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Sleep moderates and mediates the relationship between acculturation and depressive symptoms in pregnant Mexican-American women

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Abstract

Purpose—Greater acculturation is associated with adverse perinatal outcomes in Mexican-American women, but the mechanisms by which acculturation influences perinatal outcomes are unclear. Pregnant acculturated Mexican-American women are more likely to engage in unhealthy prenatal behaviors relative to those less acculturated, including poor sleep. As sleep disruptions are associated with acculturation and negative perinatal outcomes, particularly maternal depression, alterations in sleep may adversely affect pregnant Mexican-American women.

Methods—Sixty pregnant women of Mexican descent completed surveys about sleep, acculturation, depressive symptoms and potential protective factor of social support.

Results—Acculturation, but not social support, significantly predicted increased sleep disruptions as well as overall feeling less refreshed upon waking across pregnancy. Moderation analysis indicated that more acculturated women who took longer to fall asleep reported increased depressive symptoms. Feeling refreshed upon waking also mediated the relationship between increased acculturation and elevated maternal depressive symptoms.

Conclusions—Acculturation and altered sleep contribute to greater risk in Mexican-American women for maternal depressive symptoms in the perinatal period. These findings have implications for prevention and treatment of maternal mental health disorders, which may adversely affect perinatal outcomes in the vulnerable Mexican-American population.

Keywords

pregnancy; mother; immigrant; perinatal; mood

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Mexican-American women experience elevated levels of maternal depression during pregnancy [1, 2] relative to the general population [3]. While the reason for these elevated rates of depression are unclear, cultural factors may play a role [1, 2, 4]. Mexican-Americans experience acculturation, a process of cultural and psychological change following contact between cultural groups [5], associated with adverse health behavior changes [6, 7], including sleep [8, 9]. During pregnancy, there are harmful consequences for sleep disruption not only for the mother (e.g., depression) [10], but also for the child [11]. As Mexican-American women report high birth rates (22.1%) relative to non-Hispanic Whites (11.6%) [12], attention to perinatal sleep is increasingly important. Although acculturation in pregnant Mexican women is related to a host of adverse perinatal outcomes [13, 14], little research has investigated the role of sleep in the negative relationship between acculturation and these outcomes. This study predicts that increased acculturation will be related to increases in self-reported sleep disturbance and elevated prenatal maternal depressive symptoms.

Sleep is a risk factor for adverse health outcomes [15, 16] and is particularly potent amongst those with low socioeconomic status [17] and racial/ethnic minorities [17, 18]. Pregnant women may be especially vulnerable to negative effects of altered sleep as sleep quality decreases during pregnancy [19–21]. Disrupted and insufficient sleep during pregnancy increase risk for prolonged labor, cesarean deliveries [22, 23], an infant small for gestational age [23, 24], and alterations in infant's sleep [11] as well as place women at risk for maternal depression [11, 25, 26]. High risk, low SES, minority women are at increased risk for perinatal complications [27], which could be further compounded by sleep disruptions. Thus, altered sleep during pregnancy has implications for both maternal and child health, particularly for vulnerable populations.

Individual differences in acculturative status can also impact health outcomes. The Latino Health Paradox states that the longer Latino immigrant populations remain in the US, their health outcomes (both physical and mental) worsen [6, 28]. Following this theory, less acculturated Mexican-Americans report better health despite lower socioeconomic status, limited education and decreased healthcare access [6]. As generations of immigrants acculturate to mainstream US culture, they are more likely to engage in unhealthy behaviors, including substance use, unhealthy eating and a less active lifestyle [6, 29]. During pregnancy, more acculturation is also associated with adverse health behaviors [30, 31] and negative perinatal outcomes, such as early gestational age and low birth weight [4, 14], declines in breastfeeding [32, 33] and postpartum depression [2, 34]. However, the exact mechanisms of these acculturation-related health declines are unknown.

One important factor to consider in the relationship between acculturation and behavioral health outcomes is social support. Women of low SES and racial/ethnic minority status may particularly benefit from social support [35, 36], a factor that improves health behavior [37, 38]. Acculturation is generally associated with low levels of social support [39] despite the collectivistic nature of Mexican culture [40] and strong associations with familial and community support [41, 42]. Social support has been shown to buffer against the negative effects of acculturation on mental health [43, 44]. In addition, social support increases positive sleep behaviors [45, 46] and is protective against perinatal outcomes [21, 47]. Close

supportive relationships may be particularly important in promoting healthy sleep habits [48]. Thus, for a pregnant mother who is struggling with sleep issues, support from their social network may be critical [49]. Therefore, lack of social support might play a role between acculturation and maternal-child health, but this is not yet known.

Sleep may also be altered by acculturation [50–52]. For example, Mexican immigrants are more likely to have longer sleep duration relative to Mexican-Americans [53]. Sleep disturbances can also be predicted by high acculturation levels [54], low socioeconomic status and increased depressive symptoms [9]. Thus sleep may be a mediator between acculturation and adverse health [50, 51]. Given the commonality in sleep disturbance among pregnant women, poor sleep during pregnancy may also be a moderator. For example, clinically diagnosed insomnia during pregnancy was related to maternal depression and acculturation in a low income sample of Latinas, including Mexican-Americans [55]. Despite this initial report, research is lacking on the moderate but more common sub-diagnostic sleep disturbance often seen in pregnancy and vulnerable high risk populations. The current study explores the relationship between acculturation and daily sleep measures in a sample of low income pregnant Mexican-American women and tests the hypotheses that sleep is a mediator and/or moderator between acculturation and one important pregnancy outcome, maternal depressive symptoms. Specifically, elevated scores on the Short Acculturation Scale for Hispanics will be related to less hours slept, more time to sleep onset, more sleep disruptions and decreased satisfaction with sleep as well as be associated with increased maternal depressive symptoms. As social support is often hypothesized as a protective factor on acculturation [31, 56] and pregnancy outcomes [57], the role of social support on sleep outcomes will also be examined. It is hypothesized that adverse sleep outcomes will be related to less satisfaction with social support.

Materials and Methods

Sample

Seventy Mexican-American pregnant women (ages 18–45 mean $\pm$ STD: 28.2 $\pm$ 5.9), without current or past illicit drug use, were recruited at a local county hospital. Visits occurred between February 2009 and July 2010. The hospital was in an urban setting, in which 92% of patients live below the poverty line and 42% are uninsured [58]. One participant withdrew due to lack of availability and seven participants switched to other clinics. One participant tested positive for an illicit substance and one participant failed to provide sleep diaries at one time point. A final sample of 60 mothers was evaluated. An apriori power analysis determined that for a multiple linear regression analysis with 4 predictors based on a medium-large effect size [47, 59], 58 participants would have had 80% power to determine study outcomes. Thus, the 60 reported had adequate power to address the current hypotheses in a cross-sectional manner. This work was conducted in accord with ethical principles approved by the Institutional Review Board.

Procedure

Participants were seen during early, mid and late pregnancy (15–18, 26–29, 32–36 weeks gestation, respectively). All participants provided informed consent.

Surveys

Surveys were presented to participants in their preferred language. Questionnaires were translated from English to Spanish using a double translation procedure [60]. Depression and social support questionnaires were collected at early, mid and late pregnancy; As pregnancy lasts ~9 months, changes in acculturation were expected to be minimal and measured once in late pregnancy.

Maternal acculturation status

Acculturative status was measured using the 12-item Short Acculturation Scale for Hispanics (SASH) [60]. The SASH evaluates language use, media and ethnic social relations on a 5-pt Likert scale and has evaluated health outcomes [61] and acculturation [14, 62] in Mexican-American mothers. SASH has good reliability $\alpha=0.92$ and higher scores indicate higher acculturation.

Maternal depressive symptoms

The Edinburgh Postnatal Depression Scale (EPDS) [63] is a 10-item self-report measure of depressive symptoms. Responses were anchored to 7 days prior and sleep diary collection occurred the following day. Responses were scored 0–3. The EPDS has been translated and validated in Spanish [64, 65] and effectively detects perinatal depressive symptoms [66–68]. As disrupted sleep is a symptom of depression and to adjust for potential collinearity, question 7 was omitted “I have been so unhappy that I had difficulty sleeping.” A modified EPDS with nine questions was analyzed as in previous studies of sleep and perinatal depression [69]. This version showed an acceptable reliability of $\alpha=0.819$.

Prenatal Social Support

Prenatal social support was measured using the Prenatal Social Support Instrument - Revised (PSSI) [70, 71]. Satisfaction of social support received was measured on three subscales. The first has eight items measuring received social support (e.g. material aid, task assistance, advice and listening). Participants responded if they received support in the previous week and if yes, rated their satisfaction on a 4-point scale. The second subscale referred to the child's father and the third subscale addressed support received from medical providers. The scale was developed for use in both English and Spanish [70]. Higher scores indicate higher satisfaction with social support.

Maternal sleep diary collection

Sleep diaries were collected on three consecutive days at each phase (average: 17.3 ± 1.8 , 28.1 ± 1.5 , 34.3 ± 1.4 weeks gestation). Mothers reported bed and wake times and total hours slept calculated. They also reported minutes to fall asleep (sleep onset), times woke during the night (sleep disruptions), and refreshed feelings upon waking from 1 (extremely tired) to 7 (extremely refreshed). Similar sleep diaries relating sleep in pregnancy to maternal depressive symptoms have been used [47].

Statistical Analysis

To address the relationship between age on outcomes of interest (acculturation, depressive symptoms, and sleep outcomes), a correlation was used. One-way analyses of variance (ANOVAs) analyzed categorical variables including education, employment status, marital status, family income, on outcomes of interest and a t-test evaluated previous depression. Only age was significantly related to acculturation, thus controlled for in all analyses.

Modified EPDS score of depressive symptoms, SASH score of acculturation, PSSI score of social support, and self-reported sleep outcomes were evaluated as continuous. Longitudinal analyses were performed to determine the predictive utility of acculturation on trajectory of sleep outcomes from early to late pregnancy. Slopes of hours slept, minutes to sleep, number of times up and feeling refreshed upon waking were compared using repeated measures multilevel modeling in SPSS with an unstructured covariance pattern. In all analyses with depression, previous depression was accounted for.

Repeated measures (RM) ANOVAs compared depressive symptoms and sleep outcomes across three pregnancy phases. As there were no differences in depressive symptoms or sleep outcomes (with the exception of sleep disruptions, see Results), scores across pregnancy were averaged and a cross-sectional analyses was performed. All averaged variables of interest were correlated. Separate multiple linear regressions were performed using SPSS to determine the roles of acculturation and social support on each sleep outcome as the dependent variable. Multiple linear regressions also determined the effects of acculturation, sleep outcomes and their interactions on depressive symptoms. Mediation analyses on the effects of acculturation on maternal depressive symptoms through sleep outcomes were performed according to Preacher and Hayes (2008) and statistical significance of the indirect (i.e., mediated) effects tested via bootstrapping [72].

Results

Maternal demographic characteristics

Maternal age was not correlated to sleep outcomes during pregnancy (data not shown), however, younger women were more likely to be acculturated ($r = -0.27$, $p = 0.03$). All other demographic variables in Table 1 were also analyzed and unrelated to sleep outcomes or acculturation (data not shown).

Pregnancy timing differences amongst self-report sleep, support and depressive symptoms

There were no differences between depressive symptoms, social support or sleep variables across pregnancy for hours slept, minutes to sleep onset and feeling refreshed upon waking as determined via RM ANOVA (Table 2). There was a significant difference in pregnancy phase with times up at night. Post-hoc tests suggest a non-significant trend that women reported more times up at night in late relative to early ($t = 2.29$, $p = 0.07$) and mid-pregnancy ($t = 2.22$, $p = 0.06$), but not between early and mid-pregnancy ($t = 0.07$, $p = 0.94$).

Correlation between acculturation, depressive symptoms, sleep and social support variables

Less acculturation and more depressive symptoms were significantly correlated with feeling less refreshed upon waking. More depressive symptoms were associated with more times up at night and less satisfaction with the child's father. Time to sleep onset was negatively correlated to satisfaction with received support. Lastly, more satisfaction with received and medical support were positively associated (Table 3).

Role of acculturation and social support on sleep outcomes

Cross-sectional—There was no effect of either maternal acculturation or prenatal social support on hours slept, number of times up nor number of minutes to sleep onset. However, higher acculturation, but not social support, significantly predicted feeling less refreshed upon awakening (Table 4).

Longitudinal—Multilevel modeling analyses revealed a significant effect of acculturation on times up at night and feeling refreshed upon awakening across pregnancy. For times up during the night, time showed a significant linear decrease ($b=-0.681$; $p=0.01$) and there was a marginally significant trend of acculturation ($b=0.381$; $p=0.075$), indicating that those acculturated reported more times up during the night. There was also a time x acculturation interaction ($b=-0.172$, $p=0.026$), indicating that acculturated mothers experience increased sleep disruptions more quickly during pregnancy (Figure 1A). For feeling refreshed upon awakening, time showed a linear decrease ($b=-0.482$; $p=0.019$) and acculturation was significant ($b=-0.618$, $p=0.006$), indicating that those acculturated report lower feelings of being refreshed. The time x acculturation interaction was significant ($b=0.178$, $p=0.032$), indicating that acculturated mother's perceived quality of sleep increased more quickly over time. (Figure 1B). There were few significant effects of social support on sleep outcomes. Less satisfaction with support from the child's father was associated with more time to sleep onset overtime and satisfaction with medical support for mothers with more sleep disruptions increased more quickly over time (See supplemental files).

Role of acculturation and sleep variables on maternal depressive symptoms

Cross-sectional—The number of times a pregnant woman was up at night significantly predicted depressive symptoms during pregnancy. Women that reported more sleep disruptions also exhibited elevated depressive symptoms (Model 1, Table 5). Analyses were controlled for previous depression and maternal age.

Longitudinal—For times up during the night, multilevel modeling showed that the time effect was not significant ($b=0.675$; $p=0.427$). However, the effect of times up at night was significant ($b=2.439$; $p=0.002$), indicating that women with more times up tended to have elevated depressive symptoms. There was a marginally significant effect of times up during the night by time interaction ($b=0.558$, $p=0.076$), indicating that mothers with increasing sleep disruptions experience increasing depressive symptoms more quickly over pregnancy.

Moderation—A moderation analysis determined a marginally significant effect of acculturation by average minutes to fall asleep on maternal depressive symptoms (Model 2,

Table 5). More acculturated pregnant women reporting more minutes to sleep onset also reported elevated depressive symptoms (Figure 2). No other interactions were found. Moderation analyses were also performed with depressive symptoms as the potential moderator between acculturation and sleep outcomes, but no significant interactions were found (see Supplemental Files).

Mediation—Following Preacher and Hayes (2008), a bootstrapping approach was used with the PROCESS computational tool in SPSS 19.0 to test whether the relationship between acculturation and maternal depressive symptoms was mediated by how refreshed a women felt upon awakening. There was no direct effect of acculturation on depressive symptoms, however, a direct effect between predictor and outcome is not a prerequisite to determine indirect effects via a mediator [73–75]. The proper estimate of indirect effects via a mediator is with a single inferential test of *ab* [75, 76]. Thus, there was an *indirect* effect of acculturation on depressive symptoms such that with those with greater acculturation reported feeling less refreshed upon waking ($a = -0.327$), which translated to more depressive symptoms ($b = -1.961$; Figure 3). This indirect effect (0.642) is statistically different from zero as realized by a 95% confidence interval that does not include zero (0.123–1.397) while controlling for maternal age and previous depression. The normal theory-based Sobel Test ($Z = 2.139$, $p = 0.032$) agrees with the inference made using a bias-corrected bootstrap confidence interval. Analyses were also performed with depressive symptoms as the potential mediator between acculturation and sleep outcomes, but no effects were found (see Supplemental Files).

Discussion and Conclusion

This study examined self-reported sleep during pregnancy as a contributor to the negative association between acculturation and maternal depressive symptoms in pregnant Mexican-American women. As this was an initial investigation, both cross-sectional and longitudinal analyses were used in a small high risk sample with similar results. Acculturation, but not depression, was related to the trajectory of how woman felt about her sleep quality. However, both acculturation and elevated depressive symptoms were associated with increased nighttime disruptions throughout pregnancy. In addition, increased time to sleep onset moderated, while feeling less refreshed upon waking mediated, the relationship between greater acculturation and elevated maternal depressive symptoms. This research is important as disruptions in sleep and maternal depression have adverse consequences for offspring [11, 21, 77], particularly in low SES high-risk populations. As increases in the Mexican-American population are driven by high birth rates [12], perinatal healthcare needs of Mexican-American women must be addressed in a culturally sensitive manner.

Perception of one's sleep is associated with acculturation in non-pregnant populations. For example, acculturated Mexican-American women with lower income and high depressive symptomatology reported greater sleep disturbances [9]. Studies have found that subjective sleep reports rather objective measures of sleep (actigraphy) are related to postpartum depressive symptoms [69, 78] and explain most variance in maternal depressive symptomatology [79]. As disrupted sleep quality is a symptom of depression [80], it is important to note, in the current study when the EPDS sleep question was omitted,

perception of sleep independently predicted prenatal depressive symptoms. In addition, acculturated women reported lower sleep quality throughout pregnancy, though by late pregnancy, non-acculturated women reported equally as low levels. This is in line with other studies that report decreased sleep quality late in pregnancy [19–21], however, the current study points to acculturation as an additional risk factor in the perception of sleep quality in Mexican-Americans during pregnancy.

The mechanism by which acculturation may be affecting sleep quality is not clear. The Latino Health Paradox suggests the longer generations of Mexican immigrants spend in the US, the worse their physical and mental health outcomes [81–83]. These health declines may be due to US lifestyle adoption and subsequent unhealthy behaviors [6] with particular detriment during pregnancy. For example, acculturated Mexican mothers are more likely to engage in alcohol and substance use during pregnancy than those less acculturated [31]. It is possible that acculturation is representative of reporting bias, such that less acculturated women may be less likely to “complain” of sleep problems. However, acculturation is related to adverse objective measures of health during pregnancy [14] and non-pregnancy [6, 84]. This suggests acculturation status and subsequent health behaviors maybe a relevant risk factor for both perceived and objective health outcomes in the perinatal period.

Social support has been suggested as another means by which acculturation may affect health [43, 44]. In the current study, there was a null finding between social support and sleep outcomes when acculturation was in the model. This is significant as acculturation to US culture is often associated with a social network loss [31], even though Mexican culture is considered collectivistic [40]. In addition, previous studies suggest social support buffers against the effects of stress on sleep deficiencies [85, 86]. However, satisfaction with social support was not protective of adverse sleep outcomes in the current study nor associated with acculturation. This is noteworthy as our work suggests that the role of acculturation in sleep outcomes is above and beyond that of social support. However, the measure used, PSSSI [71], is specific to pregnancy-related issues. A global non-pregnancy measure of support may have revealed protective relationships.

Maternal depressive symptoms were negatively associated with sleep quality, but not with acculturation alone. Sleep disturbances contribute to depression during pregnancy [47, 77, 87, 88], however, the role of acculturation in maternal depression is less clear [2, 4, 34]. In the current study, while acculturation was not directly associated with increased depressive symptoms, acculturation had an indirect negative relationship on acculturation via feeling less refreshed upon awakening as a mediator. This suggests sleep quality could be the behavioral mechanism by which acculturation exerts adverse effects on depressive symptoms, however, work addressing causality is needed. In addition, increased time to sleep onset moderated the relationship between increased acculturation and elevated depressive symptoms. Difficulty falling asleep is associated with poor health outcomes [89], insomnia [90, 91] and is a risk factor for maternal depression [92, 93]. Temporal association of these factors should be investigated in a larger sample, however, this study was one of the first to relate acculturation and sleep to elevated depression symptoms in pregnant Mexican-American women.

While this study points to important relationships between acculturation, sleep and maternal depressive symptoms, there are limitations. Sleep self-reports were used rather than objective measures such as actigraphy. However, sleep perceptions are important to daily functioning [69, 78, 79] and highly correlated to objective measures [79]. We also assessed sleep for three days at each phase. Collection of sleep variables for a week or longer is common and might be more sensitive to uncovering relationships between prenatal sleep and depression. As well, acculturation was only measured once during pregnancy. Acculturation is often tied to generation [94] and likely to remain stable during the short time of pregnancy. Yet, as social pressures change, acculturation status may differentially affect sleeping patterns. There are many ways to measure acculturation and there is considerable variability amongst the measures [13, 95]. Future work should investigate aspects of acculturation, such as acculturative stress, discrimination and ethnic identity, to identify which components are detrimental to maternal mental health. It will also be important to collect objective sleep measures as well as potential biomarkers that are related to sleep and depression, i.e. cortisol [11, 96, 97] and inflammatory markers [21, 98, 99]. Lastly, larger samples should be obtained with sufficient power to fully address temporal relationships between variables and path analyses to determine indices of fit. Although the current results are preliminary, important information about the impact of sleep patterns and acculturative status on maternal depression was obtained.

This initial work points to acculturation as a risk factor for women of Mexican descent susceptible to adverse outcomes (depressive symptoms and/or sleep disturbances) during the prenatal period. The current study suggests that together reports of sleep quality and acculturation may provide a means for assessing risk for perinatal outcomes, such as depression, in high risk pregnant Mexican American women. Such work can begin to identify if sleep is the behavioral mechanism by which acculturation-related processes may have negative effects on the mother-child dyad. The current work extends our knowledge to the interaction between cultural risk factors, sleep behavior and maternal mental health in high risk populations with implications for healthy mother/child dyads.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Fig 1.

A) Relationship between acculturation and number of self-reported times up during the night by pregnant Mexican-American women. Pregnant acculturated women reported an overall increasing trajectory of increased nighttime awakenings relative to non-acculturated women during pregnancy ($b=-0.172$, $p=0.026$). B) Relationship between acculturation and self-reports of feeling refreshed upon waking by pregnant Mexican-American women. Self-reports occurred in a 7 point Likert from 1 (extremely tired) to 7 (extremely refreshed). Pregnant acculturated women reported overall lower feelings of being refreshed upon waking ($b=-0.618$, $p=0.006$), however, non-acculturated women showed a significant decrease in sleep quality over pregnancy ($b=0.178$, $p=0.032$). For graphical representation only, dichotomous categories of levels of acculturation levels and cultural values were created via median splits.

Fig 2.

Interaction between acculturation and time to sleep onset in pregnant Mexican-American women. There was an interaction between acculturation and time to sleep onset (minutes to sleep) ($t = 1.94$, $p = 0.05$). More acculturated women who took longer on average during pregnancy to fall asleep reported elevated depressive symptoms relative to those less acculturated. For graphical representation only, dichotomous categories of levels of acculturation and time to sleep onset were created via median splits.

Fig 3.

Unstandardized regression coefficients of the relationship between maternal acculturation and maternal depressive symptoms as mediated by how refreshed a woman felt upon waking. Using the PROCESS computational tool in SPSS 19.0 [75], the proposed mediator, how refreshed a women felt upon waking, is regressed on acculturation to produce a (0.330) and depressive symptoms is regressed on both feeling refreshed and maternal acculturation, which yields b (−2.011) and c' (−0.568), respectively. This indirect effect of $ab=0.664$ means that two mothers who differ by one unit in their reported acculturation status are estimated to differ by 0.644 units in their report of maternal depressive symptoms as a result of the tendency for those who are more acculturated to feel less refreshed upon awakening, which translates into elevated maternal depressive symptoms. This indirect effect (0.663) is statistically different from zero as realized by a 95% confidence interval that does not include zero (0.157–1.388). * $p<0.05$

Table 1**Maternal characteristics**

Characteristic	N	%
Age		
18–20	4	6.7
21–29	31	51.7
30–39	23	38.3
40	2	3.3
Employment status		
Unemployed	21	35.0
Homemaker	20	33.3
Part-time	8	13.3
Full-time	8	13.3
Unknown	3	5.1
Years of education		
<12	33	55.0
12	17	28.4
>12	5	8.3
Unknown	5	8.3
Marital status		
Married	19	31.7
Living together, not married	20	33.3
Not living together, not married	15	25.0
Separated	4	6.7
Unknown	2	3.3
Family Income		
<\$10,000	20	33.3
\$11,000–\$20,000	14	23.3
\$21,000–\$30,000	19	31.7
\$31,000–40,000	1	1.7
>\$41,000	2	3.3
Unknown	4	6.7
Previous Depression		
Yes	7	11.7
No	53	88.3

Table 2

Descriptives of study variables across pregnancy

Variables	Early Pregnancy			Mid pregnancy			Late pregnancy			F	Sig (p)
	Min	Max	Mean	STD	Mean	STD	Mean	STD	Mean		
Acculturation	1	4.667	2.338	1.277							
Depressive symptoms	0	25	8.180	5.969	7.340	4.979	7.270	4.708	1.862	0.166	
Hours slept	3	16.806	9.924	2.419	9.700	2.871	9.041	2.923	1.250	0.292	
Min to sleep	0	116.667	23.490	21.351	20.180	17.616	22.685	28.424	0.348	0.707	
Times up	0	6.333	2.049	1.278	2.029	1.216	2.739	1.516	3.396	0.039	
Feeling Refreshed	0	7	4.070	1.551	4.211	1.563	3.739	1.694	2.206	0.124	
Task Support	0	4	1.238	1.014	1.212	1.251	1.296	1.114	0.108	0.859	
Boyfriend Support	0	4	2.234	0.951	1.967	0.769	2.410	0.856	0.554	0.538	
Medical Support	1	4	2.730	0.481	2.800	0.593	2.840	0.570	0.452	0.638	

Table 3

Pearson correlation coefficients between acculturation, depressive symptoms, sleep outcomes and social support averaged across pregnancy

Variables	1	2	3	4	5	6	7	8
1. Acculturation								
2. Depressive symptoms	0.007							
3. Hours slept	0.20	-0.061						
4. Min to sleep	0.241 [†]	0.112	0.124					
5. Times up	-0.094	0.476 ^{**}	-0.188	0.140				
6. Feeling Refreshed	-0.346 ^{**}	-0.536 [*]	0.120	-0.110	-0.237 [†]			
7. Received Support	0.219	0.117	0.037	-0.256 [*]	-0.025	-0.147		
8. Child's Father Support	0.093	-0.347 [*]	-0.064	-0.054	-0.139	-0.074	0.130	
9. Medical Support	0.658	0.110	-0.047	0.129	0.004	0.069	0.337 ^{**}	0.154

[†] p=0.06,

^{*} p<0.05,

^{**} p<0.01

Table 4

Multiple regression models explaining maternal sleep variables averaged across pregnancy (n=60). **Bold** indicates significant predictor variable, $p < 0.05$.

Outcome Variable	R ²	Variables included	B	SE	t value	Sig (p)
Hours slept	0.03	Maternal age	-0.03	0.05	-0.44	0.66
		Acculturation	-0.12	0.27	-0.45	0.66
		Task support	0.09	0.34	0.27	0.79
		Support from father	-0.31	0.41	0.75	0.46
		Medical support	-0.34	0.74	0.45	0.66
# of times up	0.08	Maternal age	0.008	0.04	0.19	0.85
		Acculturation	-0.30	0.19	-1.62	0.11
		Task support	0.07	0.24	0.30	0.76
		Boyfriend support	0.10	0.31	0.33	0.75
		Medical support	-0.27	0.51	0.52	0.61
Min to sleep	0.15	Maternal age	0.35	0.44	0.80	0.43
		Acculturation	-2.62	2.02	-1.3	0.20
		Task support	-4.13	2.65	-1.56	0.13
		Boyfriend support	-1.82	3.12	-0.58	0.56
		Medical Support	7.64	5.5	1.39	0.17
Feeling refreshed	0.11	Maternal age	-0.009	0.03	-0.29	0.77
		Acculturation	-0.36	0.16	-2.28	0.03
		Task support	0.07	0.2	0.32	0.75
		Boyfriend support	-0.02	0.24	-0.10	0.92
		Medical support	0.17	0.43	0.39	0.70

Table 5

Multiple regression models explaining maternal depressive symptoms averaged across pregnancy (n=60). **Bold** indicates significant predictor variable, $p < 0.05$.

Variables included	R ²	B	SE	t value	Sig (p)	B	SE	t value	Sig (p)
Model 1	0.43								
Maternal age		-0.06	0.088	-0.684	0.497	-0.129	0.094	-1.367	0.178
Previous depression		0.621	1.595	0.390	0.699	0.660	1.584	0.416	0.679
Acculturation		-0.446	0.434	-1.027	0.309	2.806	2.560	1.096	0.279
Hours slept		0.055	0.242	0.228	0.820	0.566	0.569	0.995	0.325
Min to sleep		0.022	0.029	0.757	0.452	-0.090	0.074	-1.213	0.231
Times up		1.241	0.488	2.542	0.014	2.326	0.990	2.350	0.023
Feeling Refreshed		-1.654	0.410	-4.035	<0.001	-0.918	0.894	-1.027	0.309
Model 2	0.49								
Acc*hrs slept						-0.261	0.256	-1.020	0.313
Acc*min						<i>0.061</i>	<i>0.036</i>	<i>1.700</i>	<i>0.056</i>
Acc*times up						-0.473	0.349	-1.356	0.182
Acc*Feeling refreshed						-0.239	0.350	-0.681	0.499
Acc- acculturation									