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Research Article

Age at First Birth and Later-Life Depression in Women

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Abstract

Introduction: Previous studies showed that depression in women could be related to the age of their first birth. By analyzing the recently collected data, this study aimed to investigate the trends of the age of first birth and its relationship to depression in later life among women in the United States (US).

Methods: This cross-sectional study combined 2011-2018 data from the National Health and Nutrition Examination Survey (NHANES). US women between 20-79 years old who had ever had a live birth were included. We calculated the prevalence of depression by characteristics and estimated the association between current depression and age at first birth.

Results: Women whose age at first birth was ≤34 years had a decreased odds of depression (OR = 0.90; 95% CI, 0.88-0.93) whereas those whose age at first birth was > 34 years were at an increased odds of developing depression (OR = 1.38; 95% CI, 1.05-1.82) for every year increase of age.

Conclusions: A curvilinear relationship exists between age at first birth and later-life depression in women. When considering women's general health and family relationships, further investigation of women's age at birth should be taken as an important component of their mental health.

Keywords: *Women; Depression; Maternal Age; Live Birth; National Health and Nutrition Examination Survey*

Abbreviations

US: United States; HHS: Health and Human Services; NHANES: National Health and Nutrition Examination Survey; NCHS: National Center for Health Statistics; PHQ-9: Patient Health Questionnaire-9; MHP: Mental Health Professional; BMI: Body Mass Index; HHS: United States Department of Health and Human Services; LOWESS: Locally Weighted Scatterplot Smoothing; SES: Socioeconomic Status; GDM: Gestational Diabetes

Introduction

From 2009 to 2019, the prevalence of adults reporting at least one major depressive episode [1] increased from 6.6% to nearly 8.0% in the US, representing about 19 million US adults [2]. This burden of depression varies by sex, with 21.8% of women having depressive symptoms compared to 15.0% of men in 2019 [3]. Given increasing depression prevalence, the US Department of Health and Human Services (HHS) has established a national objective in increasing screening for depression as part of its Healthy People 2030 [4].

Prior studies have suggested that depression in women could be related to the age at their first birth. Data from the US National Vital Statistics System has shown that the age at first birth has increased from 24.9 years in 2000 to 27.0 years in 2019 [5,6]. Broken down by race/ethnicity, non-Hispanic Asians had the highest age at first birth of 30.7 years while Hispanics had the lowest of 25.1 years [5]. In addition, a curvilinear relationship has been observed between depression and age at first birth, with those at the extremes at age of first birth having the highest depressive burden [7]. A previous study hypothesized that an early first birth may indicate a more disordered transition into adulthood that could lead to lifelong emotional consequences. They found those with a first birth before age 23 had increased depressive signs whereas having first birth after age 30 had the lowest impact. The emotional benefits of delaying first birth were correlated with later first marriages, higher educational attainment, income for necessities, and employment status [8]. On the other hand, extreme late age at first birth has also been associated with increased depressive symptoms, which could be partially attributed to having later than expected births [7]. Hence, studies are needed to clarify the association between age at first birth and general mental health.

This study seeks to trend the age of first birth in recent years and discover whether a curvilinear relationship exists between age at first birth and depression in women. Furthermore, it aims to assess the associations between depression and age at first birth, and other potential risk factors of depression.

Materials and Methods

Data and study population

The National Health and Nutrition Examination Survey (NHANES) is a cross-sectional household survey consisting of interviews and physical examinations using a nationally representative sample of the noninstitutionalized individuals in the US. NHANES has been conducted by the National Center for Health Statistics (NCHS) in two-year cycles since 1999. Our analysis used NHANES data of four survey cycles across 2011-12, 2013-14, 2015-16, and 2017-18. The 2011-18 NHANES oversample Hispanics, African Americans, Asians, persons aged 80 years and older, and persons living on a low income [9].

We included 1) women aged 20-79 years, 2) who responded to depression screening of the Patient Health Questionnaire-9 (PHQ-9), 3) and ever being pregnant and having a live birth; and excluded those who 1) did not respond to either of the depression or pregnancy questions, 2) never being pregnant or with an unclear answer for this question, 3) or were currently pregnant or gave her latest birth within a year.

Measures

The PHQ-9 is a 9-item, 4-point Likert scale to measure depressive disorders and symptom severity [10,11]. Each item was scored from 0 (not at all) to 3 (nearly every day). The sum scores of PHQ-9 ≥10 indicate a major depression [10,11]. The primary exposure measurement in the study was women's reported age at first birth in years, ranging 14-45 years in NHANES 2011-18. We considered the following covariates: age at survey in years, race/ethnicity, US nativity, education level, marital status, employment status, financial disadvantage (≤185% and > 185% of the federal poverty level), health insurance, self-reported health condition, physical, mental and emotional limitations, body mass index (BMI), history of hysterectomy or bilateral oophorectomy, history of borderline or gestational diabetes, dietary quality, heavy/binge drinking, number of pregnancies not ending in a live birth, and number of children in the household.

Statistical analyses

All analyses were conducted accounting for the complex survey design of NHANES by the SAS survey procedures. We summarized and compared characteristics by PHQ-9 score groups (< 10, ≥10) using a t-test or Rao-Scott χ^2 test. Next, simple logistic regression was used to estimate the crude association between dichotomized depression outcome and potential risk factors. Furthermore, four multivariable logistic regression models were conducted to assess the association between depression and age at first birth after adjusting for selected covariates. Model 1 adjusted for socio-demographic covariates including age, race/ethnicity, US nativity, marital status, health insurance, educational attainment, family income level, and employment status. Model 2 adjusted for reproductive history and health-related covariates including numbers of adverse pregnancy outcomes, numbers of children in the household, ever hysterectomy or bilateral oophorectomy, and ever borderline or gestational diabetes, plus the socio-demographic covariates in Model 1. Model 3 additionally adjusted for covariates regarding current health status including health condition, ever had physical, mental and emotional limitations, and whether being obese, compared to Model 2. Model 4 adjusted for all the covariates aforementioned. Following, a linear spline term was added in Model 1-4 to account for the curvilinear correlation between PHQ-9 score and age at first birth [12]. In general, the logistic regression equation applied was: Log odds (*PHQ-9 score group*) = Linear combination of (*Covariates* * Regression Coefficients) + *Age at first birth* * β_1 + (*Age at first birth - 34*) * β_2.

The estimated slope of age at first birth changed by age at first birth ≤34 or > 34 years. When an observed age at first birth ≤34 years, the spline term — (Age at first birth -34 years) * β_2 was equal to zero and the estimated slope of age at first birth was β_1. Otherwise, the regression coefficient β_2 of spline term took part in the association between age at first birth and PHQ-9 score. This cutoff of 34 years was decided by observing the points on the Locally Weighted Scatterplot Smoothing (LOWESS) curve where the slope of the log-transformed odds of PHQ-9 ≥10 (odds scaled by +1) over age at first birth suddenly appeared a major change around, and then locating the lowest point where β_2 became significant by the logistic regression between age at first birth and dichotomized PHQ-9 score group, adjusted for age at survey. Missing data were considered not missing completely at random and accounted for in all logistic models. We used SAS version 9.4 (SAS Institute) for all analyses, and RStudio version 4.1.2 (RStudio PBC) for plotting graphs. All statistical tests were 2-sided, with the significant level at 0.05, and 0.1 to be borderline significant.

Results

Among the weighted population of 72,935,017 (raw population N = 6,792) US women aged 20-79 years who had given birth, approximately 11% reported having major depression. There were significant differences in demographic, socioeconomic, health, and behavior factors by the presence of depression (PHQ-9 < 10 vs. ≥10). Women with depression were younger (50.3 vs. 52.0 years; p = 0.03) and had their first live birth at a younger age (21.0 vs. 23.3 years; p < 0.001) compared to their non-depressed counterparts. Less Asian women (1.4% vs. 5.0%) and more other/multiple race women (7.5% vs. 2.7%) reported being depressed than their non-depressed peers (p < 0.001). Women with major depression tended to have experienced more pregnancies not ending in a live birth delivery (1.1 vs. 0.7; p < 0.001) and have a hysterectomy or bilateral oophorectomy (35.7% vs. 25.0%; p < 0.001) (Table 1).

The odds of major depression had a curvilinear association with age at first birth in women. The LOWESS curve showed that teenage pregnancy (under 20 years) and late pregnancy (above 35 years) for the first delivery correlated with a higher rate of depression, and the lowest rate of reported depression was among women aged 34-35 years at first birth. Age at first birth over 40 years had an unclear relationship with depression due to the limited sample size for this group (Figure 1).

Women whose age at first birth was ≤34 years had a decreased odds of major depression (adjusted odds ratio [aOR] = 0.90; 95% CI, 0.88-0.93) for every year older, adjusted for age. This negative association remained significant in Model 1 (aOR = 0.94; 95% CI, 0.91-0.98), Model 2 (aOR = 0.95; 95% CI, 0.92-0.98), and Model 3 (aOR = 0.96; 95% CI, 0.93-1.00), and became borderline significant (aOR =

Characteristics	PHQ-9 score ≥10 (N = 827, Weighted N = 8,078,731)	PHQ-9 score < 10 (N = 5,965, Weighted N = 64,856,286)	P-value
	Weighted Mean (SD)	**Weighted Mean (SD)**	
Age at survey	50.3 (0.7)	52.0 (0.2)	0.03
Age at first birth	21.0 (0.3)	23.3 (0.2)	< 0.001
Number of adverse pregnancy outcomes[a]	1.1 (0.1)	0.7 (0.02)	< 0.001
Number of children in the household	0.8 (0.1)	0.9 (0.02)	0.22
	N (Weighted %)	**N (Weighted %)**	
Race/Ethnic			< 0.001
NH White	309 (60.9)	2045 (65.6)	
NH Black	190 (13.0)	1452 (12.2)	
NH Asian	24 (1.4)	696 (5.0)	
Hispanic	257 (17.2)	1598 (14.5)	
NH Other/Multiple race	47 (7.5)	174 (2.7)	
Born in the US			0.05
Yes	620 (85.5)	4011 (82.0)	
No	207 (14.5)	1950 (18.0)	
Education			< 0.001
≤High school/GED	473 (52.4)	2592 (35.6)	
Above high school	352 (47.6)	3370 (64.4)	
Marital status			< 0.001
Married/ Living with partner	350 (47.7)	3622 (68.0)	
Single/ Separated, divorced, widowed	477 (52.3)	2338 (32.0)	
Family monthly poverty level index			< 0.001
≤1.85	566 (62.8)	2814 (36.3)	
> 1.85	200 (37.2)	2729 (63.7)	
Employment status			< 0.001
Employed	253 (36.7)	3199 (57.6)	
Unemployed	573 (63.3)	2760 (42.4)	
Have insurance			0.001
Yes	667 (82.0)	4921 (86.8)	
No	158 (18.0)	1038 (13.2)	

Ever hysterectomy or bilateral oophorectomy			< 0.001
Yes	278 (35.7)	1431 (25.0)	
No	548 (64.3)	4516 (75.0)	
Ever borderline or gestational diabetes			0.02
Yes	94 (13.5)	579 (9.6)	
No	731 (86.5)	5374 (90.4)	
Health condition			< 0.001
Excellent/Very good/Good	302 (45.5)	4525 (83.0)	
Fair/Poor	524 (54.5)	1437 (17.0)	
Physical, mental and emotional limitations			< 0.001
Yes	559 (65.7)	1548 (24.7)	
No	268 (34.3)	4417 (75.3)	
BMI			< 0.001
Not obese	341 (43.6)	3236 (57.9)	
Obese	479 (56.4)	2676 (42.1)	
Ever heavy/binge drinking[b]			< 0.001
Yes	160 (25.3)	356 (7.2)	
No	552 (74.7)	4375 (92.8)	
Healthy diet			< 0.001
Excellent/Very good/Good	366 (46.9)	4168 (75.5)	
Fair/Poor	460 (53.1)	1796 (24.5)	
Survey cycle			0.57
2011-2012	206 (22.8)	1320 (22.3)	
2013-2014	246 (28.2)	1559 (24.6)	
2015-2016	181 (23.5)	1549 (25.6)	
2017-2018	194 (25.6)	1537 (27.4)	

Table 1: *Characteristics by PHQ-9 Score ≥10 and < 10 among women aged 20-70 years, United States, NHANES 2011-2018.*

Notes:

BMI = Body Mass Index; NH = Non-Hispanic; NHANES = National Health and Examination Survey; PHQ-9 = The Patient Health Questionnaire-9; SD = Standard Deviation.

Percentages may not add to 100% due to rounding.

[a]*Number of adverse pregnancy outcomes was calculated by times of pregnancy subtracting number of deliveries resulted in a live birth, after two outliers: 25 and 33, were removed from the variable of time of pregnancy.*

[b]*Women who had a history of having 4 or more drinks every day were considered as heavy/binge drinkers.*

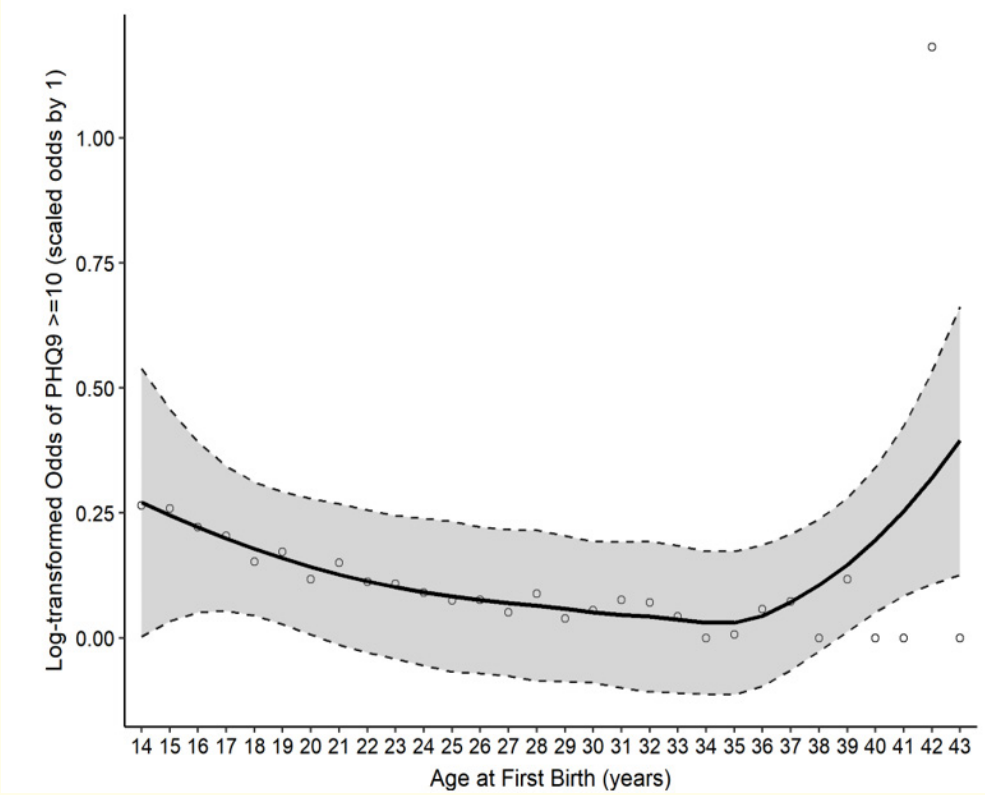

Figure 1: *Log-transformed odds of PHQ-9 score ≥ 10 by age at first birth.*

Notes: Odds of PHQ-9 Score ≥10 were scaled by plus 1 to avoid indefinite log odds when odds = 0; PHQ-9 = the Patient Health Questionnaire-9.

Source: National Health and Nutrition Examination Survey (NHANES) 2011-2018 data.

0.97; 95% CI, 0.93-1.01) when additionally adjusted for alcohol use and dietary quality in Model 4. Among women who had their first delivery > 34 years, a significantly increased odds of major depression for every one year older was found when adjusted by age (aOR = 1.38; 95% CI, 1.05-1.82). The OR point estimates of associations between age at first birth and depression in Model 1-4 were above 1 although were not significant, perhaps indicating a weak association of late pregnancy and leveled odds of major depression (Table 2).

Meanwhile, non-Hispanic Black women had a lower odds whereas non-Hispanic other/multiple race women had an increased odds (aOR = 2.36; 95%CI, 1.29-4.31) of major depression than non-Hispanic White women (aOR = 0.58; 95% CI, 0.42-0.81), adjusted by all the other covariates; non-Hispanic Asian women also had a decreased odds of depression compared to the non-Hispanic White peers (aOR = 0.49; 95% CI, 0.27-0.89 in Model 1; aOR = 0.53; 95% CI, 0.29-0.96 in Model 2), but this association became borderline significant in Model 3 and not significant in Model 4 (Table 2).

Characteristics	Crude OR (95% CI)	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Age at survey	0.99 [0.98, 1.00]	0.99 [0.98, 0.99]	0.97 [0.96, 0.98]	0.97 [0.96, 0.98]	0.98 [0.97, 0.99]
Age at first birth (≤ 34)	0.90 [0.88, 0.93]	0.94 [0.91, 0.98]	0.95 [0.92, 0.98]	0.96 [0.93, 1.00]	0.97 [0.93, 1.01]
Age at first birth (> 34)[a]	1.38 [1.05, 1.82]	1.19 [0.90, 1.48]	1.15 [0.90, 1.40]	1.10 [0.87, 1.32]	1.05 [0.81, 1.30]
Number of adverse pregnancy outcomes[b]	1.28 [1.18, 1.38]		1.24 [1.13, 1.36]	1.19 [1.07, 1.32]	1.17 [1.05, 1.30]
Number of children in the household	0.95 [0.87, 1.04]		0.82 [0.73, 0.91]	0.91 [0.82, 1.01]	0.93 [0.83, 1.05]
Race/Ethnic					
NH White	ref	ref	ref	ref	ref
NH Black	1.15 [0.90, 1.47]	0.60 [0.45, 0.82]	0.62 [0.45, 0.84]	0.60 [0.44, 0.81]	0.58 [0.42, 0.81]
NH Asian	0.30 [0.18, 0.50]	0.49 [0.27, 0.89]	0.53 [0.29, 0.96]	0.64 [0.35, 1.15]	1.06 [0.53, 2.11]
Hispanic	1.27 [0.99, 1.64]	0.97 [0.68, 1.37]	1.05 [0.75, 1.48]	0.91 [0.65, 1.28]	0.92 [0.63, 1.34]
NH Other/Multiple race	3.04 [2.00, 4.64]	2.72 [1.53, 4.81]	2.48 [1.43, 4.29]	2.05 [1.18, 3.58]	2.36 [1.29, 4.31]
Born in the US					
Yes	1.3 [1.00, 1.68]	0.73 [0.50, 1.07]	0.77 [0.54, 1.11]	0.82 [0.56, 1.19]	0.82 [0.52, 1.28]
No	ref	ref	ref	ref	ref
Education					
≤High school/GED	1.99 [1.61, 2.46]	1.32 [0.97, 1.79]	1.36 [1.00, 1.85]	1.22 [0.88, 1.71]	1.17 [0.83, 1.65]
Above high school	ref	ref	ref	ref	ref
Marital status					
Married/Living with partner	ref	ref	ref	ref	ref
Single/Separated, divorced, widowed	2.65 [1.93, 3.64]	1.85 [1.42, 2.42]	1.78 [1.35, 2.35]	1.67 [1.26, 2.19]	1.63 [1.19, 2.24]
Family monthly poverty level index					
≤ 1.85	2.97 [2.21, 3.99]	1.80 [1.30, 2.49]	1.86 [1.32, 2.6]	1.26 [0.88, 1.79]	1.15 [0.81, 1.65]
> 1.85	ref	ref	ref	ref	ref

Employment status					
employed	ref	ref	ref	ref	ref
not employed	2.34 [1.94, 2.84]	2.12 [1.65, 2.72]	2.1 [1.61, 2.73]	1.31 [0.99, 1.73]	1.39 [1.02, 1.89]
Have insurance					
Yes	ref	ref	ref	ref	ref
No	1.45 [1.15, 1.82]	0.90 [0.69, 1.18]	0.90 [0.7, 1.17]	0.99 [0.76, 1.29]	1.02 [0.78, 1.32]
Ever hysterectomy or bilateral oophorectomy					
Yes	1.67 [1.36, 2.05]		1.66 [1.24, 2.22]	1.52 [1.12, 2.06]	1.58 [1.10, 2.25]
No	ref		ref	ref	ref
Ever borderline or gestational diabetes					
Yes	1.47 [1.05, 2.05]		1.64 [1.17, 2.31]	1.5 [1.05, 2.13]	1.67 [1.14, 2.44]
No	ref		ref	ref	ref
Health condition					
Excellent/Very good/ Good	ref			ref	ref
Fair/Poor	5.86 [4.8, 7.16]			2.97 [2.24, 3.93]	2.44 [1.75, 3.40]
Physical, mental and emotional limitations					
Yes	5.84 [4.74, 7.2]			2.99 [2.23, 4.00]	2.67 [1.95, 3.67]
No	ref			ref	ref
BMI					
Not obese	ref			ref	ref
Obese	1.78 [1.42, 2.22]			1.15 [0.89, 1.50]	1.15 [0.85, 1.55]
Ever heavy/binge drinking[c]					
Yes	4.4 [3.33, 5.81]				1.99 [1.31, 3.04]

No	ref				ref
Healthy diet					
Excellent/Very good/ Good	ref				ref
Fair/Poor	3.49 [2.82, 4.31]				1.99 [1.42, 2.78]

Table 2: *Odds ratios for potential factors associated with major depression (PHQ-9 Score ≥10) among women aged 20-79 years, by logistic regression models, United States, NHANES 2011-2018.*

Notes: BMI: Body Mass Index; CI: Confidence Interval; NH: Non-Hispanic; NHANES: National Health and Examination Survey; OR: Odds Ratio; PHQ-9: The Patient Health Questionnaire-9; ref is the reference category.

Model 1 adjusted for demographic covariates including age at survey, race/ethnicity, US nativity, health insurance, educational attainment, family poverty level and employment.

Model 2 additionally adjusted for reproductive history and health related covariates such as adverse pregnancy outcomes, number of children in the household, ever hysterectomy or bilateral oophorectomy, and ever borderline or gestational diabetes than Model 1.

Model 3 additionally adjusted for current health status related covariates including self-reported health condition, physical, mental and emotional limitations, and body mass index than Model 2.

Model 4 additional adjusted for health behavior regarded covariates such as heavy/binge drink and healthiness of diet than Model 3.

[a]*Model 1-4 all adjusted for a spline term of age at first birth. When an observed age at first birth was < 34 years, the spline term was equal to zero. When an observed age at first birth was > 35 years, the spline term in addition accounted for the association between age at first birth and whether to be depressive.*

[b]*Number of adverse pregnancy outcomes was calculated by times of pregnancy subtracting number of deliveries resulted in a live birth, after two outliers: 25 and 33, were removed from the variable of time of pregnancy.*

[c]*Women who had a history of having 4 or more drinks every day were considered as heavy/binge drinkers.*

Discussion

This is the first study using the updated national data from NHANES 2011-18 assessing the association between women's age at first birth and odds of later-life depression. Overall, this study revealed a curvilinear relationship between age at first birth and depression among US women. The risk of depression was inversely associated with age at first birth until the age of 34 years, while after 35 years old, a positive association was dominated instead. Women with their first birth at 34-35 years old had the lowest odds of developing depression. After adjusting for confounders, we found that being single or separated, unemployed, having self-reported poor health, had a hysterectomy or bilateral oophorectomy, gestational diabetes, heavy alcohol use, poor diet, and reporting having physical, mental, or emotional limitations were independent risk factors of developing later-life depression.

Although limited evidence regarding possible intrinsic biological mechanisms exists to explain the observed curvilinear relationship between age at first birth and risk of depression, current literature suggests that there is likely a complex interaction between environmental and neurobiological stressors in the antepartum and postpartum period that can have an impact on maternal mental health [13].

A recent study by Zhang., *et al*. found gray and white matter changes in multiple regions of the brain at both 8 months and 2 years postpartum in mothers compared to women who did not give birth [14]. While the duration of these structural changes remains unknown, a study by Martinez-Garcia., *et al*. found these changes could be persistent, even at 6 years after childbirth [15]. Dysregulation of these brain regions has been proposed to play a role in developing depression [16]. While further studies are necessary to understand the long-term neurobiological changes after pregnancy and its implications on mental health, one possible biological explanation for increased later-life depression at those with younger age at first birth could be due to lasting neurobiological alterations.

Other studies that have observed a similar curvilinear relationship have tried to explain this relationship through their association with health status, psychosocial and economic stressors. An earlier study by Carlson found a curvilinear relationship between depression and age at first birth, with the lowest levels of depression between 31-32 years old, which is similar to our findings. Besides raising mediating effects from physical and socioeconomic status (SES), Carlson suggested that deviations from expected age at first birth play a larger role than physical health in mediating the relationship between age at first birth and depression, with depressive symptoms lowest when women meet their expectations for age at first birth [7]. Additionally, previous studies documented that SES and physical health were primary mediators between mental health and first births at both young and old ages [8,17]. By comparing SES and physical health-related factors between age at first birth of ≤34 and > 34 years (results not shown), we found a potential mediating role from SES factors such as low educational level, being single, having more financial difficulties, and having less health coverage at young ages, however, whether any mediators exist for old ages remain unclear. Further studies are needed to examine potential mediators lying between mental health and age at first birth among women with various age cohorts.

Our study revealed that factors of reproductive health were associated with major depression. A history of hysterectomy or bilateral oophorectomy was associated with an increased risk of current depression. Prior literature is mixed regarding the association between depression and hysterectomy. Depression after hysterectomy has been documented since the 1970s as an entity termed post-hysterectomy syndrome [18]. Other prior studies found that it may be secondary to hypoestrogenism, perceived loss of femininity, reduced sexual interest, impaired body image, and loss of reproductive potential [19-21]. Contrastingly, some research found that those undergoing hysterectomy for benign gynecologic conditions had a reduced risk of depression when compared to those who did not undergo a hysterectomy [22,23]. The inconsistent finding may be explained by relieved bleeding, dysmenorrhea, and pelvic pain after surgical intervention [22]. However, foregoing analyses showed that unilateral or bilateral oophorectomy for benign conditions increased the risk of depression compared to controls, possibly attributed to a decrease in ovarian associated hormones [24-26]. When hysterectomy is concomitantly performed with oophorectomy the association is less clear [27]. This study is limited by the fact that reasons for hysterectomy and oophorectomy were not asked and therefore further explanation of the increased depression risk is unclear. This study also found that gestational diabetes (GDM) is associated with increased depression risk. This is consistent with other studies which found women with GDM had an increased risk of depression although the investigations were limited to a year after delivery [28,29]. Given these findings, it may be prudent to screen women with a history of gestational diabetes, hysterectomy, or oophorectomy for depression later in life. This is particularly true in women with earlier or later age at first birth which may itself be an independent depression risk factor.

Limitations of the Study

Several limitations should be noted in our study. First, a causal relationship between age at the first birth and depression could not be determined. Second, populations with a possibly higher risk of depression such as those who are institutionalized in nursing homes or other facilities were not included and therefore our estimates of depression might be conservative. Third, due to the limited sample size of women aged ≥35 years at their first birth in our study, the findings should be cautiously interpreted for this age group. Future studies exploring depression in women of various ages are warranted. Also, the selection bias due to nonresponse is impossible to be eliminated in survey data. Meanwhile, participants currently treated for depression may not be captured as having major depression when screened by

PHQ-9. Future research should include medical records in order to increase the reliability of the outcome classification. Lastly, we did not measure other potential confounders, such as knowledge of participant's expected age at first birth, religiosity, early life socioeconomic characteristics and mental illness, any other historical antepartum/postpartum complications or mental disorders, and family-related variables. This limits any conclusions on their effects of depression and might result in residual bias.

Implications for practice and/or policy

Given a higher risk of later-life depression found among women whose first birth was at either young (under 20 years) or old ages (above 35 years), increased awareness for such association is needed in clinical practice to identify this high-risk population and the subsequent intervention towards depression prevention and treatment. For teenagers and young women under 20 years old, contraceptive education and access remain important to prevent teenage pregnancy and encourage young women to delay pregnancy to a later time to avoid later-life depression. Compared to first birth at young ages, fewer factors are known that can mediate later-life depression in women above 35 years old except physical and reproductive health and possible mistimed birth [7,8]. Thus, for women who had their first birth over 35 years old, we should focus on screening for later-life depression by adding assessment to yearly wellness visits, and possibly increasing the frequency of the assessment if needed. Furthermore, our results also underline the importance of family and social support, tailored age- and life partner- friendly primary cares, and effective school-/community-based programs in alleviating mental stress during pregnancy and after child birth [30]. The effects of life changes after childbirth did not diminish by age, suggesting that this could be ongoing source of difficulty for some mothers. For counselors/therapists working with mothers with depression symptoms (borderline depression), increasing social resources for mothers may be a promising avenue to pursue.

Conclusion

A curvilinear relationship continues to exist between depression and age at first birth in women from analyzing recent national data. Meanwhile, depression is associated with numerous socioeconomic, physical and mental health, and reproductive health indicators. Our findings highlight the importance of recognizing women's age at first birth as a potential risk factor for depression in clinical practice. Reproductive history should also be considered in screening efforts for depression in women. Future studies with a longitudinal approach are needed to establish a clear pattern of association between depression and age at first birth among women across all ages.

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Ethical Statement

The study used public-accessed, de-identified data; thus, Institutional Review Board approval was not required.

Conflicts of Interest

The authors report there are no competing interests to declare.

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