results of women with at least a year post final menstruation without hysterectomy and women with at least a year post final menstruation with and without hysterectomy

PHQ-9 depression category	Women with at least a year post final menstruation following hysterectomy		Women with at least a year post final menstruation without hysterectomy without hysterectomy	
	Number	%	Number	%
None to minimal depression	297	61.62	525	68.45
Mild depression	111	23.03	150	19.56
Moderate depression	43	8.92	62	8.08
Moderate to severe depression	25	5.19	19	2.48
Severe depression	6	1.24	11	1.43

Table 5b: Distribution of depression after use of cut point of 10 on PHQ-9

Depression category	Women with at least a year post final menstruation following hysterectomy		Women with at least a year post final menstruation without hysterectomy without hysterectomy	
	Number	%	Number	%

No depression	408	84.65	675	88.01
Depression	74	15.35	92	11.99

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