<div align="center">**Title Page**</div>

**Title**: Oxytocin and Epstein-Barr Virus: Stress biomarkers in the postpartum period among first-time mothers from São Paulo, Brazil

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**Running Head**: Oxytocin and EBV: Stress in the postpartum.

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## Abstract

**Objectives**: The purpose of the study was to examine the relationship between self-reported stress levels among new mothers in São Paulo, Brazil and two biomarkers of stressful experience, oxytocin (OT) and Epstein-Barr Virus antibody level (EBV-ab), with planned pregnancy hypothesised as a moderator of biological response to stressful conditions.

**Methods**: Sixty-three first-time mothers between the ages of 15 and 45 were recruited from neighbourhoods in São Paulo, Brazil. Quantitative and qualitative data were collected longitudinally, bi-weekly between two and 12 weeks postpartum. OT level was assessed from breast milk samples and EBV-ab from blood spot samples. An Interpersonal Satisfaction scale was developed, validated and administered, along with the Cohen Perceived Stress Scale (PSS).

**Results**: In-depth interview data revealed unplanned pregnancy to be a significant stressor in the lives of first-time mothers. In linear regression, OT level was negatively associated with Interpersonal Satisfaction score (p=.022) and positively associated with PSS score (p=.007). When splitting the sample by planned status of the pregnancy, women with an unplanned pregnancy showed a strengthened positive association between OT level and PSS (p=.001; Adj $R^2$=0.44) and negative association with Interpersonal Satisfaction (p=.017; Adj $R^2$=0.15), while no associations existed for women with a planned pregnancy. EBV-ab level was not correlated or associated with stress/satisfaction measures.

**Conclusion**: OT is an effective biomarker in the measurement of stress in the body, and additionally reflects differential experiences with difficult interpersonal circumstances, such as unplanned pregnancy. By contrast, EBV-ab failed to reflect differences in self-reported stress levels between mothers.

**Key Words:** postpartum period; stress; oxytocin; Epstein-Barr-Virus; biocultural; qualitative/quantitative;

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**Introduction**

The early post-partum period can be a particularly stressful time for first-time mothers, which can impact their mental health and parenting practices (Grajeda and Perez-Escamilla, 2002; Rudzik, 2011; Rudzik, 2012). As anthropologists working from a biocultural perspective, we seek to understand women's experiences through their narratives, self-reports and through biomarkers measuring the internal response of the body to somatic challenges, or "stress." The stress process involves exposure to a stressor, a bodily response, and consequences for the individual that often compromise health and well-being. The deployment of biomarkers that serve to quantify stresses within the body have become increasingly common in biological anthropology in recent years. This study examines the relationship between self-reported stress among 63 low-income new mothers in São Paulo, Brazil and two biomarkers of stressful experience, the hormone oxytocin (OT) and Epstein-Barr Virus antibody level (EBV-ab), put in context of wider stressful life experiences. These wider experiences were gleaned through the use of in-depth ethnographic interviews with participants. The combination of narratives, self-reports of stress and biological markers of stress allows us to examine the experience of postpartum women within stressful circumstances. The data presented here were collected as part of larger study of the effects of stress on breastfeeding duration.

Different individuals may respond to the same set of external circumstances or stressors in different ways, meaning that subjective self-reports can provide important information about the impact on the individual. In this study, the biomarkers OT and EBV-ab are used to quantify to bodily response to this subjective perception of stress. OT has been extensively linked to stress, both among lactating women and women in non-reproductive contexts (Taylor, 2006; Tu et al., 2005), while EBV-ab has been

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widely used as a marker of psychological stress  (Glaser et al., 1991; Sorensen et al., 2009).

*Oxytocin and Stress*

OT is an evolutionarily ancient hormone produced by the hypothalamus and strongly identified with its role in labour, delivery, and in the breastfeeding letdown reflex (Evans, 1997) though many additional functions of OT are now being identified (Lippert et al., 2003).  OT is also widely accepted as neuroendocrine factor that initiates, supports, and promotes maternal bonding and other forms of affiliative relationships and behavior in humans and other vertebrates (Kumsta and Heinrichs, 2013).

In early work, the association between stress and OT was consistently found to be negative. Oxytocin release by women during breastfeeding has been shown to dampen the Hypothalamic Pituitary Adrenal (HPA) axis response to stress (Altemus et al., 2001; Amico et al., 1994; Chiodera et al., 1991; Heinrichs et al., 2001; Light et al., 2000), while sufficiently high acute levels of stress in lactating women suppress OT release and the letdown reflex altogether (Newton and Newton, 1967).

Taylor and colleagues have suggested that the anxiolytic effect of OT upon the HPA axis constitutes an alternate pathway to 'fight or flight', which they have dubbed the "tend and befriend" response (Taylor et al., 2000; Taylor, 2006). This response promotes affiliative and social behaviour in response to stressful circumstances (Boutet et al., 2006; Engelmann et al., 2004; Lippert et al., 2003), maximising fitness through care (or 'tending') of offspring  or others during periods of stress.

However, the relationship in which OT suppresses or attenuates stress response is neither straightforward nor universal. Rather, the relationship appears to be deeply influenced by an individual's context and personal circumstances. Taylor

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suggests that the prosocial effect of OT, when met by a lack of reciprocation or a hostile response, may result in an exacerbation of biological or psychological stress response (Taylor, 2006). Engelmann characterises this as the "Janus-faced" nature of OT whereby its effects are dualistic and contingent on personal circumstances (Engelmann et al., 2004).

The positive association between OT and stress has been noted particularly in women (Taylor et al., 2010; Taylor, 2006; Turner et al., 1999). Among college-aged women, higher OT levels were associated with greater interpersonal distress and lack of a primary romantic relationship (Turner et al., 1999). Among post-menopausal women OT was elevated among those who spent less time with their central social contacts and those who rated a relationship with a primary partner as less warm and positive (Taylor et al., 2006). Hoge and colleagues found that those with greater dissatisfaction with social relationships showed higher OT levels (Hoge et al., 2008). These studies show that OT is not related to general psychological distress, but specifically to gaps or problems in important relationships in women's lives (Taylor, 2006). Hence "women with high levels of oxytocin may be especially attuned to social features of the environment and their levels of stress may be especially exacerbated by unsupportive contacts…if affiliative efforts are unrequited, negative, heightened stress responses may occur" (Taylor 2006: 275).

*Epstein - Barr Virus antibodies and Stress*

Biological anthropologists and others have used Epstein - Barr virus (EBV) as a measure of stress (McDade, 2002; Panter-Brick et al., 2008; Worthman and Panter-Brick, 2008). EBV is a ubiquitous herpes virus, present in latent form in 80-100% of individuals globally (Worthman and Panter-Brick, 2008). Under conditions of stress, the virus reactivates causing an antibody response to the infection. The level of

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antibody has been used as a biological measure of the degree of stress experienced by an individual (Glaser et al., 1991; Sorensen et al., 2009), although not all studies have found the relationship between stress measures and EBV borne out (Christian et al., 2012; Glaser et al., 1999; McClure et al., 2010; Worthman and Panter-Brick, 2008).

*Unplanned Pregnancy and stress*

Compared with planned pregnancy unplanned pregnancy has negative associations and consequences, including increased experience of maternal stress in many contexts (Bouchard, 2005; McCrory and McNally, 2013). Among young Brazilian women, unplanned pregnancy is often associated with stigma (Sax, 2010), decreased quality of life (Campos et al., 2012) and increased stress (dos Santos and Schor, 2003). In the present group of Brazilian women, those with unplanned pregnancies showed differential parenting practice to those who had planned the pregnancy, with a much increased risk of early supplementation of the infant diet (Rudzik, 2012).

We hypothesise that both OT and EBV-ab will demonstrate a positive relationship with women's self-reported stress levels. Planned pregnancy is proposed as a moderator of biological stress response to stressful conditions because of the salience of unplanned pregnancy within women's narratives of stressful experiences in their lives. Unplanned pregnancy has previously been identified as particularly important in shaping women's responses to pregnancy and breastfeeding among this group of participants (Rudzik, 2012).

**Methods**

Sixty-five women between the ages of 15 and 45 (22.2 ±5.5) were recruited as part of a larger study examining the effect of stressful life situations on breastfeeding duration and breastfeeding status in São Paulo, Brazil (Rudzik, 2012). The study was

carried out in six low-income neighbourhoods in the eastern zone of the city, between January 2006 and February 2007.  Ethical approval for the study was obtained from the University of Massachusetts Amherst Institutional Review Board, as well as the Ethics Review Board for the Santa Marcelina Foundation, and all participants provided written informed consent. Participants were enrolled through neighbourhood health clinics run by the Santa Marcelina Foundation Family Health Program, which provides free care to the population through 58 neighbourhood health clinics and three hospitals. All participants were first-time mothers.

*Research Design*

Participants were interviewed once pre-partum, to obtain baseline demographic information and breastfeeding intention data. After the birth, participants were interviewed on a bi-weekly schedule, between two and 12 weeks post-partum, using an in-depth and conversational method, with interviews lasting between 30 and 75 minutes (Rudzik 2011, Rudzik 2012). Stress scale instruments were administered during the interviews. All interviews were conducted and all scales were administered in Portuguese by the same investigator (A.R.). Interviews were also digitally recorded. Of the 65 participants recruited, 61 completed the full 12 week study; two participants were lost to follow-up after birth and two participants withdrew from the study, one as a result of relocation away from the city. Among the 63 women interviewed post-partum, the number of post-partum interviews completed per participant ranged from two to six; 68% completed 6 interviews; 21% completed 5; 5% completed 4, 5% completed 3, and 2% completed 2 interviews.

*Self-reported stress scales*

Three instruments were used to measure participants' experiences of stress. The first was a context-specific scale constructed for this study, which was developed

through pilot interviews and discussions with first-time mothers from the same neighbourhoods prior to data collection beginning. The scale was designed to evaluate participants' levels of satisfaction in eight domains of daily life which had been identified as particularly salient among first-time post-partum mothers. At each interview, participants were asked to rate their satisfaction on a scale from one to five (one=low satisfaction, five=high satisfaction) for each domain. The eight domains included three interpersonal domains (happiness at home, relationship with father of the baby, and relationship with family), two external (finances and sleep) and three personal (capacity to cope, well-being, and self-esteem). Validation of the new scale is reported elsewhere (Rudzik, 2012). Additionally, at each interview participants rated their overall stress level on a scale from one (low) to ten (high). A sub-sample of the women (n=34) completed the Cohen Perceived Stress Scale (PSS) a widely used self-reported measure of global stress (Cohen et al., 1983) which has been validated for use in Brazil (Luft et al., 2007; Reis et al., 2010). A mean score for each of the three stress scales was calculated for each participant.

*Sample Collection*

Biological samples were collected at each post-partum interview. Breast milk samples were collected for analysis of OT level, while blood-spot samples were collected for analysis of Epstein-Barr Virus antibody level. Breast milk was selected for OT analysis in preference to salivary, serum or blood spot samples, due to the hormone's stability in milk (Takeda et al., 1986) and the practicality of milk expression. The reliability and physiological relevance of salivary OT remains in question (Horvat-Gordon et al., 2005), while drawing and storing whole blood in this field setting was impracticable. Participants expressed and collected a milk sample between 8am and 6pm on the day of each interview; samples were collected between

these hours to avoid registering the nocturnal circadian increase of OT (Forsling, 2000). In most cases participants expressed the sample during the interview. Samples collected earlier in the day were stored in the household refrigerator until the interview. All samples were transported in an ice-water bath in an insulated container, and were then stored frozen. A total of 300 samples of breast milk were collected.

Blood spot samples were collected by the investigator, by piercing the participant's finger using an automatic single-use retractable lancet, following cleansing with an alcohol swab. Five drops of blood were collected on specialised filter paper. Sample cards were allowed to dry and then stored frozen. Blood spots were preferred over whole blood due to the ease of collection and the stability of the sample and ease of transport once dry (McDade et al., 2000). Two participants declined to provide blood samples, one for religious reasons and one due to discomfort from the lancet. One participant had inadequate blood flow for sample analysis. A total of 348 samples were collected.

*Analysis of biological samples*

Upon completion of the study, breast milk and blood spot samples were shipped to the United States on dry ice. Milk samples were analysed for OT levels at the Reproductive Ecology Laboratory in the Department of Anthropology at Yale University according to the validated protocol for human breast milk provided by the assay kit manufacturer (by A.B. and R.B.; Assay Designs Kit Ref #: 900-153). Due to the complexity of the assay protocol involving the removal of the solid fraction of the milk, of the 300 samples analysed, 171 samples from 60 participants provided reliable OT results (based on co-efficient of variation). Using hierarchical linear modelling, it was determined that no variability existed through time for participants' OT values. Therefore, a mean OT value was calculated for each participant, based on the

available reliable OT values; unreliable OT values were discarded prior to calculation of mean OT value. Mean OT scores were then log transformed to obtain a normal distribution prior to analysis..

Blood spot samples were analysed for EBV-ab at the Laboratory for Human Biology at Northwestern University (by A.R.) following lab protocols (DiaSorin Inc. Kit Ref #: P001606A). Of 348 blood spots, 312 yielded usable EBV-ab results (based on co-efficient of variation). One participant's samples indicated that she was seronegative for EBV infection. C-Reactive Protein (CRP) values were obtained for each blood-spot sample to rule out the possibility of active infection, as active infection makes EBV-ab values inaccurate for the quantification of stress (McDade et al., 2004). Three blood spot samples had CRP values that indicated infection (>9.2). Using HLM, no within-participant variability through time was found for EBV-ab, so a mean value was calculated for each participant from their EBV-ab levels. The EBV-ab values obtained from the three blood spot samples with high CRP were excluded from the calculation of the respective participants' mean EBV-ab levels. Mean scores for EBV-ab were log-transformed to obtain a normal distribution for analysis. Relationships between self-reported stress scales and biological stress measures were examined using SPSS 19.0 for Windows.

*Analysis of Ethnographic Data*

The in-depth interviews were translated and transcribed from the digital recordings (by A.R.). Themes related to unplanned pregnancy emerged and were coded manually from interview transcripts. All names assigned to participants' quotes are pseudonyms.

**Results**

*Ethnographic Analysis*

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Unplanned pregnancy was found to be an important source of stress in the lives of many, though not all, of the women who had not planned to become pregnant. Participants were asked explicitly whether their pregnancy was "unplanned", though the distinction between "unplanned" and "unwanted" pregnancy was not systematically explored. However, through the course of the multiple interviews it emerge that for all but a few participants the experience of an unplanned pregnancy was a negative one. These "reluctant mothers"—those who did not desire motherhood and were not pleased when pregnancy occurred— took on the role of mother in opposition to, rather than in fulfillment of their own desires. Some women felt such resistance to their pregnancy that they were willing to deal with the social and physical ramifications of a clandestine termination of the pregnancy, had they not been prevented by family members. Amaracleia, 18, said "I wanted to get rid of it because the father was going to leave me with a mouth to feed. I didn't ….because my mother wouldn't let me. I didn't want to get pregnant, but it happened.  What're you going to do?" Likewise, Claudinha, 15, reported that through the first six months of pregnancy she "kept saying 'if I am [pregnant] I'll get rid of it, if I am I'll get rid of it.'" Speaking of her unplanned pregnancy, she stated "I was so ashamed.  I wouldn't even come out to the gate.  I didn't want to talk to anyone, I didn't go out. I stayed locked in the house…it was hard for me to accept it". Depression and feelings of loss also accompanied the experience of unplanned pregnancy for women in the study. Mônica, 21, felt:

> "sad, you know? Especially at the end of the pregnancy. I was really teary, I cried a lot. After the birth because I was in that crisis, I wasn't close to him. When I gave birth to him they put him next to me, I just watched him. I watched him. After I got that fever, I didn't even watch him."

Following the birth of the baby, the ambivalence of these "reluctant" mothers' regarding motherhood persisted. The women expressed difficulty in coming to terms

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with their new motherly role. Eva, 16, reported that since becoming a mother she feels "imprisoned, alone, you know? Like, as if there was an emptiness inside me." Marina, 24, agreed, saying "Your liberty…You lose it completely. Completely. You don't have it." These responses characterised the experience of unplanned pregnancy as an important stressor in these women's lives, supporting a possible moderating role with regard to OT levels experienced by post-partum women.

*Sample Characteristics and Bi-variate Analysis*

Frequencies and descriptive statistics for demographic variables, self-report scales and biological variables are presented in Table 1, for the complete sample and, separately, for the sub-sample of women with a PSS score.

[Table 1 about here]

Statistical associations between OT and EBV-ab, stress scales and all demographic variables were examined using t-tests/ANOVA for categorical variables and correlation analysis for continuous variables (Table 2). No associations existed between OT or EBV-ab and any of the demographic variables. OT level was significantly positively correlated with PSS score (n=34; Pearson=0.456, p=0.007) and score on the 10-point stress scale (n=58; Pearson=.269, p=0.041) and negatively correlated with score on the Interpersonal Satisfaction scale (n=58; Pearson=-0.303, p=0.022). EBV-ab was not correlated with score on the 10-point scale score, the Interpersonal Satisfaction scale or the PSS. OT level and EBV-ab level were not correlated (n=57; Pearson=0.131, p=0.330).

[Table 2 about here]

*Regression analysis*

Separate linear regression models were fitted to examine the association between mean OT level and Interpersonal Satisfaction Scale score and PSS score.

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Results are shown in Table 3. Age in years was entered into the model but was not significant and did not alter the relationship between OT and the self-reported scores. Mean OT level was significantly negatively associated with Interpersonal Satisfaction score (n=58, $F$=5.549, p=.022; Adj $R^2$=.092) and significantly positively associated with the 10-point stress scale score (n=58, $F$=4.373, p=.041; Adj $R^2$=.056) and PSS score (n=34, $F$=8.411, p=.007; Adj $R^2$=.183).

[Table 3 about here]

Figure 1 shows the distribution of PSS score by OT level.

[Figure 1 about here]

*Unplanned pregnancy as a moderator of the association between stress and milk OT*

Based on the association in the existing literature between difficult interpersonal circumstances and women's OT levels outlined above (Taylor 2006; Turner 1999), and the ethnographic data drawn from the participants, separate models were constructed for women who had planned their pregnancy and women who had not (Table 4). This revealed that for women with planned pregnancies no relationship existed between Interpersonal Satisfaction score or PSS score and OT level. By contrast, for women who had *not* planned their pregnancy, the relationships between mean OT level and Interpersonal Satisfaction score (n=39, $F$=6.321, p=.017; Adj $R^2$=0.15) and mean OT level and 10-point stress score (n=38, $F$=6.702, p=.014; Adj $R^2$=0.13) were considerably stronger. Likewise, in the sub-sample the relationship between mean OT level and PSS was significantly stronger when only women with unplanned pregnancies were considered (n=20, $F$ =15.861, p=.001; Adj $R^2$=0.44).

[Table 4 about here]

The difference in association of  PSS scores with OT level for women with unplanned and planned pregnancies is shown in Figure 2.

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[Figure 2 about here]

**Discussion**

In this study, we examine the ability of biomarkers to reflect women's reports of experiences of stress in their lives. This is the first study to examine the relationship between OT, EBV-ab and social stress measures, including the widely used Cohen PSS and a context-specific, validated Interpersonal Satisfaction scale. In an additional layer of analysis, we also examine the relationship between these variables placed in the wider context of narratives drawn from in-depth interviews with the participants. These interviews point to an important role for unplanned pregnancy in shaping women's experience of stress in the post-partum.

Previous work with breastfeeding women has shown an inverse relationship between stress and OT. The release of OT in the letdown reflex is suppressed in the face of acute stressors such as mental arithmetic and pain stimuli (Newton and Newton, 1948; Ueda et al., 1994), while at the same time release of OT during nursing can reduce the stress response in breastfeeding women (Altemus et al., 1995). Outside the context of breastfeeding, Taylor and colleagues (Taylor et al., 2006), Turner and colleagues (Turner et al., 1999) and others have demonstrated that OT does not always show this inverse relationship with stress, but rather that women with higher levels of OT are those who experience gaps in their interpersonal relationships.

The results of the present study support these previous findings. Among the participants in this study higher mean OT level is associated with higher general stress (PSS score) and lower Interpersonal Satisfaction score. These results support the idea that OT no longer serves an anxiolytic function in a context of negative or unsatisfactory interpersonal relationships. At the same time, no association is found in the present study between OT level and dissatisfaction with other domains of life that

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are important during the post-partum period (Well-Being, Self-Esteem, Personal Capacity, Financial Situation, Sleep). Again, this bears out findings from previous studies that OT levels rise in response specifically to gaps in or dissatisfaction with interpersonal relationships, rather than in response to generally high stress (Taylor, 2006).

In an additional dimension to our analysis, in-depth interview data and qualitative analyses drawn from this study reveal that unplanned pregnancy is a marker of stressful interpersonal circumstances surrounding the woman's experience of mothering among this group of women. Quantitative analyses support this, demonstrating that associations between PSS, Interpersonal Satisfaction and OT strengthen greatly when analysis is split based on whether women experienced an unplanned pregnancy. Having planned the pregnancy therefore moderates the relationship between self-reported stress and the biological response of OT to stress.

The results of this study indicate that OT may be an effective biomarker in the measurement of stress in the body, and that OT levels additionally appear to reflect the differential experiences of difficult interpersonal circumstances, in this case that planned pregnancy has a buffering effect against stress. By contrast, in this study EBV-ab did not reflect differences in self-reported stress levels among breastfeeding new mothers. These results are similar to those of Christian and colleagues (2010) who found that PSS was not associated with EBV among pregnant and postpartum women.

The study is not without its limitations. Although longitudinal data collection and multiple interviews took place, the sample from which the data are drawn is relatively small, being based on 63 women. Additionally, the participants were drawn from six socio-economically deprived neighbourhoods of São Paulo. These women

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may have experienced a more stressful post-partum period than more affluent women and therefore results may not be generalizable to a larger population, though results from other studies and contexts appear to indicate a similar OT response to interpersonal stress among a variety of populations of women (Taylor et al., 2006; Turner et al., 1999). Additionally, hormonal values from OT are drawn from breast milk samples, rather than the more standard serum, though we feel that the practicality and improved stability of OT in milk balances out this disadvantage.

This study is one of the first to investigate the experiences of stress in the post-partum among a group of women in an industrialising context using both qualitative and quantitative methods. In addition, the study offers an important contribution to the understanding of biomarkers as bodily traces of experience, drawing together biological, quantitative and ethnographic analysis in a truly biocultural anthropological analysis. While supporting previous findings from the psychological literature regarding the importance of interpersonal experience in shaping the biological response to stress that is captured by OT levels in women (Taylor et al., 2010) this approach moves beyond a quantitative analysis alone, to create a nexus between the social and biological, such that we can understand more fully women's experiences of stress in the post-partum.

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Table 1: Sample characteristics for complete sample and for sub-sample with Cohen PSS score

| Variable | Sample Characteristics n=61 | Sub-sample Characteristics n=34 | Sample/sub-sample differences (p=) |
|---|---|---|---|
| Age (mean ±s.d.) | 22.0 ±5.4 | 21.6 ±5.1 | .384 |
| Education | | | |
|    Incomplete high school or less | 22 (36.1%) | 11 (32.4%) | .840 |
|    Complete high school or more | 34 (55.7%) | 20 (58.8%) | |
|    In high school | 5 (8.2%) | 3 (8.8%) | |
| Employed | | | |
|    No | 44 (69.2%) | 23 (67.6%) | .772 |
|    Yes | 17 (30.8%) | 11 (32.4%) | |
| Monthly household income (1 Real≈0.50 USD) | R$767 ±643 (US$383.50 ±321.50) | R$855 ±684 (US$427.50 ±342) | .261 |
| Relationship Status | | | |
|    Single | 23 (36.9%) | 13 (38.2%) | .954 |
|    "Together" | 13 (23.1%) | 8 (23.5%) | |
|    Married | 25 (40.0%) | 13 (38.2%) | |
| Participant living situation | 21 (34.4%) | | |
|    With partner only | 17 (27.9%) | 12 (35.3%) | .989 |
|    Mother's household without partner | 14 (23.0%) | 10 (29.4%) | |
|    Mother's household with partner | 7 (11.5%) | 7 (20.6%) | |
|    Mother-in-law's household with partner | 2 (3.3%) | 4 (11.8%) | |
|    Alone | | 1 (2.9%) | |
| Planned Pregnancy? | | | |
|    No | 41 (67.7%) | 20 (58.8%) | .109 |
|    Yes | 20 (32.3%) | 14 (41.2%) | |
| Delivery Type | | | |
|    Vaginal delivery | 37 (60.7%) | 21 (61.8%) | .799 |
|    Caesarean or forceps delivery | 24 (39.3%) | 13 (38.2%) | |
| Infant Sex | | | |
|    Girl | 35 (57.4%) | 20 (58.8%) | .572 |
|    Boy | 26 (42.6%) | 14 (41.2%) | |
| Interpersonal satisfaction score (mean ±s.d.) | 12.9 ±1.7 | 13.2 ±1.8 | .245 |
| 10-point stress scale score (mean ±s.d.) | 4.9 ±2.2 | 4.8 ±2.0 | .573 |
| mean EBV-ab level | 83.7 ±43.8 | 78.6 ±41.1 | .335 |

Table 2: Association of bio-markers with demographic variables and stress scale scores

| Variable | n= | Association with mean OT level (log) (p=) | n= | Association with EBV level (log) (p=) |
|---|---|---|---|---|
| Age | 60 | .585 | 60 | .837 |
| Education | 60 | .298 | 60 | .275 |
| Employed | 60 | .916 | 60 | .429 |
| Monthly household income (1 Real≈0.50 USD) | 47 | .117 | 48 | .955 |
| Relationship Status | 60 | .283 | 60 | .675 |
| Participant living situation | 60 | .071 | 60 | .415 |
| Planned Pregnancy? | 60 | .209 | 60 | .095 |
| Delivery Type | 60 | .854 | 60 | .522 |
| Infant Sex | 60 | .938 | 60 | .789 |
| Interpersonal satisfaction score | 58 | .022* | 58 | .223 |
| 10-point stress scale score | 58 | .041* | 58 | .127 |
| Cohen Perceived Stress Score | 34 | .007* | 33 | .367 |

* significant at .05 level

Table 3: Linear regression associations between mean OT level (log) and stress/satisfaction scores

| Scale Name | n= | B | 95% CI of B | | β | Adj R$^2$ | F | Sig. |
|---|---|---|---|---|---|---|---|---|
| | | | Lower | Upper | | | | |
| Interpersonal Satisfaction | 58 | -.030 | -.056 | -.005 | -.303 | .092 | 5.549 | .022 |
| 10-point stress scale | 58 | .023 | .001 | .045 | .269 | .056 | 4.373 | .041 |
| Cohen PSS | 34 | .010 | .003 | .018 | .456 | .183 | 8.411 | .007 |

Table 4: Linear regression models of mean OT level (log) on stress/satisfaction scores, for women with unplanned and planned pregnancy

| Scale Name | n= | Planned Pregnancy? | B | 95% CI of B | | β | Adj $R^2$ | *F* | Sig. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Lower | Upper | | | | |
| Interpersonal Scale | 39 | No | 2.355 | -.051 | -.005 | -.386 | .149 | 6.321 | .017 |
| | 19 | Yes | -.013 | -.099 | .072 | -.080 | .006 | .109 | .746 |
| 10-pt stress scale | 38 | No | .025 | .005 | .045 | .396 | .134 | 6.702 | .014 |
| | 20 | Yes | .012 | -.049 | .071 | .095 | -.046 | .165 | .689 |
| Cohen PSS | 20 | No | .013 | .006 | .020 | .684 | .439 | 15.861 | .001 |
| | 14 | Yes | .009 | -.006 | .024 | .346 | .120 | 1.631 | .226 |

Figure 1: Distribution of individuals by Cohen PSS score and mean OT level (log).
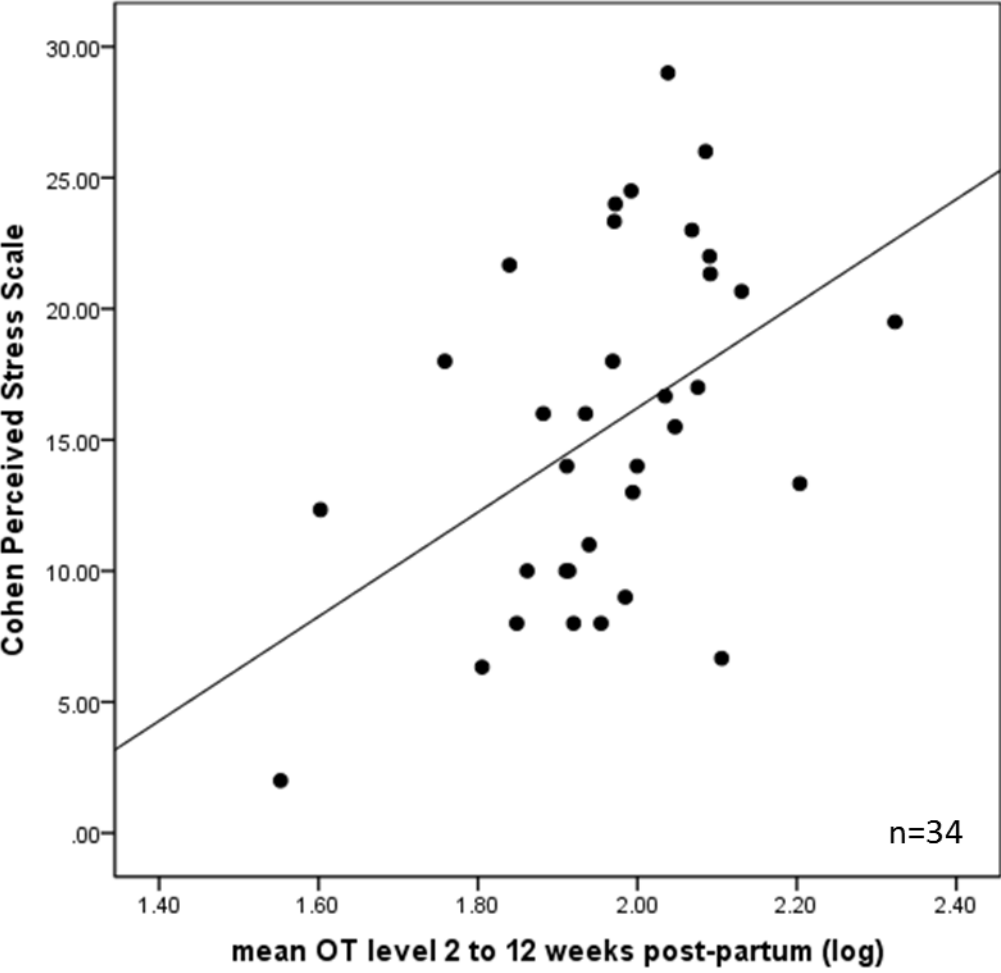
Figure 2: Difference in association of Cohen PSS scores with mean OT level (log) for women with unplanned and planned pregnancies