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BRIEF REPORT

Chronic Stress and Adiposity in Youth–Parent Dyads: An Actor–Partner Interdependence Analysis

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Objective: Obesity is one of the most prominent health issues in modern society. Although previous research has identified chronic psychological stress as a risk factor for obesity, much of this research only examined how an individual's own stress affects their adiposity. The current study utilized an actor–partner interdependence model to examine the unique associations of youths' and parents' chronic stress with both their own and each other's adiposity. ***Method:*** Five hundred sixty-nine dyads of youths (48.7% females, 49.9% Whites, $M_{age} = 13.70$ years) and one of their parents (82.6% females, 58.2% Whites, $M_{age} = 45.38$ years) participated in a cross-sectional lab study, where both youths and parents completed interviews and anthropometric measurements. Trained interviewers conducted the UCLA Life Stress Interview to assess chronic psychological stress of youths and parents, respectively. Youth and parent adiposity was measured using three indicators, including body mass index, waist circumference, and body fat percentage. ***Results:*** The actor–partner interdependence model showed that when both youths' and parents' chronic stress were included simultaneously in the model, youths' chronic stress was uniquely associated with both their own and their parents' adiposity, and parents' chronic stress was also uniquely associated with youths' adiposity. ***Conclusion:*** Chronic psychological stress of youths and parents is uniquely associated with each other's adiposity, over and above their own stress. Thus, the psychosocial experiences of close others can be linked to both youth and adult obesity.

Public Significance Statement
The current study sheds light on the potential roles of youths' and parents' chronic stress in each other's adiposity. The findings emphasize the importance of better understanding the contributions that dyadic family relationships can make to the serious public health threat of obesity today.

Keywords: psychological stress, obesity, children, adolescents, parents

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Obesity is one of the most prominent health issues in modern society. The prevalence of obesity has reached epidemic levels in many countries worldwide (Blüher, 2019). For example, in the United States, over 40% of adults and 20% of youth have obesity (Stierman et al., 2021). Obesity increases the risk of morbidity and mortality from many diseases, particularly cardiovascular disease (Blüher, 2019). Thus, it becomes imperative to understand the causes of obesity in order to identify ways to combat it.

Although obesity has many causes, including genetic and environmental factors, chronic psychological stress—life demands that are ongoing and persistent—is considered one risk factor (Tomiyama, 2019). Indeed, empirical evidence shows that chronic psychological stress is associated with greater adiposity in both adults and youths, both cross-sectionally and longitudinally (Cuevas et al., 2019; Gardner et al., 2019; Wardle et al., 2011). If causal, this association may reflect the effects of chronic stress on cognitions, behaviors, and physiological responses that are linked to obesity (Tomiyama, 2019).

However, much of the extant research has had an individual focus: that is, it examines how an individual's own stress relates to their own weight gain. Yet, humans are social creatures. As such, an individual's weight gain may also be influenced by the stress experienced by significant others around them (see Huelsnitz et al., 2022). In the current study, we utilize an actor–partner interdependence model (APIM; Kenny et al., 2006) to disentangle associations between chronic psychological stress and adiposity among both youths and their parents. The APIM captures the interdependence that naturally exists within dyadic relationships (e.g., youth–parent dyads), allowing us to differentiate the unique associations of youth and parent chronic stress with both their own and each other's adiposity.

While it is clear that youth stress should be associated with youth obesity, and parent stress with parent obesity, the question that has been less clearly answered is how parent stress might relate to youth obesity, and conversely, how youth stress might relate to parent obesity. Previous literature has shown evidence that parent stress is positively associated with youth adiposity (see Tate et al., 2015 for a meta-analysis). This may be because parent stress affects parent health behaviors that are relevant to the whole family (e.g., types of food that parents purchase or prepare for the family; see Dimitratos et al., 2022 for a review). Parent stress may also affect parenting behaviors (e.g., parent monitoring of youth food intake and sedentary behaviors) that have implications for youth weight (Dimitratos et al., 2022). Furthermore, evidence from animal studies suggests that parent stress can be linked to offspring weight gain through epigenetic modifications in offspring (Xiao et al., 2020). However, the possibility remains that the association between parent stress and youth adiposity could be a spurious relationship due to associations of youth stress with both parent stress and youth adiposity. Using the APIM, the current study aims to disentangle the associations of youths' and parents' stress with youth adiposity.

Much less attention has been paid to how youth stress might be linked to parent obesity. We propose that parents are often attuned to the stress their youths are experiencing, and they might take on this stress in ways that have implications for their own weight. Related studies have provided indirect evidence for this idea. For example, youths' feelings of loneliness are associated positively with parents' emotional eating (Mason, 2020) and negatively with their fruit/vegetable consumption (Welch et al., 2019). When children have a less positive mood, their mothers also have a decreased activity level (Yang et al., 2020). Furthermore, there is evidence in other close relationships involving adults (married couples) that stress experienced by one person is positively associated with the other person's waist circumference (Birditt et al., 2019). However, to our knowledge, no research has examined the association between youth stress and parent adiposity. The current study aims to fill this gap.

Thus, the current study employs a dyadic perspective and examines the cross-sectional associations between chronic stress and adiposity within youth–parent dyads. Using the APIM, we test the unique associations of youth and parent chronic stress with both their own and each other's adiposity. Besides well-established actor effects (i.e., youth and parent stress on their own adiposity), we hypothesize that there are partner effects; that is, parent stress shows a unique positive association with youth adiposity, and youth stress shows a unique positive association with parent adiposity.

Method

Transparency and Openness

This study was not preregistered. The analysis scripts are available via the Open Science Framework page: https://osf.io/tdgy9/?view_only=15274cbfb3b144c0a1d7afca1a7007c3 (Jiang, 2023). The study was approved by the Research Ethics Board of the University of British Columbia and by the Institutional Review Board of Northwestern University. Because the participants who provided the data were informed that their study-related information would be kept confidential, the data for this study are not publicly available. The data can be available upon request with Institutional Review Board approval and a data use agreement.

Participants and Procedure

We recruited two independent samples of youth–parent dyads for studies on family life experiences and health. The first sample was recruited through public schools, community postings, and newspaper ads between 2010 and 2012 from the greater Vancouver area, Canada ($N = 261$ dyads). The second sample was recruited through health facilities between 2015 and 2017 from the greater Chicago area, United States ($N = 308$ dyads, in which youths were physician-diagnosed with asthma). For both samples, youth–parent pairs attended an in-person lab session, in which both youths and parents completed interviews and anthropometric measurements. The online supplemental materials provide further details about sample recruitment and characteristics of each sample (see Table S1 in the online supplemental materials).

To maximize statistical power and more precisely estimate effects (Curran & Hussong, 2009), we pooled the data from the two samples. We harmonized the data from the two samples by standardizing the primary variables (i.e., predictors and outcomes) within each sample before we pooled the data, which removed the between-sample variability while preserving the within-sample variability[1]

[1] We tested whether study sample moderated the primary results using a multigroup analysis. Study sample did not moderate the results (see the online supplemental materials for the full results), indicating that the results were consistent across the two samples.

(see Jolink et al., 2022). The pooled sample of youths consisted of 48.7% females and 49.9% Whites and ranged in age from 8 to 17 ($M = 13.70$ years, $SD = 2.12$ years). The pooled sample of parents or guardians consisted of 82.6% females and 58.2% Whites and ranged in age from 26 to 64 ($M = 45.38$ years, $SD = 6.21$ years). A sensitivity power analysis showed that this total sample size ($N = 569$ dyads) provided 80% power to detect effect sizes as small as Cohen's $f^2 = 0.014$ (i.e., $R^2 = .014$) at $p = .05$. All analyses below are based on cross-sectional data.

Measures

Chronic Psychological Stress

In both samples, chronic psychological stress of youths and parents was assessed with the youth and adult versions, respectively, of the UCLA Life Stress Interview (Hammen, 1991). Trained interviewers conducted a semistructured interview separately with each youth and parent to obtain information about chronic strains over the last 6 months across four broad life domains, including family relationships, social relationships, work/school, and home life (see the online supplemental materials for detailed information). Interviewers then rated chronic stress on a 1–5 scale for each domain, using behaviorally specific anchors for each value. Higher values reflect higher levels of stress. The validity and reliability of this interview, both the youth and adult versions, have been previously established (Hammen et al., 2009; Shih et al., 2006). In the current study, a consensus rating was achieved through discussion for a subset of the participants. The intraclass correlations between individual interviewers' and consensus ratings ranged from .81 to .89 across domains. To capture overall chronic stress across life domains (see Lam et al., 2022), we created a composite score by averaging ratings across the four domains separately for parents and youths (αs ranging from .64 to .78 across the samples). Table 1 shows the descriptive statistics of chronic stress composites for each sample.

Adiposity Measures

In both samples, three indicators of adiposity were collected from parents and youths, including body mass index, waist circumference, and body fat percentage. Body mass index (kilograms/meter^2) was calculated with height and weight measurements taken from a medical-grade balance-beam scale. Waist circumference was obtained by measuring the circumference of the midpoint between the upper iliac crest and the lower costal margin. Body fat percentage was obtained from a scale (Tanita Model BF-350) that uses bioelectrical impedance to measure the percentage of body fat. Table 1 shows the descriptive statistics of each indicator for each sample. To capture overall adiposity and reduce measurement error (see the online supplemental materials for detailed explanations), in each sample, we created a composite score of adiposity by first standardizing each of the three indicators and then averaging them separately for parents and youths[2] (α's ranging from .84 to .93 across the two samples), with higher scores reflecting higher adiposity.

Covariates

Following prior research (e.g., Miller et al., 2022), a set of covariates were selected a priori and included in the APIM. They were parents' and youths' age, sex, race (White vs. non-White), and youths' pubertal status. We also included a covariate indicating the study sample (Vancouver vs. Chicago sample).

Analytic Strategies

We tested the APIM using structural equation modeling (Lavaan Version 0.6-9). Specifically, the model included both youths' and parents' adiposity as outcomes and youths' and parents' chronic stress as simultaneous predictors of each outcome. The model also included the covariates described above. We conducted the analyses on the pooled data from the two samples, which we harmonized by standardizing the predictors and outcomes within each sample. To reduce the influence of outliers while maximizing statistical power, outliers for the predictors and outcomes (defined as ± 3 *SD* from the sample mean) were winsorized to the next highest/lowest value within each sample. Full information maximum likelihood was used to handle missing data (see the online supplemental materials for the details).

Results

Table S2 in the online supplemental materials shows zero-order correlations for all variables. In zero-order correlations, parents' chronic stress was positively correlated with their own adiposity ($r = .18$, $p < .001$) and their youths' adiposity ($r = .20$, $p < .001$), and youths' chronic stress was positively correlated with their own adiposity ($r = .23$, $p < .001$) and their parents' adiposity ($r = .22$, $p < .001$). In addition, positive correlations occurred between youths' and parents' adiposity ($r = .36$, $p < .001$) and between youths' and parents' chronic stress ($r = .48$, $p < .001$). The moderately positive correlation between parents' and youths' chronic stress underscores the importance of conducting the APIM to disentangle the unique associations between chronic stress and adiposity within dyads.

The results of the APIM are shown in Figure 1. In this model, parents' chronic stress was uniquely associated with youths' adiposity ($b = 0.09$, 95% confidence interval [CI] = [0.001, 0.17], $\beta = .09$, $p = .048$). With both parent and youth stress in the model, parent chronic stress was marginally associated with their own adiposity ($b = 0.08$, 95% CI = [−0.01, 0.18], $\beta = .09$, $p = .073$).[3] Youths' chronic stress was uniquely associated with both their own ($b = 0.10$, 95% CI = [0.02, 0.19], $\beta = .11$, $p = .018$) and their parents' adiposity ($b = 0.14$, 95% CI = [0.05, 0.24], $\beta = .15$, $p = .002$), when both youths' and parents' chronic stress were included simultaneously in the model. The full results, including those for the covariates, are reported in Table S3 in the online supplemental materials.

We conducted sensitivity analyses to assess the robustness of the results. First, to assess the influence of the extreme values, we reran the model without winsorizing the outliers. Second, to assess the

[2] Youths' raw body mass index (BMI), instead of age- and sex-adjusted BMI percentiles, was used to calculate their adiposity composite. Given that our samples came from two countries, youths' BMI percentiles generated by country-specific growth charts may not be comparable across the two samples. Thus, we used raw BMI in youths' adiposity composite and adjusted for youths' age and sex in the primary analyses. In the online supplemental materials, we reported the results using age- and sex-adjusted BMI percentiles in youths' adiposity composite. The results were largely consistent with those from the primary analyses.

[3] The positive association between parents' chronic stress and their own adiposity was significant ($b = .15$, 95% CI = [.07, .23], $\beta = .15$, $p < .001$) if youths' chronic stress was not controlled (with all covariates included in the model). See the online supplemental materials for the full results.

Table 1
Descriptive Statistics of Primary Variables by Sample

Variables	Vancouver sample youths	Vancouver sample parents	Chicago sample youths	Chicago sample parents
Chronic stress, *M* (*SD*)	2.16 (0.54)	2.38 (0.61)	2.11 (0.61)	2.36 (0.71)
Chronic stress range	1.25–4.00	1.13–4.38	1.13–4.00	1.00–4.75
BMI, *M* (*SD*)	21.37 (3.70)	25.38 (4.61)	22.47 (5.72)	29.05 (6.79)
BMI range	14.84–37.64	17.69–47.65	13.05–56.05	16.83–56.74
Waist circumference, *M* (*SD*)	30.10 (4.06)	34.32 (5.28)	29.66 (5.41)	36.73 (6.31)
Waist circumference range	23.35–48.43	24.41–57.09	20.50–54.50	26.00–60.50
Body fat percentage, *M* (*SD*)	21.46 (9.44)	29.68 (7.72)	24.85 (11.31)	36.10 (8.85)
Body fat percentage range	3.80–47.40	12.40–50.20	1.70–56.30	15.60–60.60

Note. Chronic stress was rated on a 1–5 scale and averaged across four life domains, with higher values reflecting higher levels of stress; waist circumference was recorded in inches in both samples. BMI = body mass index.

influence of overadjustment bias on the results (van Zwieten et al., 2022), we reran the model without including covariates. In both sets of analyses, the patterns of associations were largely the same as those reported above. The full results of these sensitivity analyses are reported in the online supplemental materials.

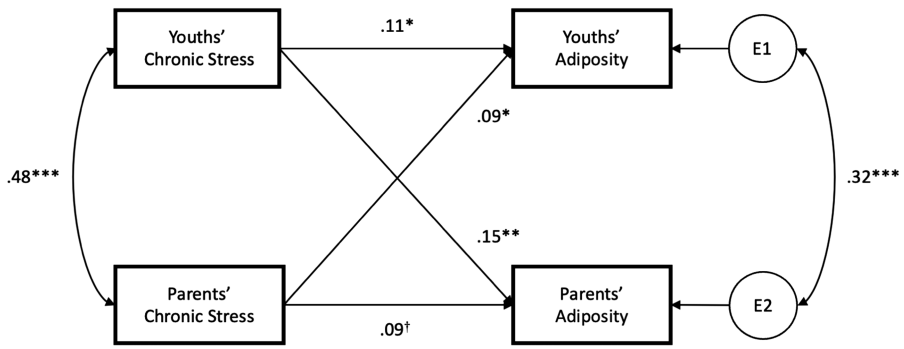
Discussion

To our knowledge, the current study is the first to examine the dyadic associations between chronic psychological stress and adiposity among youths and their parents using the APIM. Consistent with well-established findings from previous research (Gardner et al., 2019; Wardle et al., 2011), our study observed that youth chronic stress was associated with youth adiposity and that parent chronic stress was associated with parent adiposity when not adjusting for youth stress. More novel to our study, however, was the observation that parent chronic stress was associated with youth adiposity, over and above youth stress. Furthermore, youth chronic stress was associated with parent adiposity over and above parent stress. Neither of these associations could be accounted for by youths' or parents' age, sex, race, or youths' pubertal status. Although limited by the cross-sectional nature of this study, these findings suggest the possibility that the chronic stress experienced by close others may be important in the context of obesity, underscoring the importance of incorporating a dyadic perspective into research on the link between chronic stress and obesity.

Previous research has shown an association between parent stress and youth obesity (Tate et al., 2015), but it was unclear from this previous research whether this association would still hold after adjusting for youth stress. Extending this research, the current findings showed that this association held, suggesting that parent chronic stress may have unique associations with youth obesity. Potential mechanisms for this association could be that parents' stress promotes certain types of unhealthy behaviors that have implications for the whole family (e.g., parents under high stress not having time to prepare healthy meals for the family), or that parents' stress is associated with certain types of negative parenting behaviors (e.g., high levels of parents' own stress leading to lack of availability to supervise their children's eating and activity behaviors), which lead to youths' obesity (see Dimitratos et al., 2022). Epigenetic modifications in offspring due to parents' stress could be another potential mechanism for this association (see Xiao et al., 2020).

The current study is the first to document that youths' chronic stress is uniquely associated with parent adiposity, above and beyond the relationship that parents' stress has with their own adiposity.

Figure 1
The APIM Model Including Youths' and Parents' Chronic Stress and Youths' and Parents' Adiposity



Note. Covariates included parents' and youths' age, sex, race (White vs. non-White), youths' pubertal status, and the study sample variable. E indicates an error term. All coefficients represent standardized effects. APIM = actor–partner interdependence model.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Although the exact underlying mechanisms are not known, it is possible that youths' chronic stress can affect their parents' own behaviors, which in turn may influence parents' weight gain. For example, caring for children who are highly stressed may be time-consuming, and as a result, parents may change their own eating habits (e.g., eating more fast food; see Welch et al., 2019) and/or activity levels (e.g., doing less physical exercise; see Yang et al., 2020), all of which have implications for their weight.

One unexpected finding was that the parents' chronic stress was marginally associated with their own adiposity after adjusting for youth stress. However, in both the bivariate correlation and regression analysis (when youth stress was not controlled), we observed a significant stress-adiposity association for parents, which is consistent with previous research (Wardle et al., 2011). These findings suggest that the association between parent stress and their adiposity may be at least partly accounted for by the association that youth stress has with both parent stress and parent adiposity. A speculative explanation is that youth stress sometimes takes precedence for parents over their own stress, but future research is needed to replicate the findings and explicitly test this potential mechanism.

The current findings have theoretical and clinical implications. For one, the findings increase our understanding of the link between chronic stress and adiposity by bringing in a dyadic perspective. Future research is needed to identify potential mechanisms underlying the associations of youths' and adults' chronic stress with each other's adiposity. It is also possible that the current findings may be clinically meaningful. In the current study, the associations of youth and parent stress with the other person's adiposity are similar in magnitude to the associations between one's stress and their own adiposity. The clinical significance of the within-person associations of stress and obesity has been established in past research (e.g., Cuevas et al., 2019; Gardner et al., 2019). Thus, the current findings suggest that family-based interventions centered around stress reduction may be useful to implement in combating both youth and adult obesity (see Poole et al., 2018 for an example of a family-based intervention showing effects on both youth and parent mental health outcomes).

However, before drawing any conclusions about clinical significance, we caution that the cross-sectional design of the current study prevents us from drawing conclusions about causality or even about the temporal order of the relationships between stress and adiposity. While the explanations we proposed above center around reasons why chronic stress may have effects on obesity, an equally plausible alternative explanation of the current results is that parent and youth adiposity may affect parent and youth chronic stress. Although existing theories suggest that an individual's obesity may increase their own stress (Tomiyama, 2019), we are unaware of any theory suggesting that parent or youth adiposity can affect the other person's stress. However, this possibility obviously cannot be ruled out with the present study design. Thus, the results of the current study would need to be replicated and tested in longitudinal studies with at least one follow-up of a minimum of 6 months to determine whether youth and parent stress are associated with changes in each other's adiposity over time (or vice versa).

In conclusion, the current study utilizes a dyadic perspective to examine the link between chronic stress and adiposity in both youths and adults. The findings emphasize the importance of better understanding the role that dyadic family relationships may play in the context of the serious public health threat of obesity today.

Resumen

Objetivo: La obesidad es uno de los problemas de salud más destacados en la sociedad moderna. Aunque investigaciones anteriores han identificado el estrés psicológico crónico como un factor de riesgo de obesidad, gran parte de esta investigación solo examinó cómo el propio estrés de un individuo afecta su adiposidad. El estudio actual utilizó un modelo de interdependencia actor-pareja (APIM, por sus siglas en inglés) para examinar las asociaciones únicas del estrés crónico de los jóvenes y los padres con su propia adiposidad y la de los demás. ***Método:*** 569 diadas de jóvenes (48.7% mujeres; 49.9% Blancos/as; Medad = 13.70 años) y uno de sus padres (82.6% mujeres; 58.2% Blancos/as; Medad = 45.38 años) participaron en un estudio de laboratorio transversal, donde ambos Jóvenes y padres completaron entrevistas y mediciones antropométricas. Entrevistadores capacitados realizaron la Entrevista sobre Estrés Vital de UCLA para evaluar el estrés psicológico crónico de los jóvenes y los padres, respectivamente. La adiposidad de los jóvenes y de los padres se midió utilizando tres indicadores, incluido el índice de masa corporal (BMI, por sus siglas en inglés), la circunferencia de la cintura y el porcentaje de grasa corporal. ***Resultados:*** El APIM mostró que cuando el estrés crónico de los jóvenes y de los padres se incluía simultáneamente en el modelo, el estrés crónico de los jóvenes se asociaba de manera única con su propia adiposidad y la de sus padres, y el estrés crónico de los padres también se asociaba de manera única con la adiposidad de los jóvenes. ***Conclusión:*** El estrés psicológico crónico de los jóvenes y los padres está asociado de manera única con la adiposidad de cada uno, más allá de su propio estrés. Por lo tanto, las experiencias psicosociales de otras personas cercanas pueden vincularse con la obesidad tanto en jóvenes como en adultos.

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