

Bi-Directional Spillover Across Days Between Family Assistance
and Physical Health Experiences During Adolescence

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Abstract

Helping the family may either promote or undermine adolescents' physical health and wellbeing. Adolescents ($N = 396$, 58% female, $M_{\text{age}} = 14.57$ years) completed diary checklists for 14 days, reporting whether they provided instrumental assistance (e.g., tangible tasks) and emotional support (e.g., listening, giving advice) to family, as well as their amount of physical activity, sleep, and physical symptoms (e.g., headache, backpain) each day. After providing emotional support, adolescents slept more that night and experienced fewer physical symptoms the next day, over and above prior day levels. When adolescents provided instrumental assistance on school days (but not non-school days), they engaged in less physical activity that day. These results were consistent across individual differences in gender, age, socio-economic status and ethnicity. In addition, bi-directional associations emerged such that adolescents were more likely to provide instrumental assistance on days after they slept more.

Keywords: *adolescence, family assistance, family systems, physical health, sleep*

Bi-Directional Spillover Across Days Between Family Assistance and Physical Health Experiences During Adolescence

Helping the family (i.e., providing family assistance) is a meaningful feature of adolescents' daily lives around the world (Weisner, 2001). Family assistance includes instrumental tasks such as cleaning, cooking, and errands, as well as emotional support such as listening to or advising a parent or sibling (Tsai, Gonzales, & Fuligni, 2016). A small but growing literature has linked provision of instrumental and emotional support with both positive and negative measures of physical health (Armstrong- Carter, Ivory, Lin, Muscatell, & Telzer, 2020; Doane et al., 2018; Fuligni et al., 2009). However, this research has largely focused on biological indices (e.g., inflammatory markers and stress-hormones), and it remains unclear whether family assistance is related to adolescents' daily, lived physical health experiences and behaviors. Examining how family assistance is related to daily physical health experiences such as physical activity, sleep, and physical pain may help to illuminate how family assistance "gets under the skin" during adolescence (Fuligni & Telzer, 2013). In the current study, we investigated how adolescents' provision of instrumental and emotional support to the family is related to the amount of physical activity they engage in that day, the amount of sleep they get that night, and whether it spills over into physical symptoms the next day. Further, we investigated potential bi-directional associations, to allow for the possibility that physical activity, sleep and symptoms reciprocally influence adolescents' capacity to provide instrumental and emotional support each day.

Home as a Context for Physical Health and Development

The family environment is crucial for children's and adolescents' physical health and wellbeing. Biopsychosocial models of youth development emphasize that youths' physical health is shaped by their daily activities and experiences in the home (Engel, 1977). For instance, youth

who grow up in homes with relatively greater adversity — such as poverty or family stress — are at risk for developing poor physical and mental health across the lifespan (Miller & Chen, 2013). Conversely, positive relational processes within the home environment — such as mutual support — promote youths' physical health and well-being, as indexed by more optimal sleep, higher levels of physical activity and lower cardio-vascular risk (MacPhee, Lunkenheimer, & Riggs, 2015). Investigations of adolescents' physical health should be situated in the context of their daily activities in the home.

Instrumental Assistance and Emotional Support

During the period of adolescence, youth become increasingly able to contribute to the family in meaningful and impactful ways (Fuligni, 2018). One nearly universal, daily activity during adolescence is family assistance (Weisner, 2001), which can be separated into instrumental assistance (i.e., helping with tangible household tasks) and emotional support, such as listening or advising a family member (Tsai et al., 2016; Hibbert, 2010). Emotional support involves adolescents' awareness and response to another person's challenges or worries (Tsai et al., 2016), and may impact adolescents' own well-being in ways that are not apparent by their provision of instrumental assistance (Tsai et al., 2016). For example, one small study found that providing emotional support to a close friend was associated with greater emotional well-being the same day (Morelli, Lee, Arnn, & Zaki, 2015). In contrast, providing instrumental support was only associated with well-being when it also co-occurred with emotional support (Morelli et al., 2015). Another study found that providing instrumental assistance to a friend, but not emotional support, was associated with greater emotional well-being the same day among older adolescents (Armstrong- Carter, Guassi Moreira, Ivory, & Telzer, 2020). This work suggests that instrumental and emotional support may also have unique associations with adolescents' well-being.

Family Assistance and Health

Research examining how adolescents' provision of family assistance relates to physical health has largely focused on biological markers. This research has shown divergent results; family assistance has been linked to both positive and negative biological measures of health. On the one hand, adolescents who provide greater instrumental assistance to the family show heightened levels of circulating inflammatory markers (Fuligni et al., 2009). Similarly, more frequent demands from family predicts greater inflammatory response to bacterial inoculation (Levine, Hoffer, & Chen, 2017). Assisting the family with instrumental tasks is also associated with flatter diurnal cortisol slopes the next day (Doane et al., 2018), which is linked to greater risk for physical illness (Doane & Adam, 2010). On the other hand, helping behaviors have also been associated with biological indices that are interpreted as positive. For example, after helping the family with both instrumental tasks and emotional support, adolescents exhibit lower cortisol awakening response the next day (Armstrong- Carter, Ivory, et al., 2020; Doane et al., 2018). Together, this research demonstrates a link between family assistance and physiological health markers during adolescence, suggesting that family assistance may either support or undermine physical health, potentially setting the stage for well-being across the lifespan (Dahl, Allen, Wilbrecht, & Suleiman, 2018). However, less is known about how instrumental and emotional support relate to adolescents' daily health experiences and behaviors, including sleep, physical activity, and physical health symptoms.

Family Assistance and Sleep

Adequate sleep is crucial for physical and mental well-being, and is particularly important during adolescence (Dahl et al., 2018). Biopsychosocial models of sleep emphasize the importance of studying adolescents' sleep patterns in the context of their daily contextual experiences (Becker,

Langberg, & Byars, 2015). Broadly, stressful or challenging family dynamics are associated with poor sleep health (i.e., less sleep, lower quality sleep), whereas positive relational dynamics in the home can promote healthy sleep patterns (Gunn & Eberhardt, 2019). For example, when adolescents experience higher levels of stress or family chaos, they sleep fewer hours that night (Doane & Thurston, 2014) and experience poorer sleep quality (Peltz, Rogge, & O'Connor, 2019; Zeiders, 2017). Similarly, perceived stressful demands from family, peers, and school are associated with fewer hours of sleep the following evening (Hardway & Fuligni, 2006). Only a few studies have specifically examined whether adolescents' helping behaviors are related to patterns of sleep. Correlational analyses averaging across days showed that average levels of instrumental family assistance and family demands were not significantly correlated with sleep duration (Chiang et al., 2016; Doane et al., 2018; Hardway & Fuligni, 2006). Similarly, one daily-level study found that time spent helping the family with instrumental tasks was not associated with sleep duration that evening (Hardway & Fuligni, 2006). However, this analysis did not control for prior day sleep habits, which spill over into the next day (Hardway & Fuligni, 2006). Controlling for prior day sleep may offer a more robust predictive model and reveal previously undetected associations between family assistance and sleep duration on the daily level. In addition, differentiating between instrumental assistance and emotional support may reveal new, meaningful associations with sleep duration. For example, instrumental support may be physically taxing—which may prompt the need for more sleep—or occur early in the morning or late in the evening—which could detract from sleep time. Since providing emotional support involves awareness of a loved one's challenges but also close interpersonal connection, it may either interfere with adequate sleep by creating worries or rumination, or alternatively promote sleep by

contributing to a sense of peacefulness and rest. In these ways, family assistance may be related to sleep by impacting levels of physical, cognitive, and emotional arousal.

Family Assistance and Physical Activity

Physical activity is another key component of health that is crucial for adolescents' wellbeing. Adolescents who helped their families with more instrumental tasks across two weeks had higher body mass index compared to their peers who help relatively less (Fuligni et al., 2009). Consistent with research among adult caregivers (Vitaliano, Zhang, & Scanlan, 2003), this suggests that high levels of family assistance are linked to greater risk for the later development of cardiovascular disease (Fuligni et al., 2009). Despite this link between family assistance and physical weight, no known research has examined how family assistance relates to levels of physical activity, which is integral to weight maintenance and cardiovascular health.

Family assistance may relate to physical activity in divergent ways. On the one hand, family assistance might provide opportunities for more physical activity. For example, while adolescents are completing instrumental tasks such as looking after siblings, they may play games outdoors, and looking after a pet may include walking dogs. Moreover, providing instrumental and emotional support has been associated with positive emotions the same day (Armstrong- Carter, Ivory, et al., 2020; Telzer & Fuligni, 2009b), which are in turn associated with greater physical activity (Debeuf, Verbeken, Van Beveren, Michels, & Braet, 2018; Lang et al., 2016). On the other hand, family assistance may detract time or conflict with opportunities for physical activity. If adolescents are helping the family, they may be less likely to exercise, participate in sports, or spend time with peers and family outdoors. Further, if family assistance conflicts with other demands and is experienced as stressful (Siskowski, 2006), stress may detract from adolescents'

motivation, time or ability to engage in physical activity that day (Debeuf et al., 2018; Lang et al., 2016).

Family Assistance and Physical Symptoms

Symptoms of pain (e.g., headache, stomachache) are another crucial marker of physical health, yet no known studies have examined links between family assistance and physical symptoms. Family assistance has been positively associated with inflammation (Fuligni et al., 2009), and inflammation is positively associated with physical pain (Parkitny et al., 2013). Moreover, fulfilling family obligations is associated with greater airway inflammation and parent-reported asthma symptoms among adolescents in low SES homes (Lam et al., 2018). Similarly, adolescents who provide significant, time-consuming, ongoing amounts of family work (e.g., caregiving for a family member) are more likely to experience physical health problems (Hibbert, 2010). For example, youth who routinely care for family members are at risk for insufficient or restricted sleep, and injuries from carrying, lifting, and other physical demands (Becker, 2007). In contrast, it is also possible that family assistance could provide a context that is protective against physical health symptoms. One study demonstrated that adolescents whose parents are more knowledgeable about adolescents' daily activities (e.g., where adolescents spent their time, who they spent time with) experienced fewer physical health symptoms, including headaches and stomachaches (Lippold, Davis, McHale, & Almeida, 2016). Since adolescents' family assistance occurs in the home and parents are likely aware of it, family assistance could similarly be associated with fewer physical symptoms due to greater family cohesion and mutual understanding. Taken together, these studies suggest that family assistance may be linked to daily experiences of physical health symptoms, although the direction of effects is unknown. Examining how family assistance relates to physical pain the next day, over and above current levels, may

provide more insight into the direction of effects by revealing across-day spillover in a predictive model.

School days Versus Non-school days

Investigations of family assistance and physical health also need to capture differences between school days and non-school days (Hardway & Fuligni, 2006). During the week, in the context of multiple academic and social demands, family assistance may detract from adolescents' time sleeping (Fuligni, Yip, & Tseng, 2002), engaging in physical activity, or resting in order to prevent and reduce physical pain. In contrast, non-school days (including weekends and holidays) may allow more time for adolescents to assist the family while also experiencing sufficient sleep, physical activity, and rest. For example, the association between household structure and sleep depends on the day of the week, such that stricter household rules are associated with more sleep during the week but not on the weekend (Adam, Snell, & Pendry, 2007). This research suggests that family experiences relate to sleep and other measures of physical health differently depending on whether it is a school day or not.

Bi-Directional Associations: The Contexts for Instrumental and Emotional Support

While providing instrumental and emotional support may impact adolescents' physical wellbeing, physical wellbeing may also conversely influence adolescents' capacity to provide instrumental and emotional support. Family systems theory posits that adolescents' behaviors in the home are partially influenced by their emotional and physical wellbeing (Cox & Paley, 2003). Theories of prosocial motivation further propose that youth are more likely to help others when their own needs are met (Eisenberg et al., 2016). In particular, adolescents may be more likely to provide instrumental and emotional support to the family when they are well-rested, energized, and feeling better, because physical well-being may enable them to engage with helping tasks in

the moment and respond to the needs of others (Eisenberg et al., 2016). However, little is known about how adolescents' physical wellbeing influences their propensity to help others. Several studies have shown that adolescents are more likely to help the family on days that they feel *emotionally* better (Armstrong-Carter et al., 2020; Telzer & Fuligni, 2009). One study examined how adolescents' provision of instrumental assistance fluctuated in response to their *parents'* physical wellbeing, revealing that adolescents were more likely to help on days when their mothers felt fatigued (Tsai et al., 2013). To build on this work, it is crucial to explore whether daily fluctuations in adolescents' own physical health experiences predict their family assistance behaviors, because such research can illuminate daily, individual factors that influence adolescents' capacity to contribute in the home. By investigating bi-directional affects, researchers can also strengthen interpretations of directionality.

Current Study

In the present study, we capitalized on the daily diary method in a large, diverse sample of adolescents. We investigated whether family assistance is related physical activity, sleep, and physical symptoms within and across days. We tested the following key questions: (1) Is the provision of instrumental and emotional support to the family related to physical activity the same day, sleep that night, and physical pain symptoms the next day, controlling for prior day levels of each health experience? We did not have strong hypotheses for the directions of these direct associations, given mixed links with biological health markers in prior research (Armstrong-Carter, Ivory, et al., 2020; Chiang et al., 2016; Doane et al., 2018; Fuligni et al., 2009). (2) Do these associations differ on school days compared to non-school days? We hypothesized that family assistance would be associated with worse health experiences (i.e., less physical activity, less sleep, and more physical pain symptoms) during the week, when there were greater demands

from school work that might conflict, compared to on non-school days when adolescents have more time to complete different tasks. As follow up exploratory analysis, we tested whether these associations varied by adolescents' race, age, gender, or socioeconomic status (SES; operationalized as maternal education). Past research is equivocal, suggesting both that demographic characteristics may moderate associations between family assistance and adolescent functioning (Telzer & Fuligni, 2009b; Telzer, Masten, Berkman, Lieberman, & Fuligni, 2010), and also that family assistance operates similarly across groups of adolescents (Armstrong- Carter, Ivory, et al., 2020; Fuligni et al., 2009; Telzer & Fuligni, 2009b). (3) Are there bi-directional associations, such that physical health may influence whether adolescents feel physically well enough to help the family with instrumental tasks or emotional support? We hypothesized that adolescents would be more likely to provide instrumental and emotional support on days after they slept more, had fewer physical pain symptoms, and had engaged in more physical activity.

Methods

Participants

Participants were 396 adolescents (57.92% young women) between the ages of 11 and 18 years ($M_{\text{age}} = 14.57$ years, $SD = 1.39$ years). The sample was racially and ethnically diverse: 38.89% identified as non-Hispanic White (from here on referred to as White, $N = 154$), 26.77% Asian ($N = 106$, 17 of whom were mixed race [e.g., Asian and White]), 16.16% Hispanic/Latinx ($N = 64$, 12 of whom were mixed [e.g., Hispanic and White]), 11.36% African American ($N = 45$, 18 of whom were mixed [e.g., African American and White]), and 6.81% other race ($N = 27$, 16 of whom self-identified as other and 9 were mixed race). The sample was also socioeconomically diverse: approximately 10% of mothers had less than an 8th grade education, 13% did not complete high

school, 24% completed high school, 27% completed post-secondary education (college, trade, or vocational school), and 23% completed graduate school (3% declined to answer).

Participants were recruited as part of 7 sub-studies in the US Midwest and West. These sub-studies were all combined for the current sample. Because of this methodology, participants in some studies completed slightly different protocols (described further below). Differences were due to limitations of time and resources, and the protocol being improved over the course of the full study with slight alterations. All participants were recruited from their community using convenience sampling, including posting flyers at schools, posting on listservs serving ethnic minority families, recruiting participants from previous studies who agreed to be contacted for other research studies, and word of mouth. Participants were compensated \$10 in total for completing the daily diaries as well as a \$20 bonus if inspection of the data indicated that they had completed all the diaries on time. Participants provided written consent/assent and procedures were approved by the sponsoring institution's Committee on Human Subjects.

Procedure

Participants were provided with diary checklists; most participants (80%) were provided 14 days of diaries, whereas 20% of participants ($N = 83$) were only provided with 7 days of diaries. Most participants (89.82%) completed all days of their dairies ($M = 93.87\%$ of days, $SD = 15.51\%$ of days, Range = 14.29% – 100%). There were 4,369 total person-day observations (Level 1 reports). Diaries included both weekdays and weekends. The order of days differed between participants depending on the day of the week that they started, but all participants had the same proportion of weekday to weekend data if they completed all of the diaries. Participants were instructed to complete their diary in the evening before bedtime. Participants chose to complete the diaries either on paper (63.20%) or via a secure website (36.80%). Participants who responded with paper and

pencil were given 14 manila envelopes and an electronic time stamper (Dymo Corporation, Stamford, CT), which verified the time that checklists were completed. The time stamper is a small device that imprints the current date and time and is programmed with a security code so that the correct date and time cannot be changed. Participants were instructed to place their completed checklists into a sealed envelope each night and to stamp the seal of the envelope with the time stamper. Participants who completed surveys online were sent an email with the link to each daily diary survey, and the time and date of completion were recorded via the website. The daily diary checklists were 3 pages long and each took approximately 5 – 10 minutes to complete.

Measures

Daily Family Assistance. Participants responded to a set of questions on the daily checklist indicating whether they participated in any of 7 activities to help their family each day. These items yielded two dichotomous indexes of family assistance, each of which was coded as 0 = no assistance of that type that day, 1 = any assistance of that type that day. *Instrumental Assistance* was indexed from 6 items pertaining to instrumental tasks (e.g. did you run an errand for your parents or family, did you help to cook a meal for your family). *Emotional Support* was indexed with a single item: did you help your family today by providing emotional support to your family (i.e., listened, gave advice, comforted). The list of activities was derived from focus groups of adolescents and has been used successfully in previous studies (Bolger, Davis, & Rafaeli, 2003; Fuligni et al., 2009; Hardway & Fuligni, 2006). As in prior studies (e.g., Tsai et al., 2016), we used dichotomous measures to represent whether or not adolescents supported their family instrumentally and emotionally each day; this approach allowed us to directly compare unique associations with instrumental and emotional support. Notably, studies examining the amount of helping each day or helping versus not helping demonstrate nearly identical links to adjustment outcomes (Telzer & Fuligni, 2009b).

Daily Health Experiences. Participants responded to questions on the daily checklist indicating their health experiences each day. For *Sleep Time*, adolescents reported on the daily checklist the time they fell asleep the night before and the time they woke up each day. We then calculated the number of hours they slept each night. This method is commonly used in diary studies and responses are moderately correlated with sleep estimates obtained from wrist actigraphy indexes of sleep (Fuligni, Bai, Krull, & Gonzales, 2019; Matthews, Hall, & Dahl, 2014). This item yielded a continuous measure of sleep time (in hours) from the previous night, $M = 8.39$, $SD = 1.74$, Range 0 – 12.5. For follow up analysis, we also used the individual items reflecting participants' *wake time* each day and *sleep time* each night.

For *Physical Activity*, a subset of the sample ($n = 251$) responded to a single item on the daily checklist: "How much time did you engage in physical activity today?" This item yielded a continuous measure of physical activity time (in hours), $M = 1.56$, $SD = 1.60$, Range 0 – 12.

For *Physical Symptoms*, adolescents reported the extent to which they experienced a "Headache" or "Back, joint or muscle pain" that day. For each of the two items, adolescents responded on a Likert-type scale ranging from 1 to 5. The two items were averaged to create a single continuous measure indexing the amount of physical pain that adolescents experienced each day, $M = 1.78$, $SD = 0.94$, Range 1 – 5.

School days. On the daily diaries, adolescents indicated whether they attended school that day or not (1 = school day, 0 = not a school day). This variable was used as a moderator in our analysis.

Individual and family characteristics. Mothers reported their education level as an index of family socio-economic status (SES), which ranged from 0 (representing less than 8th grade completed) to 6 (representing completed graduate school). In addition, adolescents self-reported

their age, gender, and race/ethnicity. Age was entered as numeric age. Gender was dichotomous and was coded Young Men = 0 and Young Women = 1. Race was dummy coded within each race (i.e., African American = 1, not African American = 0) and categorized into five groups: African American, Asian, Hispanic/Latinx, White and Other Race.

Data Analysis

Our aim was to understand how provision of instrumental and emotional support to family relates to health experiences within and across days, and if these associations vary by school days, compared to non-school days. We conducted linear mixed effect models that nested days (Level 1) within participants (Level 2). We person-centered all Level 1, daily predictors, and we included on the intercept person-mean values for each of our daily predictors. This statistical approach helps to isolate within-subject vs between-subject effects (Curran & Bauer, 2011; Wang & Maxwell, 2015). To increase the robustness of our findings, we additionally controlled for prior-day levels of each health experience or helping behavior (i.e., to associations over and above prior day levels). We used full estimation maximum likelihood (FIML) via the “gsem” command in Stata (StataSE, Version 15.1.632).

Model 1 tested instrumental and emotional support as simultaneous Level 1 (i.e., daily) predictors of physical activity the same day, sleep that night, and physical symptoms the next day, controlling for school day vs not school day. Each dependent variable (i.e., physical activity, sleep, and physical symptoms) was run separately. Model 2 additionally included an interaction term between whether it was a school day and each helping behavior (i.e., instrumental and emotional support). To probe significant interactions, we used the simple slopes technique (Aiken, West, & Reno, 1991) testing the relations between family assistance and each health variable for school days versus non-school days. We conducted additional models to test demographic differences in these

associations (i.e., cross-level interactions) and potential bi-directional effects (i.e., each health experience predicting instrumental and emotional support), as described further below. Aside from the one item which was only given to a subset of participants as noted above (i.e., *Physical Activity*), the percentage of missing data ranged from 5.01% to 10.27% of days depending on the variable.

Results

Sample Characteristics and Bivariate Correlations

Table 1 displays descriptive statistics separated by school day versus non-school day. Adolescents provided instrumental assistance to family on 72% of days and emotional support to family on 23% of days. On non-school days compared to school days, adolescents provided more instrumental assistance, slept more, and engaged in more physical activity. Emotional support and physical symptoms did not differ on school days compared to non-school days.

Table 1 also displays bivariate correlations of mean values across days between study variables. On average, adolescents who provided instrumental assistance more frequently also provided emotional support more frequently. At the daily level, instrumental assistance and emotional support also tended to co-occur on the same days ($\beta = .04$, $SE = .02$, $p = .025$). Adolescents who provided instrumental assistance more frequently were older and had lower family SES. Adolescents who provided emotional support more frequently were also older, but did not differ in family SES.

In addition, adolescents who provided instrumental assistance more frequently slept more, and experienced more physical symptoms, but showed no differences in physical activity. Adolescents who provided emotional support more frequently experienced more physical symptoms, but did not differ in amount of sleep or physical activity. Finally, adolescents who experienced more physical symptoms engaged in more physical activity and slept less.

Additional independent samples T-tests showed that girls provided instrumental assistance more frequently ($M = 0.78$, $SE = 0.01$) compared to boys ($M = 0.63$, $SE = 0.02$, $p < .001$). Similarly, girls provided emotional support more frequently ($M = 0.27$, $SE = 0.01$) compared to boys ($M = 0.19$, $SE = 0.01$, $p < .001$). Girls also experienced more physical symptoms ($M = 1.88$, $SE = 0.02$) compared to boys ($M = 1.61$, $SE = 0.02$, $p < .001$). Boys and girls did not differ in their levels of sleep or physical activity ($ps > .21$).

Daily Links between Family Assistance and Health Experiences

Table 2 displays daily-level, within-person associations (i.e., mean-centered daily-level variables). We first tested whether daily instrumental assistance and emotional support to family were uniquely associated with physical activity the same day, sleep that night, and physical symptoms the next day, controlling for levels of each health behavior the previous day. These direct associations are shown in Model 1 under the header “Mean-centered daily-level variables”. When adolescents provided emotional support to the family, they slept more hours that night and experienced fewer physical symptoms the next day. There were no direct daily associations between emotional support and physical activity, or instrumental assistance and any health experience.

To test the robustness of our findings, we applied Bonferroni correction by multiplying each observed (uncorrected) p -value by the number of comparisons made (i.e., 3 based on the 3 outcomes; Bland & Altman, 1995). The link between emotional support and sleep remained significant ($p = .015$). The link between emotional support and physical symptoms became marginally significant ($p = .057$).

To further understand why emotional support was linked to sleep time and physical symptoms, we conducted follow-up mediation analyses that tested indirect effects: first via the time that adolescents went to bed that night, and next via the time that adolescents woke up the following

morning. The indirect effect of emotional support on sleep time via wake-up time was significant ($\beta = .05$, $SE = .02$, $p = .029$). Specifically, adolescents woke up later the morning after providing emotional support ($\beta = .21$, $SE = .10$, $p = .028$), and slept for more total hours when they woke up later ($\beta = .23$, $SE = .10$, $p < .001$), which partially explained the association between providing emotional support and sleep time ($\beta = .05$, $SE = .02$, $p = .029$). In this mediation model, the direct association between providing emotional support and sleep time became marginal ($\beta = .10$, $SE = .05$, $p = .062$). This suggests that providing emotional support is associated with more sleep that night because adolescents sleep longer the next morning. There were no other significant indirect effects ($ps > .718$).

Variations by School Day

Our next model tested whether the daily-level associations between instrumental and emotional support and health experiences differed depending on whether it was a school day or not. Table 2 Model 2 displays these interactive associations. Providing instrumental assistance significantly interacted with school day to predict physical activity. As shown in Figure 1, when adolescents provided instrumental assistance to the family, they engaged in less physical activity the same day when it was a school day, but not when it was a non-school day. This result remained significant ($p = .018$) with Bonferroni correction. There were no other significant interactions.

Consistent Effects Across Gender, Age, SES, and Race/Ethnicity

To probe consistency of our findings across demographic groups, we tested whether instrumental and emotional support related to health experiences differently depending on adolescents' gender, age, family SES, and race/ethnicity. We modeled each health experience (i.e., physical activity, sleep, and physical symptoms the next day) as a function of instrumental assistance and emotional support (simultaneously) with gender, age, family SES, and race/ethnicity entered as

cross-level interactions. Young men and White youth served as the reference group. There was one significant interaction with Asian ethnicity ($p = .018$), but the simple slopes were not significant, and when adjusting for multiple tests, none of these 48 interactions were significant ($ps > .054$).

Health Experiences Preceding Family Assistance

To investigate the possibility of bi-directional effects, we tested binary logistic multilevel models in which each health experience simultaneously predicted instrumental and emotional support the same day, controlling for levels of instrumental assistance and emotional support the previous day. Table 3 displays these results. Adolescents were 18% more likely to provide instrumental assistance after they had slept more the previous night. There were no other significant direct associations or interactive associations (i.e., between health experience and school day) predicting helping behaviors in these models.¹

Discussion

The goal of this study was to understand how family assistance relates to adolescents' physical health experiences within and across days. In a large and diverse sample of adolescents, we investigated how adolescents' daily provision of instrumental and emotional support to the family predicted their physical activity that day, sleep that night, and physical symptoms the next day. We found that when adolescents helped a family member by listening or giving advice, they slept more that night and experienced fewer physical symptoms (i.e., headache, stomachache) the next day, over and above prior day levels. Moreover, on school days when adolescents helped the family with tangible household chores, they engaged in less physical activity. These results were consistent across individual differences in gender, age, ethnicity, and socio-economic status. Together, these

¹ We conducted additional sensitivity analyses that adjusted for time trends over the course of the daily diaries (i.e., controlled for the day of study). This approach did not change the observed pattern or significance of results.

findings suggest that helping the family may “get under the skin,” as evidenced in prior work by higher inflammation and BMI (Fuligni & Telzer, 2013), in part by influencing patterns of sleep, physical activity, and physical experiences of pain.

Emotional Support is Linked to More Sleep That Night

We found that when adolescents helped a family member by listening or giving advice (but not when they helped with instrumental tasks), they slept more that night. To our knowledge, this represents the first evidence linking prosocial behavior towards family and sleep patterns on a daily level. Consistent with biopsychosocial models (Becker et al., 2015; Engel, 1977), this finding highlights how a key daily experience in the home—namely, helping the family—may set the stage or context for adolescents to set and maintain adequate sleep. Since we controlled for prior-day sleep levels, our results also offer some evidence that this may be at least in part a causal or predictive effect. Moreover, follow-up analysis revealed that this association was partially because adolescents slept in later the morning after providing instrumental assistance; they did not go to sleep earlier that night. This finding is consistent with prior sleep research illustrating that adolescents’ sleep duration is more often impacted by wake time compared to bedtime (Becker et al., 2015).

An increase in sleep as a function of providing emotional support is a meaningful outcome, as sleep is a key index of well-being. Furthermore, sleep contributes to a variety of other positive outcomes in youth, ranging from school achievement and school behaviors (Quinn & Duckworth, 2007) to physical health and mood, both in the short and long term (El-Sheikh, 2011). One possible mechanism is that providing emotional support to the family promotes youths’ feelings of connectedness with family members—which in turn helps them to feel at peace and take sufficient rest that evening. Helping the family is associated with increased feelings of personal fulfillment (Armstrong- Carter, Ivory, et al., 2020), concern for others, and empathy (Padilla-Walker &

Christensen, 2011). These positive emotions and feelings of connectedness could enable adolescents to rest longer the following morning. This could also explain why providing instrumental assistance to the family—which is more focused on tangible household tasks and is less of a relational process—was *not* associated with adolescents' sleep duration. Consistent with this idea, providing emotional support to a close friend, but not instrumental assistance, was associated with greater emotional well-being in a small sample of older adolescents (Morelli et al., 2015).

These results could be considered surprising, however. Correlational analyses across days and one daily-level analysis in prior work found that time spent helping the family was not related to sleep time (Chiang et al., 2016; Doane et al., 2018; Hardway & Fuligni, 2006). Moreover, providing emotional support involves adolescents' awareness and response to another person's challenges or worries (Tsai et al., 2016). In light of this, it could have been expected that adolescents may sleep *less* after providing emotional support, due to worries that they have heard their loved-one express, or increased stress-hormones waking them up in the morning. To clarify why providing emotional support is associated with greater sleep duration, future research should investigate psychological experiences which may mediate and moderate this association. For example, it is possible that providing emotional support is only associated with greater sleep when the emotional support is moderate and connecting, but not when providing emotional support is intense, ongoing or taxing. Providing emotional support can be particularly burdensome in families with economic hardship or parental illness (Hooper, L'Abate, Sweeney, Gianesini, & Jankowski, 2014), and may be related to less optimal sleep in these family contexts.

Emotional Support is Linked to Fewer Physical Symptoms the Next Day

We also found that when adolescents provided emotional support to the family, they felt physically better the next day (i.e., they experienced less physical pain such as headaches and

backaches), over and above same-day levels. It is possible that when adolescents provide emotional support, they are sitting or resting more, which helps them to feel better the next day. Providing emotional support may also co-occur with receiving emotional support, which can reduce physical symptoms of pain (Eccleston, Crombez, Scotford, Clinch, & Connell, 2004). Future research should investigate the conditions under which adolescents provide emotional support, in order to shed light on why providing emotional support may be associated with reduced pain the next day. For example, adolescents whose parents were more knowledgeable about adolescents' daily activities (e.g., where adolescents spent their time) experienced fewer physical health symptoms including headaches and stomachaches (Lippold et al., 2016). Since adolescents provide emotional support in the home, parental awareness of adolescents' experiences could also partially explain why providing emotional support is associated with reduced physical symptoms.

These results could also be considered surprising in light of some prior research. Average levels of family assistance are longitudinally associated with higher levels of inflammation (Fuligni et al., 2009), and inflammation is positively associated with physical pain (Parkitny et al., 2013). Similarly, cross-sectional research shows that greater family obligations are associated with greater airway inflammation and parent-reported asthma symptoms among adolescents in low SES homes (Lam et al., 2018). Moreover, adolescents who provide significant, time-consuming, ongoing amounts of family caregiving experience more physical health problems (Becker, 2007; Hibbert, 2010). One reason for the divergence in findings is because our study captures within-person fluctuations from day to day, whereas prior studies examining family assistance and health have focused more on between-person differences (i.e., comparing adolescents who help relatively more versus less; Armstrong-Carter, Olson, & Telzer, 2019). Thus, at the between-person level, adolescents who provide more chronic or intense levels of family assistance may suffer physically

in the long-term, whereas within adolescents, daily fluctuations in family assistance may be associated with alleviated physical pain. Our bi-variate correlations support this interpretation by showing that both instrumental and emotional support are positively correlated with physical symptoms. However, neither instrumental and emotional support were significantly associated with physical symptoms in the regression models.

Another reason for this divergence from prior work—i.e., that we found emotional support was related to fewer physical symptoms, but some prior studies suggest family assistance might be related to more physical symptoms—may center around the intensity of emotional support. Providing high levels of ongoing emotional support to family is relatively uncommon (such as in families with economic hardship or parental illness), and this taxing experience of intense emotional support provision may not have been captured in our sample as it was in prior research (Hooper et al., 2014). Future research should investigate whether providing emotional support is divergently related to physical pain depending on the intensity and duration, as well as family characteristics such as parental illness or family needs. A third possible reason for this divergence is that prior research has focused largely on instrumental assistance (e.g., Fuligni et al., 2009; Doane et al., 2018), whereas we found that emotional support was uniquely associated with reduced physical pain. Finally, the link between emotional support and reduced physical symptoms the next day should also be interpreted with caution and replicated in future research, because Bonferroni correction reduced this result to marginal.

Instrumental Assistance is Linked with Less Physical Activity on School Days

Our findings also demonstrated that on school days when adolescents helped their families with at least one instrumental household task (e.g., cooking, cleaning), they engaged in fewer hours of physical activity that day. In contrast, there was no association between instrumental assistance

and physical activity on non-school days. This result suggests that family assistance might interfere with adolescents' available time or opportunities for physical activity and exercise when it occurs in the context of other daily demands. When adolescents help the family on school days in the context of other academic and social demands, they may be less likely to exercise, participate in sports, or spend time outdoors. Moreover, when adolescents help the family on school days, conflict with other demands may make the experience more stressful (Siskowski, 2006) and detract from adolescents' motivation, time or ability to engage in physical activity that day (Debeuf et al., 2018; Lang et al., 2016). In contrast, when adolescents help the family on the non-school day, there may be sufficient time to juggle both (i.e., helping the family, and engaging in physical activity) so that the two activities do not interfere with each other.

Adolescents Are More Likely to Provide Instrumental Support After They Sleep More

We also found that adolescents were more likely to help their families with instrumental tasks the day after they had slept more—a pattern that was consistent across the school week and non-school days. In contrast, adolescents' provision of emotional support did not vary by duration of sleep the previous night. Sufficient sleep may enable adolescents to support their family by helping them to maintain positive mood, energy, motivation, and awareness of their family's instrumental needs. Conversely, inadequate sleep may detract from adolescents' ability to contribute to the family unit, if adolescents feel fatigued, unmotivated, or need to rest during the day. Decades of research have shown that sleep quality and quantity are crucial for adolescents' ability to engage positively in their family and peer relationships, as well as academic settings (Dahl et al., 2018; El-Sheikh, 2011). We extend this to family assistance behaviors—revealing that sleep duration also supports adolescents' capacity to contribute in the home.

Limitations and Future Directions

We acknowledge limitations. In total, we found three significant results: two direct associations and one interactive association. Although intriguing, our results are not overwhelming, and there were more non-significant effects than significant effects. Future work should replicate our results in other larger samples. In addition, there was some missing data, due to the daily nature of diary data. In particular, days that adolescents did not respond to the diaries might represent the most difficult days at home. Further, our measures of family assistance were dichotomous, indexing whether or not the adolescent provided any instrumental or emotional support that day, and do not reflect the amount of time spent on each activity, or the variation in different activities beyond the instrument/emotional categorization. Future work should incorporate more detailed measures that capture the amount of time, time of day, and intensity of family assistance. Similarly, our measures of sleep, physical activity and physical symptoms were subjective. Sleep diary measures are moderately correlated with actigraphy measures that are more objective, but sometimes slightly over-estimate sleep compared to actigraphy (Matthews et al., 2014; Short, Gradisar, Lack, Wright, & Carskadon, 2012). Future research should utilize actigraphy to obtain more objective, movement-based measures of sleep and physical activity.

In addition, future research should measure adolescents' motivations for providing instrumental and emotional support, as this may be an important moderator of the associations with physical health experiences (Eisenberg, VanSchyndel, & Spinrad, 2016). Future studies may also benefit from capturing more detailed features of adolescents' home environment and experiences, including the type of housing unit, number of siblings, parent relationship status, and immigration generation. Finally, although the present study utilizes daily diary methods that can account for individual differences and thus offers robust predictive power — particularly by controlling for

prior-day levels and examining across-day spillover effects that control for same-day levels — causality cannot be determined in this study.

Conclusions

Biopsychosocial models underscore the importance of studying adolescents' physical health in the context of their daily activities (Engel, 1977). This study extends emerging interest in understanding how adolescents' daily provision of assistance to the family impacts their physical well-being. Prior research demonstrates that family assistance is a meaningful and rewarding experience (Armstrong- Carter, Ivory, et al., 2020; Telzer & Fuligni, 2009b), but can also be taxing and associated with biological markers of physical risk (Doane et al., 2018; Fuligni et al., 2009; Telzer & Fuligni, 2009a). To shed light on how family assistance “gets under the skin” (Fuligni & Telzer, 2013), we investigated how family assistance relates on the daily level to experiences of physical activity, sleep, and pain. Our findings reveal that providing emotional support to the family is associated with increased sleep and decreased physical pain, potentially promoting physical well-being downstream. However, providing instrumental assistance to the family may detract from time spent in physical exercise when it occurs on school days, perhaps due to greater conflicting academic and family demands. Reciprocally, adequate sleep may enable adolescents' to contribute to the family via helping with instrumental tasks. As such, family assistance is closely linked with both positive and negative markers of behavioral health, depending on the type of assistance, when during the week it occurs, and the specific health behavior.

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Table 1. Bivariate Correlations Between Study Constructs and Descriptive Statistics

	1	2	3	4	5	6	Non-School Days		School Days	
							<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1. Age	1									
2. Maternal Education	-0.11***	1								
3. Instrumental Assistance to Family	0.11***	-0.16***	1				0.77	(0.42) ¹	0.67	(0.47) ²
4. Emotional Support to Family	0.03*	0.03	0.14***	1			0.24	(0.43) ¹	0.23	(0.42) ¹
5. Physical Activity Time	0.11***	0.01	0.03	0.05	1		1.98	(1.79) ¹	1.29	(1.39) ²
6. Sleep Time	-0.15***	0.02	0.13***	0.01	0.00	1	8.78	(1.94) ¹	7.76	(1.50) ²
7. Physical Symptoms	0.14***	-0.07***	0.05**	0.08***	0.12***	-0.15***	1.79	(0.98) ¹	1.74	(0.89) ¹

Note. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Means with different numbers are significantly different; means with the same number are not significantly different.

Table 2.

Multilevel linear regression models demonstrating direct and interactive associations between family assistance (instrumental assistance and emotional support) and health experiences (physical activity, sleep and physical symptoms).

	Model 1: Direct Associations				Model 2: Interactive Associations			
	Physical Activity Same Day	Sleep Time That Night	Physical Symptoms Next Day	Physical Activity Same Day	Sleep Time That Night	Physical Symptoms Next Day	Physical Symptoms Next Day	
	β	β	β	β	β	β	β	
	SE	SE	SE	SE	SE	SE	SE	
<i>Mean-Centered Daily-Level Variables</i>								
Previous Day Outcome	0.05+	(0.03)	-0.00	(0.01)	0.16***	(0.02)	0.05+	(0.03)
Instrumental Assistance	-0.12	(0.09)	-0.01	(0.05)	-0.05+	(0.03)	-0.46**	(0.15)
Emotional Support	0.06	(0.11)	0.15**	(0.05)	-0.08*	(0.03)	0.25+	(0.14)
<i>Person-Mean Average-Level Variables</i>								
Outcome	0.67***	(0.02)	0.24***	(0.03)	1.06***	(0.01)	0.67***	(0.03)
Instrumental Assistance	0.00	(0.10)	0.03	(0.10)	0.02	(0.03)	-0.36*	(0.16)
Emotional Support	0.01	(0.09)	0.15	(0.10)	-0.00	(0.03)	0.19	(0.13)
<i>Covariates and Interactions</i>								
School Day	-0.25***	(0.07)	-0.18***	(0.04)	0.01	(0.02)	-0.47***	(0.13)
Instrumental Assistance X School Day							0.43**	(0.16)
Emotional Support X School Day							-0.27+	(0.15)
Constant	-0.89***	(0.10)	-1.96***	(0.22)	-1.90**	(0.03)	-0.68***	(0.14)
Observations	558		2,586		3,525		558	
Number of groups	147		288		386		147	

Note. * p<0.05; ** p<0.01; *** p<0.001.

Table 3.

Multilevel logistic regression models: Health experiences (physical activity, sleep and physical symptoms) predicting adolescents' provision of instrumental assistance and emotional support to family the same day.

	Direct Associations				Interactive Associations			
	Instrumental Assistance		Emotional Support		Instrumental Assistance		Emotional Support	
	β	SE	β	SE	β	SE	β	SE
Previous Day Outcome	1.28***	(0.26)	1.47***	(0.31)	1.43***	(0.27)	1.59***	(0.33)
Physical Activity	-0.12	(0.08)	0.04	(0.08)	-0.15	(0.10)	-0.00	(0.11)
Sleep Time	0.18*	(0.09)	0.18+	(0.10)	0.08	(0.12)	0.22+	(0.13)
Physical Symptoms	0.14	(0.15)	0.26	(0.18)	0.36	(0.24)	0.37	(0.25)
School Day			-0.79**	(0.26)			-0.64*	(0.31)
Physical Activity X School Day					0.03	(0.24)	0.15	(0.27)
Sleep X School Day					0.29	(0.32)	-0.43	(0.39)
Physical Symptoms X School Day					-0.35	(0.27)	-0.23	(0.29)
Constant	-0.95	(0.93)	-4.13***	(1.02)	-0.45	(1.30)	-4.70***	(1.38)
Observations	988		989		876		878	
Number of groups	194		193		173		174	

Note: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Figure 1

Adolescents engaged in less physical activity on days that they provided instrumental assistance to the family when it was a school day, but not when it was a non-school day.

