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Associations between maternal mental health and well-being and physical activity and sedentary behavior in children

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Abstract

Objective—This study assessed whether aspects of maternal mental health and well-being were associated with objective monitor-based measures of child physical activity (PA) and sedentary behavior (SB) and the extent to which household structure (i.e., single- vs. multigenerational/dual-parent) and maternal employment (i.e., full-time vs not full-time) moderated those associations.

Method—Dyads (N=191) of mothers and their 8–12 year old children participated in the baseline wave of the Mother's and Their Children's Health study. Mothers ($M_{\text{age}}=40.9$ years [$SD=6.1$]; 49% Hispanic) completed a battery of questionnaires to assess maternal mental health and well-being (i.e., self-esteem, life satisfaction, depressive symptoms, anxiety, perceived stress, parenting stress, financial stress and life events stress). Children ($M_{\text{age}}=9.6$ years [$SD=0.9$]; 54% Hispanic; 51% female) wore an accelerometer across one week during waking hours to objectively measure moderate-to-vigorous PA (MVPA) and SB.

Results—In single-parent families ($n=47$), but not multigenerational/dual-parent families, mothers' parenting stress was negatively associated with child MVPA ($\beta=-0.34$, $p=0.02$). In corrected analyses, all other aspects maternal mental health and well-being were not related to children's activity patterns.

Conclusion—Parenting stress was the only maternal mental health variable associated with objective monitor-based measures of child PA after adjusting for multiple comparisons. Results indicated weaker associations between maternal mental health and well-being and child MVPA and SB than previously identified using subjective measures of behavior. Study findings support the need to utilize objective measurements of child activity patterns to minimize potential confounding due to maternal report in evaluating child PA and SB.

Keywords

mother; child; dyads; moderate- to vigorous-intensity physical activity; sitting; activity patterns; weight-related behaviors

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Recent estimates suggest that approximately three-quarters of U.S. children age 6–15 years fail to meet the Federal Physical Activity Guidelines for Americans and American Academy of Pediatrics recommendation of at least 60 minutes of moderate-to-vigorous physical activity (MVPA) per day (1–3). Additionally, nearly half of U.S. children age 6–11 years engage in two or more hours of screen time per day – a level which exceeds the recommendation of the American Academy of Pediatrics (2). Insufficient physical activity (PA) and excessive sedentary behavior (SB) among children represent significant problems because health behavior patterns in childhood often persist into adulthood and can lead to increased risk for a number of health conditions (e.g., overweight/obesity and type II diabetes) (3). Parents are integral in their children’s engagement in PA and SB because they not only serve as role models but also as gate-keepers to children’s PA and SB. However, intervention efforts involving parents have failed to consistently improve children’s activity patterns (4) suggesting that there may be other salient factors that need to be better understood to inform interventions to modify children’s PA and SB.

One such factor that may influence children’s PA and SB is parental mental health and well-being. Poor mental health and well-being may lead to comprised parenting practices such as failure to enforce rules limiting child’s screen time, which may contribute to unhealthy behaviors in children (5). Maternal mental health and well-being (i.e., self-esteem, life satisfaction, depressive symptoms, anxiety, perceived stress, parenting stress, financial stress and life events stress) may be particularly important because mothers serve as the primary caregiver in most households (6). Aspects of maternal mental health have been previously linked with child PA and SB. High levels of maternal depressive symptoms, perceived stress, and domain-specific stress such as financial stress and parenting stress have typically been found to be associated with lower levels of PA and higher levels of SB in children, both in cross-sectional and longitudinal studies (7–12). However, relationships between children’s PA and SB with other aspects of maternal mental health and well-being such as anxiety, self-esteem, and life satisfaction have received limited attention in the literature (13). This is an important gap because anxiety is one of the most common mental health problems in the overall population (14). Self-esteem and life satisfaction are not mental illness conditions per se, but markers of psychological strengths that could contribute as buffers to mental illness and promote well-being and thriving (15). Thus, to promote a nuanced understanding of the association of maternal mental health, well-being, and child activity patterns, this study offers a comprehensive assessment that addresses diverse domains of maternal mental health and well-being.

A common characteristic of studies investigating associations between maternal mental health and well-being and child activity patterns is a reliance on maternal report of child PA and SB. To our knowledge, no prior studies have investigated associations between maternal mental health and well-being and child activity patterns using an objective device-based measure such as accelerometers. The majority of previous studies have used measures which ask mothers to report on how much PA and SB is performed by their child (8,9,13) and seldom have children reported on their own behavior (7,10,11). This represents a major limitation of previous work because of the inherent risk of response biases in subjective measures of behavior as a possible means of inflating associations (16). For example, some mothers may have high social desirability and may minimize their own mental health

problems and overstate their children's activity whereas other mothers may be symptom exaggerators and extreme responders and may thus report worse mental health and less activity than is true (e.g., 17,18).

Furthermore, variability in findings pertaining to the associations of various aspects of maternal mental health and well-being and child PA and SB (e.g., 12,13) may result from subgroups of mothers and children that are differentially affected by this association. Household structure (i.e., single-parent vs. dual-parent/multigenerational household) and maternal employment status (i.e., working full-time vs. not working full-time) may adversely impact mothers' mental health and well-being as well as their ability to enforce positive parenting practices such as placing limits on child SB or monitoring of children's PA or SB (19,20). In dual-parent or multigenerational households, as opposed to single-parent households, significant others or family members may be able to buffer the effect of poor maternal mental health or well-being on child activity patterns (20). While results are mixed regarding differences in PA levels by household structure and maternal employment status (21), there seem to be consistent findings regarding SB (19,22). Children of single-parent and working mothers tend to engage in more SB compared to their respective counterparts (19,22). Previous research has not investigated household structure and maternal employment status as potential moderators of the associations between maternal mental health and well-being and child activity patterns. Such moderators may explain null and inconsistent results in the research literature.

This study addresses limitations of previous work by examining a broader constellation of maternal mental health and well-being variables, employing an objective monitor-based measure of children's PA and SB, and investigating the moderating role of demographic factors. The primary objective of this study was to assess whether an array of global (i.e., self-esteem, life satisfaction, depressive symptoms, anxiety and perceived stress) and domain-specific (i.e., parenting stress, financial stress and life events stress) indicators of maternal mental health and well-being are associated with objective monitor-based measures of child PA and SB. The second objective of this study was to examine the extent to which household structure and maternal employment status moderated associations between aspects of maternal mental health and well-being and child activity patterns.

Methods

Participants

This study used data from the first wave of the Mothers' and Their Children's Health (MATCH) study. MATCH is a multi-wave longitudinal investigation of the influence of maternal parenting factors on obesity risk in their 8–12 year old children (23). Participants were recruited from urban schools in the greater Los Angeles area. Inclusion criteria were: child in the third to fifth grade, 50% of child's custody is with the mother, and both mother and child are able to read English or Spanish. Exclusion criteria for mother or child were: currently taking medications for thyroid function or psychological conditions, health issues that limit PA, enrolled in special education programs, currently using oral or inhalant corticosteroids for asthma, pregnancy, child classified as underweight, or mothers who

worked 2 weekday evenings per week or >8 hours on any weekend day (to ensure mothers were able to spend adequate time with their child while outside of school).

Procedures

Baseline data collected included questionnaires regarding aspects of maternal mental health and demographic information and anthropometric measurements in mother-child dyads. Over the course of the following week, mother-child dyads both wore an accelerometer. All study procedures were approved by the local Institutional Review Board.

Measures

Maternal mental health—*Depression* was assessed using the 20-item Center for Epidemiologic Studies Depression Scale (24). Participants were asked how often they felt a particular way in the past week (e.g., “I felt that I could not shake off the blues even with the help of friends and family”) on a scale ranging from 0 (rarely or none of the time) to 3 (most or all of the time). Responses displayed a high level of internal consistency ($\alpha = .92$) and were summed. *Anxiety* was assessed using the 20-item State-Trait Anxiety Inventory, a validated measure of anxiety in adults (25). Participants were asked to indicate how often they felt a particular way in the past week (e.g., “I felt inadequate”) on a scale ranging from 1 (almost never) to 4 (almost always). Responses were internally consistent ($\alpha = .92$) and summed to create a composite score.

Perceived Stress was assessed using the validated, 10-item Cohen’s Perceived Stress Scale (26). Participants were asked to reflect over the past month (i.e., “In the last month, how often have you felt that you were unable to control the important things in your life?”). Participants provided ratings for each item using a 0 (never) to 3 (very often) scale. Responses to the 10-item scale were internally consistent ($\alpha = .83$) and summed. *Parenting stress* was assessed using the 18-item Parenting Stress Scale (27). Participants were asked to reflect on their experience as a parent over the past month (i.e., “Having child(ren) has meant having too few choices and too little control over my life”). Participants provided ratings for each item using a 1 (strongly disagree) to 5 (strongly agree) scale. Responses were internally consistent ($\alpha = .83$) and were summed to create a composite score. *Financial stress* was assessed using the 7-item Financial Stress Scale (28). Participants were asked to reflect on their experience as a parent over the past month (e.g., “Are you able to afford a home suitable for yourself/your family?”). Participants provided ratings for each item using a 1 (definitely not) to 7 (definitely yes) scale. Responses were internally consistent ($\alpha = .93$). Responses were reverse coded and averaged so that higher scores indicated more financial stress. *Life events stress* was assessed using the 13-item Life Events Stress Scale (29). Participants indicated if specific life events had happened to them within the past six months (e.g., marital separation or divorce; change in residence). Responses were weighted according to standard scoring procedures. Weighted values were summed so that higher values indicated greater stress from life events.

Maternal well-being—*Self-esteem* was assessed using the Rosenberg Self-Esteem Scale, a 10-item validated measure of self-esteem (30). Participants reflected on their general feelings about themselves and provide ratings of agreement with each item (e.g., “I feel that

I have a number of good qualities”) on a scale ranging from 1 (strongly disagree) and 4 (strongly agree). Responses were internally consistent ($\alpha = .87$) and summed to create a composite score. *Life Satisfaction* was assessed using the validated, five-item Satisfaction with Life Scale (31). Participants provided ratings of their agreement with each item (e.g., “In most ways my life is close to ideal”) on a scale ranging from 1 (strongly disagree) to 7 (strongly agree). Responses to the items were internally consistent ($\alpha = .89$). Therefore, responses were summed.

Child physical activity and sedentary behavior—PA and SB were objectively-measured in children via either an Actigraph GT2M or GT3X accelerometer-based activity monitor (Firmware v06.02.00; Actigraph, Pensacola, FL). Children wore the accelerometer on their right hip during all waking hours (except when bathing or swimming) for the 7-day duration of the wave. PA was operationalized as the average daily minutes of MVPA. The threshold for MVPA (4 METs) was age-adjusted using the criteria from Trost et al. (32) for children between the ages of 8 and 12. SB was operationalized as the average minutes of sedentary behavior (i.e., < 100 counts per minute) per hour of wear time (33). SB was adjusted for the duration of valid wear time in order to account for differences in SB as a result of more valid wear time. Data were screened to include valid days. A valid day consisted of 10 hours of valid wear time (34). Periods of 60 minutes of consecutive zero activity counts were considered non-wear.

Demographic factors—Mothers completed paper questionnaires assessing age, household type, marital status, maternal employment status, maternal education level, annual household income (some participants [$n = 73$] were asked about their income in 2012 which occurred one to two years prior to participation in the study), as well as race/ethnicity for themselves and their child. Children reported their age and sex.

Height and weight—Height and weight were measured in duplicate using an electronically calibrated digital scale and professional stadiometer, and were used to calculate body mass index (BMI; kg/m^2) for mothers and CDC age- and sex- specific BMI percentiles (35) for children.

Data preparation—Because MVPA data were significantly skewed, they were log transformed prior to conducting correlations and regression analyses. Mother and child age and BMI were grand-mean centered. Responses were dichotomized for (1) mother and child ethnicity (Hispanic/not Hispanic), (2) mother education level (college or higher/no college), (3) mother marital status (married/not married), (4) mother employment status (working full-time/not working full-time), and (5) household structure (single-parent household/dual-parent or multigenerational household). Finally, maternal mental health and well-being and child activity pattern variables were standardized to facilitate the interpretation of results from the linear regressions.

Data Analysis

Linear regression modeling was conducted using SPSS 22 to examine associations between aspects of maternal mental health and well-being and child PA and SB. To test the first

objective, we ran separate linear regression models with each aspect of maternal mental health and well-being predicting either child PA or SB. Demographic characteristics of mother and child were screened as potential covariates using single-level linear regression models to determine if there were any significant associations ($p < 0.05$) with child PA or SB. Only significant predictors of child PA (i.e., child age and sex) and SB (i.e., child age, ethnicity, and accelerometer wear time) were included as covariates in the final regression models.

To test the second objective, we conducted separate linear regression models that included each aspect of maternal mental health and well-being as well as an interaction between the aspect of maternal mental health and either household type (single-parent household/dual-parent or multigenerational household) or maternal employment status (working full-time/not working full-time) predicting either child PA or SB.

Adjustments for multiple comparisons in models testing study objectives were conducted using the Benjamini-Hochberg Procedure which decreases the false discovery rate (i.e., Type I error) (36).

Results

Participant Characteristics

A total of 202 mother-child dyads completed the first assessment wave of the MATCH study. Information about the demographic characteristics of mothers ($M_{\text{age}} = 40.9$ years [$SD = 6.1$]; 49% Hispanic) and children ($M_{\text{age}} = 9.6$ years [$SD = 0.9$]; 54% Hispanic; 51% female) can be found in Table 1 and Table 2, respectively. Eleven children did not have any valid days of accelerometer data and those mother-child dyads were excluded in subsequent analyses. Included versus excluded dyads did not differ on any key demographic characteristics listed in Tables 1 or 2.

Descriptive Statistics

Descriptive statistics for measures of maternal mental health and well-being, and child PA and SB are shown in Table 1 and Table 2, respectively. On average, mothers reported moderate-to-high levels of self-esteem ($M = 32.9$ on a 10 to 40 scale) and life satisfaction ($M = 24.6$ on a 7 to 35 scale). Conversely, on average, mothers reported relatively low-to-moderate levels of depressive symptoms ($M = 7.9$ on a 0 to 60 scale), anxiety ($M = 37.2$ on a 20 to 80 scale), perceived stress ($M = 14.7$ on a 0 to 30 scale) and domain-specific stress (parenting stress [$M = 35.8$ on a 18 to 90 scale], and financial stress [$M = 2.5$ on a 1 to 7 scale]). The most frequent life events endorsed by mothers were change in work hours/conditions (25.7%), responsibilities at work (24.3%), and financial state (23.8%).

According to accelerometry, children engaged in slightly less than one hour of MVPA per valid day (Median = 56.9 minutes, $M = 57.8$ minutes, $SD = 55.59$). Children spent slightly more than half of each hour of accelerometer wear time engaged in SB on average ($M = 34.6$ minutes, $SD = 5.0$). Nearly three-quarters of the children in the sample engaged in SB for at least 7 hours per day (72.8%).

Bivariate correlations between maternal mental health, child activity patterns, and key demographic characteristics are displayed in Table 3. Correlations between maternal mental health and well-being and child MVPA were generally weak and not significant ($R_s = -0.11$ to 0.12) as were correlations between maternal mental health and well-being and child SB ($R_s = -0.17$ to 0.13).

Associations between Maternal Mental Health and Well-Being and Child Activity Patterns

Standardized parameter estimates from linear regressions are displayed in Table 4.

Regarding associations between maternal mental health and well-being and child PA, only maternal self-esteem trended towards a significant association with child PA. Children of mothers who had high levels of self-esteem engaged in non-significantly greater daily MVPA ($\beta = 0.11$, $p = 0.07$). All other aspects of maternal mental health and well-being were unrelated to child PA. After adjusting for multiple comparisons using the Benjamini-Hochberg Procedure, the association between maternal self-esteem and child physical activity was no longer statistically significant.

Regarding associations between maternal mental health and well-being and child SB, self-esteem was a negative and significant predictor of child SB. Children of mothers who had higher levels of self-esteem engaged in less SB ($\beta = -0.15$, $p = 0.03$). A positive association between maternal financial stress and child SB trended towards significance. Children of mothers who experienced high levels of financial stress engaged in non-significantly greater SB ($\beta = 0.12$, $p = 0.07$). All other aspects of maternal mental health and well-being were unrelated to child SB. After adjusting for multiple comparisons using the Benjamini-Hochberg Procedure, these findings were no longer statistically significant.

Moderators of the Association between Maternal Mental Health and Well-Being and Child Activity Patterns

Household type significantly moderated the associations between maternal parenting stress and child MVPA ($\beta = -0.34$, $p = 0.02$), and the association between maternal parenting stress and child SB ($\beta = 0.32$, $p = 0.03$). Probing of the interaction revealed that for single-parent households, parenting stress was negatively associated with child PA; whereas for dual-parent/multigenerational households, parenting stress was not significantly associated with child PA. A child of a single-parent mother who experienced more parenting stress, on average, engaged in approximately ten fewer minutes of MVPA per day compared to a child in a dual-parent/multigenerational household whose mother experienced similar levels of parenting stress. Additionally, in single-parent households, parenting stress was positively associated with child SB while in dual-parent and multigenerational households parenting stress was not significantly associated with levels of child SB. A child of a single-parent mother who experienced more parenting stress, on average, engaged in approximately 33 more minutes of SB per day (assuming sixteen waking hours) compared to a child in a dual-parent/multigenerational household whose mother experienced similar levels of parenting stress. After adjusting for multiple comparisons using the Benjamini-Hochberg Procedure, the interactions between parenting stress and household type predicting child PA remained significant whereas the interaction predicting child SB was no longer statistically significant.

Maternal employment status did not moderate the associations between maternal mental health and well-being and child PA or SB.

Discussion

This study investigated associations between a broad constellation of maternal mental health and well-being variables and children's objectively-measured PA and SB, as well as possible moderators of those associations. After controlling for multiple comparisons, no main effect for maternal mental health variables was significantly associated with an objective monitor-based measure of children's activity patterns though a tentative association (i.e., uncorrected significant association) among maternal self-esteem and child SB was documented. Results indicated the association between maternal parenting stress and child PA was larger for single-parent households than dual-multigenerational households as well as a similar tentative association (i.e., uncorrected significant association) between maternal parenting stress and child SB in single-parent households. The results of this investigation are particularly meaningful because it is the first known study to employ an objective measure of child PA and SB to investigate associations between maternal mental health and well-being and child activity patterns, thus addressing a critical methodological limitation of previous studies on this topic. The preponderance of non-significant findings, a discrepancy between this study and previous research (e.g., 12,13), may be the result of social desirability and recall biases inherent in subjective measures of behavior thus inflating associations documented in previous research.

This study is one of the first to show an uncorrected significant negative association between maternal self-esteem and child SB. An individual's level of self-esteem has long been touted as a strong correlate of their own PA behavior (37); however, little work has explored how a parent's self-esteem is associated with their child's activity patterns or with SB, which is distinct from PA (13). Several possible mechanisms could explain the tentative association found in this study. Mothers with high levels of self-esteem are more likely to exhibit authoritative parenting practices, including setting limits (38), and therefore may be more likely to enforce household rules that limit SB and encourage PA. Moreover, mothers with high levels of self-esteem may themselves engage in high levels of PA or low levels of SB (39,40), which serve as positive role modeling examples for children's own health behaviors. Indeed, children are more likely to be physically active when their mother also tends to be physically activity (21). Further research should explore associations between maternal self-esteem and child activity patterns as this study was underpowered to detect effects after correction and replication is needed to confirm these findings.

Maternal depression and perceived stress represent two maternal mental health variables that have consistently been linked with child PA and SB (both total and screen time) in previous research (7–11,13); however, results from this study found no associations between these constructs. Previous research linking higher levels of maternal depression and perceived stress with lower levels of child PA and higher levels of child SB have either used mother-reported measures of child behavior (8,9,13) or, in rare instances, child self-reported measures of behavior (7,10,11) whereas this study employed an objective measure of activity. It is possible that a mother experiencing depressive symptoms or perceived stress

may be less aware of her child's actual engagement in PA and SB, resulting in inaccurate reporting of these behaviors (41). These biases are in addition to recall-based errors traditionally associated with subjective measures of behavior (16). The use of an objective measure of PA and SB in this study may provide a more valid or accurate measure of child behavior in the context of everyday life, capturing activity or lack of activity as it occurs in real-time, and thus reduce recall errors that may be affected by a mother's mental health profile. This rationale is in part supported by differences in effect sizes in previous studies using report-based measures of child PA and SB as compared with observed effect sizes in the current study. Previous studies using report-based measures of behavior have generally reported larger effect sizes (maternal depression-child PA $d_{\text{range}} = -0.03$ to -0.78 ; maternal depression-child SB $d_{\text{range}} = 0.03$ to 0.20 ; maternal perceived stress-child PA $d_{\text{range}} = -0.16$ to -0.31 ; maternal perceived stress-child SB $d = 0.26$) (12,13) compared to the effect sizes observed in this current study (maternal depression-child PA $d = -0.04$; maternal depression-child SB $d = 0.05$; maternal perceived stress-child PA $d = -0.01$; maternal perceived stress-child SB $d = -0.02$). Although the current study was reasonably well-powered to detect small main effects (.93 to .96 probability of detecting effect sizes of 0.10 or greater and .67 to .72 probability of detecting effect sizes 0.05 or greater), none of these main effects were found to be statistically significant. Thus, using an objective device-based measure of child PA and SB may result in smaller sized associations between aspects of maternal mental health and well-being and child PA and SB as compared to report-based measures.

Moreover, PA and SB are health behaviors that can occur in a variety of domains. It is possible that the domains in which these behaviors occur may be more or less susceptible to the influence of various aspects of maternal mental health and well-being and could have differential effects on health depending on the domain. For example, children's television viewing, a behavior that typically occurs while sedentary, has been positively associated with maternal depressive symptoms and perceived stress (9) and can adversely effect children's cognitive development (42). Whereas using the computer, another activity that typically occurs while sitting, is positively associated with aspects of children's cognitive development (43). Therefore, the optimal assessment of health behaviors such as PA and SB may include a combination of objective and self-report measures of behavior to capture not only total time engaged in these behaviors but also time spent in domain-specific PA and SB.

Additional aspects of maternal mental health and well-being such as life satisfaction, anxiety, and domain-specific stress were not directly associated with either child PA or SB. This is the first study to investigate whether maternal life satisfaction and anxiety are associated with child activity patterns, and there have been mixed findings in previous research investigating domain-specific stress and child activity patterns. In a study of 8 to 11 year old children Lundahl et al. (10) documented a positive association between parent-reported financial stress and child-reported PA as well as a positive association between parent-reported financial stress and child-reported SB. Furthermore, in a sample of children ages 6 to 17 years, Loprinzi (9) documented a negative association between a measure of parenting stress and mother-reported child PA but a positive association between parenting stress and mother-reported child SB.

While no direct associations between maternal financial or parenting stress and child activity patterns were documented in this study, this study is the first to establish the moderating role of household type in associations between parenting stress and child objectively-measured PA. This study also documented an uncorrected significant association between parenting stress and child objectively-measured SB in single-parent households. Previous research indicates that single-parents are more likely to experience high levels of parenting stress (44) and that children of single-parent households are permitted to watch more TV (45) compared to their dual-parent counterparts. Single-parents may have fewer financial and material resources as well as less social support to help them cope with various household duties and responsibilities or events that adversely impact their mental health and well-being as well as their ability to enforce positive parenting practices such as limiting children's SB monitoring of children's PA or SB (46). Because this study was underpowered to detect moderating effects of household type in associations between parenting stress and child SB after correction, replication is necessary. Additionally, future research is necessary to illuminate mechanisms linking maternal parental stress and child activity patterns in single-parent households.

While current results expand knowledge regarding linkages between maternal mental health and well-being and child activity patterns, some limitations should be noted. First, although the sample was as ethnically diverse, mothers in this study tended to be highly-educated as well as exhibit generally positive mental health and well-being profiles. Additionally, the eligibility criteria employed in this study (e.g., working week nights or weekend days) may have inadvertently excluded mothers with poorer mental health or well-being resulting in a selection bias. It is possible that associations between maternal mental health and well-being and child PA and SB may differ in samples of mothers with lower education levels or poorer mental health and well-being profiles. Second, to maintain our sample size, our analysis included 19 children with at least one day but less than four days of valid accelerometer data. Four days of valid accelerometer data is recommended to reliably capture typical PA levels in community samples (34), which presents the potential for measurement bias in this study. Finally, due to the cross-sectional nature of this study causal conclusions cannot be made. Future research should employ longitudinal designs to further untangle associations between maternal mental health and child PA and SB.

This study was one of the first known research investigations to use established measures of maternal mental health and well-being and objective measures of child PA and SB to determine associations between these constructs. Results largely contradict previous results using mother-reported or self-reported measures of children PA and SB, underscoring the need to understand potential sources of confounding and error introduced by maternal report in this line of research.

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Table 1

Descriptive statistics for key variables in mothers.

	n (%)	M	SD	Min	Max
Ethnicity/Race					
Hispanic/Latino	99 (49.0%)				
Non-Hispanic White	38 (18.8%)				
Non-Hispanic Black	16 (7.9%)				
Asian	9 (4.5%)				
Other	32 (15.8%)				
Two or more Races	8 (3.9%)				
Education					
Graduated high school or less	38 (19.4%)				
Some college	41 (20.3%)				
Graduated college	69 (34.2%)				
Attended graduate school	48 (23.8%)				
Marital Status					
Never married	30 (14.9%)				
Married	136 (67.3%)				
Separated/divorced/widowed	36 (17.8%)				
Employment Status					
Full-time	113 (55.9%)				
Part-time	49 (24.3%)				
Homemakers	19 (9.4%)				
Unemployed/student/retired	14 (7.0%)				
Weight Status					
Underweight/Normal Weight	69 (34.2%)				
Overweight	67 (33.1%)				
Obese	66 (32.7%)				
Household Structure					
Single-Parent	47 (23.3%)				
Dual-Parent	126 (62.4%)				

	n (%)	M	SD	Min	Max
Multigenerational	29 (14.3%)				
Annual Household Income					
Less than \$35,000	55 (27.2%)				
\$35,001–\$75,000	59 (29.2%)				
\$75,001–\$105,00	39 (19.4%)				
\$105,001 and above	48 (23.9%)				
Age		40.94	6.12	24.00	57.00
Mental Health					
Self-Esteem		32.97	5.02	17.00	40.00
Life Satisfaction		24.69	6.76	5.00	35.00
Perceived Stress		14.77	5.37	4.00	30.00
Depressive Symptoms		7.99	8.41	0.00	54.00
Anxiety		37.20	9.68	20.00	78.00
Parenting Stress		35.86	8.36	15.00	60.00
Financial Stress		2.52	1.39	1.00	7.00
Life Events Stress		58.35	55.59	0.00	294.50

Note: Self-Esteem was assessed on a 10 to 40 scale, Life Satisfaction was assessed on a 7 to 35 scale, Perceived Stress was assessed on a 0 to 30 scale, Depressive Symptoms were assessed on a 0 to 60 scale, Anxiety was assessed on a 20 to 80 scale, Parenting Stress was assessed on a 18 to 90 scale, Financial Stress was assessed on a 7 to 49. For all maternal mental health constructs, higher scores indicate more of that construct. Education data was missing for 6 mothers, employment data was missing from 7 mothers and income data was missing for 1 mother. The sample size for data analysis included 191 mother-child dyads.

Table 2

Descriptive statistics for key variables in children.

	n (%)	M	SD	Min	Max
Sex					
Male	99 (49.0%)				
Female	103 (51.0%)				
Ethnicity/Race					
Hispanic/Latino	109 (54.0%)				
Non-Hispanic White	35 (17.3%)				
Non-Hispanic Black	19 (9.4%)				
Asian	14 (6.9%)				
Other	6 (3.0%)				
Two or more races	19 (9.4%)				
Weight Status					
Underweight/Normal Weight	120 (61.5%)				
Overweight	42 (21.5%)				
Obese	33 (16.9%)				
Age		9.60	0.91	8.00	12.00
Activity Behavior					
Physical Activity (Avg. valid minutes/valid day)		57.86	25.90	0.00	163.42
Sedentary Behavior (Avg. valid minutes of SB/hour of wear)		34.61	5.04	10.72	48.41

Note: The sample size for data analysis included 191 mother-child dyads.

Table 3

Correlations among key variables and covariates in mothers and children.

	1.	2.	3.	4.	5.	6.	7.	8.	18.	19.
Maternal Characteristics										
1. Self-Esteem	–									
2. Life Satisfaction	0.55 [*]	–								
3. Perceived Stress	–0.48 [*]	–0.55 [*]	–							
4. Depressive Symptoms	–0.61 [*]	–0.59 [*]	0.61 [*]	–						
5. Anxiety	–0.72 [*]	–0.65 [*]	0.67 [*]	0.81 [*]	–					
6. Parenting Stress	–0.39 [*]	–0.32 [*]	0.47 [*]	0.40 [*]	0.45 [*]	–				
7. Financial Stress	–0.36 [*]	–0.46 [*]	0.35 [*]	0.41 [*]	0.40 [*]	0.05	–			
8. Life Events Stress	–0.01	–0.23 [*]	0.25 [*]	0.22 [*]	0.16 [*]	0.12 [†]	0.18 [*]	–		
9. Hispanic	–0.10	–0.05	0.04	–0.06	0.03	–0.05	0.03	–0.08	–0.01	0.02
10. Education	0.22 [*]	0.28 [*]	–0.13 [†]	–0.22 [*]	–0.20 [*]	0.03	–0.41 [*]	–0.02	0.02	–0.07
11. Marital Status	0.13 [†]	0.33 [*]	–0.16 [*]	–0.30 [*]	–0.17 [*]	–0.32 [*]	–0.31 [*]	–0.25 [*]	0.02	–0.06
12. Working Full Time	0.13 [†]	–0.14 [*]	–0.03	–0.06	–0.02	0.05	–0.12	0.01	–0.04	–0.01
13. Working At All	0.09	–0.03	0.04	–0.04	–0.07	0.03	–0.19 [*]	–0.06	0.08	–0.06
14. BMI	–0.21 [*]	–0.28 [*]	0.14 [†]	0.22 [*]	0.19 [*]	0.04	0.22 [*]	0.05	–0.05	–0.01
15. Household Structure	–0.10	–0.29 [*]	0.22 [*]	0.17 [*]	0.16 [*]	0.32 [*]	0.31 [*]	0.25 [*]	–0.05	0.07
16. Annual Household Income	0.29 [*]	0.40 [*]	–0.17 [*]	–0.31 [*]	–0.22 [*]	0.13 [†]	–0.60 [*]	–0.15 [*]	0.11	–0.13 [†]
17. Age	0.04	0.08	0.03	0.02	–0.07	0.05	–0.07	0.06	0.04	0.08
Child Characteristics										
18. Physical Activity	0.12 [†]	–0.01	0.07	0.01	–0.04	0.04	–0.11	0.04	–	
19. Sedentary Behavior	–0.17	–0.08	–0.02	0.06	0.06	0.08	0.13 [†]	0.07	–0.60 [*]	–
20. Sex ^a	–0.02	–0.12 [†]	0.03	0.05	0.02	–0.02	0.02	0.02	0.29 [*]	0.06
21. Hispanic ^b	–0.09	–0.10	0.04	0.04	–0.01	–0.01	0.16 [*]	–0.05	–0.04	–0.11
22. BMI	–0.15 [*]	–0.16 [*]	0.12 [†]	0.14 [*]	0.12	0.06	0.20 [*]	0.09	–0.14 [†]	0.07

	1	2	3	4	5	6	7	8	18	19
23. Age ^{a,b}	-0.04	0.01	-0.12	-0.08	-0.01	-0.10	0.05	-0.07	-0.40 *	0.28 *

Note: The following demographic characteristics were dichotomized: ethnicity (Hispanic/Latino, not Hispanic/Latino), education (college or higher, no college), marital status (married, not married), employment status (working full-time, not working full-time; working at all, not working), household structure (single-parent household, dual-parent/multigenerational household). For all maternal mental health constructs, higher scores indicate more of that construct. Physical activity was operationalized as the average daily minutes of moderate-to-vigorous physical activity. Sedentary behavior was operationalized average minutes of sedentary behavior per hour of wear time.

^a Child sex and age were included as covariates in regression models testing associations between maternal mental health and well-being and child physical activity.

^b Child ethnicity, age and accelerometer wear time (not shown in Table 3) were included as covariates in regression models testing associations between maternal mental health and well-being and child sedentary behavior. The sample size for data analysis included 191 mother-child dyads.

* $p < 0.05$,

[†] $p < 0.10$.

Linear regression models with aspects of maternal mental health and well-being predicting child activity patterns controlling for relevant covariates.

Table 4

Maternal Mental Health and Well-Being Variables	Child Average Daily MVPA (Log Transformed)				Child Average Minutes of SB Per Valid Hour			
	β	Std. Error	P value	R-squared	β	Std. Error	P value	R-squared
Self-Esteem	0.119 [‡]	0.067	0.077	0.212	-0.150 [*]	0.070	0.035	0.179
Life Satisfaction	0.024	0.067	0.716	0.212	-0.046	0.070	0.514	0.171
Perceived Stress	-0.016	0.067	0.812	0.207	0.026	0.070	0.713	0.168
Depressive Symptoms	-0.045	0.066	0.497	0.215	0.051	0.070	0.471	0.171
Anxiety	-0.057	0.070	0.417	0.218	0.030	0.073	0.679	0.166
Parenting Stress	0.022	0.066	0.737	0.213	0.013	0.068	0.845	0.169
Financial Stress	-0.096	0.066	0.146	0.222	0.125 [‡]	0.070	0.073	0.183
Life Events Stress	0.001	0.064	0.984	0.213	0.052	0.068	0.439	0.171

Note: Standardized betas are displayed in the table. Each independent variable was run in a separate model. Models predicting child physical activity included child age and child sex as covariates. Models predicting child sedentary behavior included child age, child ethnicity, and child accelerometer wear time as covariates. For all maternal mental health constructs, higher scores indicate more of that construct. The sample size for data analysis included 191 mother-child dyads.

* $p < 0.05$,

[‡] $p < 0.10$.

Table 5

Linear regression models with interaction between maternal mental health and well-being and household type or employment status predicting child activity patterns controlling for relevant covariates.

	Child Average Daily MVPA (Log Transformed)				Child Average Minutes of SB Per Valid Hour			
	β	Std. Error	P value	R-squared	β	Std. Error	P value	R-squared
Interaction between Maternal Variables and Household Type								
Self-Esteem	0.171	0.168	0.310	0.217	-0.234	0.171	0.172	0.188
Life Satisfaction	0.212	0.158	0.181	0.221	-0.160	0.163	0.330	0.171
Perceived Stress	-0.078	0.164	0.636	0.211	0.009	0.140	0.949	0.177
Depressive Symptoms	-0.035	0.166	0.835	0.216	0.226	0.171	0.186	0.180
Anxiety	-0.128	0.188	0.495	0.220	0.189	0.191	0.322	0.173
Parenting Stress	-0.343*	0.148	0.021	0.237	0.321*	0.151	0.035	0.190
Financial Stress	-0.123	0.154	0.425	0.225	0.028	0.158	0.861	0.183
Life Events Stress	-0.087	0.138	0.529	0.217	-0.012	0.144	0.936	0.172
Interaction between Maternal Variables and Employment Status								
Self-Esteem	0.072	0.136	0.597	0.231	-0.087	0.143	0.544	0.184
Life Satisfaction	0.071	0.138	0.607	0.227	-0.025	0.145	0.865	0.176
Perceived Stress	0.134	0.134	0.318	0.226	0.008	0.140	0.955	0.173
Depressive Symptoms	0.092	0.145	0.524	0.232	-0.201	0.150	0.184	0.184
Anxiety	0.051	0.143	0.719	0.236	-0.071	0.149	0.635	0.172
Parenting Stress	-0.062	0.134	0.645	0.228	0.113	0.140	0.418	0.177
Financial Stress	-0.155	0.133	0.246	0.244	0.173	0.138	0.213	0.196
Life Events Stress	0.026	0.132	0.845	0.227	0.157	0.137	0.254	0.183

Note: Standardized betas for interaction terms are displayed in the table. Each independent variable was run in a separate model that included each aspect of maternal mental health and well-being as well as an interaction between the aspect of maternal mental health and either household type (single-parent household/dual-parent or multigenerational household) or maternal employment status (working full-time/not working full-time). Models predicting child physical activity included child age and child sex as covariates. Models predicting child sedentary behavior included child age, child ethnicity, and child accelerometer wear time as covariates. For all maternal mental health constructs, higher scores indicate more of that construct. The sample size for data analysis included 191 mother-child dyads.

* $p < 0.05$,

† $p < 0.10$.