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**Influence of Seated Time During Pregnancy on Maternal Mental Wellbeing
During the COVID19 Pandemic
By Abbey Bierma**

An informal public newsletter style article submitted to the graduate faculty.
in partial fulfillment of a Creative Component for the degree of
Master of Science
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Program of Study Committee:
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Abstract:

While the time a woman is pregnant can be filled with times of joy and excitement, it can also be filled with a substantial amount of distress. From physical stress due to possible morning sickness and body changes to mental stress now exacerbated by the stress of the pandemic in this high-risk vulnerable group of individuals. In addition, research has shown that poor mental health during pregnancy can lead to many health consequences, such as premature birth, low birth weight, and learning disabilities in the child later in life. While it is widely understood that physical activity can aid in diffusing stress and anxiety in non-pregnant adults, the effects of seated time on mental health in pregnant women has not been established. In the early months of the pandemic, the Iowa State University COVID19 and Wellbeing Survey was sent electronically to the ISU community to assess the impacts of the pandemic on sedentary time, physical activity, and overall wellbeing. Using data collected from pregnant women, a secondary analysis explored the effects of seated time and overall mental wellbeing, assessed via the Short Warwick Edinburgh Mental Wellbeing Scale (SWEMWBS-7). Sedentary time (average 9.1 hours \pm 3.7) was used to divide the sampled into three groups of low (0-6 hours), moderate (6-9 hours) and high (greater than 9 hours) seated time. The average SWEMWBS-7 score of each group was determined and compared across groups via a one-way analysis of variance (ANOVA). The same comparison was done again with a two-way ANOVA while also considering gestational age, divided into groups by trimester. Trimester one included gestational weeks 1-13, trimester two included weeks 14-27, and trimester three weeks 28 to birth. While the results of both ANOVAs were not statistically significant (F values of 2.754 and 0.342 respectively), the impact of sedentary time on mental health is worthy of further exploration as the effects of maternal mental health can have long-lasting implications for mother and child.

Introduction:

Pregnancy is typically a time of many emotions and life changes and can cause many women to experience shifts in their mental wellbeing.¹ According to the World Health Organization, when someone has positive mental wellbeing, they can operate independently and productively, enjoy their free time actively contribute to the community, all while feeling mentally well.² Stress and mental wellbeing work in tandem with one another. High amounts of and/or unmanaged stress can lead to poor mental wellbeing, which potentially promotes increased stress levels.³ Changes in mental health throughout pregnancy can lead to unfavorable pregnancy outcomes including preeclampsia, premature birth, or low birth weight, which may increase future health consequences for both mother and child.¹ It is because of this relationship that observing the role of stress during pregnancy is important in order to understand pregnant women's mental wellbeing.

Cortisol is the main hormone associated with stress. Secreted from the adrenal glands, normal circulating levels are 10 to 20 mcg/dL in the morning, with a progressive decline throughout the day.⁴ During periods of stress, cortisol stimulates gluconeogenesis to increase blood sugar, enhance brain utilization of glucose, and inhibit functions in the reproduction system such as preventing release of gonadotropin-releasing hormone which can subsequently cause a decrease in circulating levels of progesterone, an important female sex hormone. Circulating plasma levels during stress could be closer to 20 mcg/dL. Cortisol is responsible for redirecting blood flow to key organs (e.g., brain, heart, skeletal muscle) during fight or flight scenarios; therefore, the fetus could be impacted with repeated bouts of stress as blood flow is directed to other parts of the mother's body.⁵

Estrogen, a female sex hormone which aids in the development of the reproductive system and other female characteristics and increases steadily throughout pregnancy, peaking during the third trimester at 20,000 pg/mL.⁶ Additionally, estrogen plays a key role in mental wellbeing by reducing the ability to counteract the response to stress therefore amplifying the stress response.⁷ Because of this, pregnant women especially, who have higher circulating levels of estrogen, not only have increased damage from cortisol which is directing blood flow away from the fetus, but also a decreased ability to manage the heightened cortisol response. Reduced fetal blood flow, in large amounts, can lead to increased chances of miscarriage, preeclampsia, or premature birth. Premature birth of a baby, marked as any birth before week 37 of gestation, can lead to many negative outcomes such as low birth weight in the infant, increased chances of developing learning and social disability in early childhood and greater likelihood of developing chronic diseases later in life. Besides these consequences, premature birth is also the leading cause of death in children under the age of five.⁸ Due to the long-lasting implications, it is imperative to better understand mental wellbeing during pregnancy to understand better ways to prevent stress and improve maternal and child health. Unfortunately, at this time, published research on wellbeing and pregnancy is less prevalent than similar research done on non-pregnant adults and the studies that do exist can be difficult to find.

Physical activity has been an identified strategy to improve mental wellbeing in pregnancy, with greater amounts of physical activity warranting increased mental health benefits.⁹ However, an interesting consideration is the influence of seated time on mental wellbeing. The level of physical activity done by a pregnant woman is not typically reflective of their amount of sedentary behavior.¹⁰ In theory, a pregnant woman could be active, meeting the recommended amount of physical activity (150 minutes of moderate activity per week) yet sit for the remaining waking hours of their day. If PA can improve mental wellbeing, it is reasonable to wonder if seated time negatively impacts mental health. On average, adults sit for eight hours of the day, while pregnant women on average sit for at least one additional hour above non-pregnant women. These averages are taken from non-pandemic times.¹¹ Meyer et al found that sedentary time in adults increased during the early stages of the COVID19 pandemic.¹² The purpose of this study was to assess the influence of seated time on the mental wellbeing of pregnant women during the COVID19 pandemic. Additionally, we evaluated the effect of trimester on mental wellbeing. We hypothesized that higher seated time (likely affected by the COVID19 pandemic) would be associated with worse mental wellbeing, with a greater difference for women in the third trimester.

Methods:

All data for this analysis was collected using the Iowa State COVID-19 and Wellbeing Survey.¹² This survey was sent by mass email to Iowa State University students, faculty, and alumni between the days of April 3rd and 7th of 2020. A snowball sampling technique was utilized. Anyone over the age of 18 was eligible to partake and a total of 3,052 responses were recorded. The survey was anonymous, completed virtually, and all metrics were self-reported. For this analysis, only survey responses of individuals identifying as pregnant were used (n=71).

Questions on the survey included demographic information such as age, relationship status, past mental health history, and income, pregnancy related details such as gestational age and pregnancy number, and health related metrics such as physical activity level, seated time, perceived stress, and mental wellbeing.

Sedentary time was self-reported as average hours per day of seated time and subsequently, categorized into low, moderate, and high of 0 to 6 hours per day, 6 to 9 hours, and 9 plus hours, respectively. These categories were developed from typical high, moderate and low amounts of seated time published in other related studies.^{13,14} Mental wellbeing was evaluated using the Short Warwick Edinburgh Mental Wellbeing Scale (SWEMWBS-7). Participants answered a series of seven questions whose responses could be related to a number on a scale of one to five. The corresponding scores for each question were then summed to determine the overall wellbeing score. A higher score indicated positive mental wellbeing.

To first get a visual representation of the relationship between seated time and mental wellbeing, a linear regression was performed. To test the first hypothesis of this study, the association between categories of seated time and mental wellbeing, a one-way analysis of variance (ANOVA) was completed with the dependent and independent variables defined as mental wellbeing score and assigned seated category (low, moderate or high) respectively. To consider the impact of trimester, a follow-up linear regression model was fit to evaluate the associations of both seated time and gestational age as independent predictors of mental wellbeing. In both evaluations, relationship status, past mental health diagnosis, and pregnancy number were included as covariates. The statistical program R was utilized to run both ANOVAS, and the level of significance was $p < 0.05$.

Results:

Of the 3052 respondents from the original survey, 71 identified as pregnant and were included in this analysis. The majority (78.8%) of the women were between 25 and 34 years old ($n=56$). Only 18.3% of the women were over 34 years old ($n=13$) leaving 2.8% under 25 years old ($n=2$). Approximately 90% of the respondents were married ($n=63$). Thirty-seven of the women were experiencing their first pregnancy, while the remaining women had been pregnant at least one other time. The respondents predominately identified as white ($n=67$), were educated (all participants attended college, $n=71$), and of high income (\$75,000 and above annual household salary, $n=48$). Twenty participants indicated they had been previously diagnosed with a mental health condition ($n=19$; depression and/or anxiety). The survey was originally distributed to Iowa State University students, faculty, and staff in Ames, Iowa, along with recent alumni.

The average daily seated time was 9.1 hours \pm 3.7 (range: 0-21 hrs.). The average mental wellbeing summed score was 23.4 \pm 3.7, (1,35). A score greater than 20 indicated positive mental wellbeing. A total of 10 participants fell below this mark. When a linear regression between seated time and mental wellbeing score was performed, a correlation of $R^2=0.1$ was observed.

A one-way ANOVA was performed examining the influence of seated time (independent variable) on mental wellbeing score (dependent variable) while controlling for relationship status, past mental health diagnosis and pregnancy number (covariates). No significant findings were observed (F-value of 2.754, p-value of 0.0712). A two-way ANOVA was performed to examine the influence of seated time (independent variable) on mental wellbeing score (dependent variable) varied between trimesters (independent variable) with the following covariates: relationship status, past mental health diagnosis and pregnancy number. The results showed the variance between trimesters to be statistically insignificant (F-value of 0.342, p-value of 0.848).

ANOVA				
	Sum Sq	df	F	Pr(>F)
Intercept	8761.2	1	630.3464	<2e-16
Sitting Category	76.6	2	2.7544	0.071
Relationship	6.8	2	0.2456	0.78
Mental Health	1	1	0.0735	0.787
Preg_first	20.1	1	1.4458	0.233
Residuals	889.5	64		

Figure 1: One Way ANOVA

ANOVA				
	Sum Sq	df	F	Pr(>F)
Intercept	1058	1	75.2731	5.24E-12
Sitting Category	6.02	2	0.2142	0.8078
Trimester	19.66	2	0.6993	0.5012
Relationship	10.76	2	0.3828	0.6837
Mental Health	0.04	1	0.0031	0.9556
Preg_First	27.32	1	1.9435	0.1687
Sitting Category: Trimester	19.25	4	0.3424	0.8482
Residuals	801.16	57		

Figure 2: Two Way ANOVA

Discussion

The purpose of this study was to identify the influence of seated time on the mental wellbeing of pregnant women during COVID19 and how that influence may vary between trimesters. Based on the average summed wellbeing score, most women scored in the positive mental wellbeing category. Average seated time was above the national average of 8 hours based on other studies which indicates that our sample was sitting on average more than the non-pregnant adult.⁹

Results revealed that there was a positive relationship between seated time and wellbeing score in the sample. However, upon closer observation, if the outliers and implausible points are removed from the data, including a response of 0 seated hours and a response of 21+ seated hours, there is no correlation between the two variables ($R^2=0.051$). While the findings of this study were not of statistical significance, it can be seen in other studies that there is a significant relationship between seated time and mental health. A study conducted with 20 male and female officer workers (age 20-45), found that sitting for more than 90 minutes consecutively, even for only a single bout, led to an increase in perceived stress and a decline in problem solving, memory and attention, all of which play a role in reduced mental wellbeing.¹⁵ Another study of almost 12,000 male and female adults in Europe found poor mental health individuals were more likely to spend large portions of their day in sedentary activities (defined as less than 1.5 METS).¹⁶

In a study done on 81 women with varying gestational age, a positive association between perceived stress and sitting time was found. Additionally, it was found that while a similar relationship existed in a population of nonpregnant adults surveyed, the effect was larger in the original sample of pregnant women.¹⁷ As mentioned earlier, the impact of these findings is substantial as studies demonstrate that dramatic effects of poor mental wellbeing on pregnancy and newborn health. In a study done in 2019 with over 200 pregnant women, found that mothers with persistent high stress throughout pregnancy had a higher chance of giving birth preterm. Out of those that had clinically diagnosed mental health issues, 72% gave birth preterm.¹⁸ Another study from 2017, including 72 women, had similar results but additionally found that infants born to mothers with high stress during pregnancy had delayed neurodevelopment through age five.¹⁹ Collectively, the published evidence from studies done on both pregnant and non-pregnant adults, demonstrated there is a warranted need for further exploration of mental wellbeing and seated time in pregnant women.

The strength of this analysis was its timing at the onset of the COVID19 pandemic. In a time of changing behaviors, including increased seated time, the study this analysis was based on gathered feedback from

the first weeks of the pandemic, allowing us to capture the initial and dramatic mental and physical reactions to the changing world. The limitations of this analysis include the lack of demographic diversity in the sample as the majority of the respondents identify as white, were well-educated and of higher income status. Therefore, the responses from this analysis may not be reflective of all pregnant women. Additionally, seated time and mental wellbeing responses were self-reported which may have led to over or under reporting.²⁰ There was also relatively small sample size (n=71). This can be contributed to the short length of data collection and the small population subset of pregnant women. And finally, evaluating seated time and mental wellbeing of pregnant women was not the primary goal of the original study and therefore the study was not structured or equipped to accurately measure the influence of one over the other.

Future Direction

Moving forward, future studies should continue to highlight the relationship of mental health and seated time in pregnant women. Specifically, exploring how mental wellbeing plays a role compared to other lifestyle behaviors (physical activity, nutrition, sleep, etc.) and how they collectively effect mental health. In addition, exploring how these effects differ, and to what extent, between non-pregnant and pregnant adults. As the research shows us, identifying how we can better support mental wellbeing is of the highest importance to not only the health of the mother but the baby as well.

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Utilizing Seated Time to Improve Maternal Mental Wellbeing

By Abbey Bierma

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Pregnancy can be a time of constantly changing emotions. Because of this, pregnant women can experience a rise in stress and an overall decline in their mental wellbeing. Mental wellbeing is a state of mental health that means one can operate independently and handle day to day stressors. Poor mental wellbeing throughout pregnancy may lead to unfavorable pregnancy outcomes, such as the development of preeclampsia, premature birth, and low birth weight. All of which could potentially cause long-term health complications to the mother or child.¹

When we experience stress, a hormone called cortisol is released from the adrenal glands. This hormone redirects blood flow to the brain, heart, and skeletal muscle. As a result, blood flow is reduced to reproductive organs, including the fetus.² The synthesis of estrogen, a female sex hormone, increases throughout pregnancy. Although estrogen is responsible for a lot of positive processes in the body, such as developing the uterus and promoting fetal organ development, it also prevents our bodies from properly handling the cortisol stress response.³ This drop in blood flow to the fetus during times of stress, if happening frequently, can lead to increased chances of high gestational weight gain, heightened blood pressure, premature birth, or low birth weight. Premature birth, defined as a birth prior to week 37 of gestation, is the main concern from this list. Besides being the leading cause of death in children under the age of five, premature birth can cause low birth weight of the baby, higher chances of the child developing a social or learning disability, or an increased risk of them developing chronic diseases later in life.⁴

To prevent adverse outcomes, it is important to understand how expecting mothers can control or limit their stress, thereby improving their mental wellbeing. Physical activity has typically been used as an effective means to decrease stress.⁵ However, in theory, a woman could live an active life, exercising for the recommended 30 minutes per day, yet still be sedentary for most of the day, which leads us to wonder how seated time plays a role in our mental health.

When looking at varying activities, the intensity of that motion (or how much energy it takes to complete) can be classified with a MET value. MET stands for metabolic equivalent of a task and shows us how much your metabolic rate must rise for the body to complete the activity at hand. Moderate activity such as walking, hiking, dancing, and yoga fall between 3.0 and 6.0 METS. Sedentary time is classified as any activity that operates below 1.5 METS. Examples of 1.5 MET activities are: watching TV, eating dinner, and driving your car.⁶ These 1.5 MET activities are the focus when trying to limit the amount of time we are seated each day.

Naturally, some seated time activities are impossible to avoid, especially during pregnancy when symptoms such as ankle edema and morning sickness are present. Despite this, some steps can be taken to improve mental wellbeing. First, consider breaking up seated time throughout the day. In one study done on a group of non-pregnant adult office workers, they found that the integral part to limiting poor mental wellbeing was breaking up long periods of seated activity, specifically every 90 minutes.⁷ While this study does not include pregnant women, it can help guide us toward a potential solution to increasing mental wellbeing. Another solution would be to increase mind-body interventions (mindfulness) during your seated time. A study done during the COVID19 pandemic aimed to develop strategies to improve maternal wellbeing, and one of the successful interventions was increasing activities that raised internal awareness. This include meditation, yoga, and deep breathing practices.⁸ Finally, this same study concluded that declines in maternal mental wellbeing could be limited by social interaction. They found that not only did spending time with others prevent an increase in anxiety, but it

also reduced antenatal anxiety.⁸ Because of this, spending your seated time with others instead of alone in front of a television or computer, may help protect against some of the downfalls discussed earlier.

This list of potential solutions to aiding mental wellbeing is not exhaustive. However, it is a good first step in addressing an important issue. Physical activity is a great answer to improving mental wellbeing.⁹ But in the case that this is insufficient or physical activity is unable to be completed due to any number of reasons (pregnancy related or not), breaking up seated time into smaller amounts, incorporating mindfulness activities, and finding social support can help to avoid declines in mental wellbeing that can occur during pregnancy. Making these changes can, in turn, aid in promoting healthy outcomes for both mother and child.

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