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Midlife Adults' Daily Support to Children and Parents: Implications for Diurnal Cortisol

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Abstract

Objectives: We examined whether providing daily support to generations above and below has a differential impact on midlife adults' diurnal cortisol. **Method:** Midlife adults ($N = 151$) from the *Family Exchanges Study* Wave 2 reported daily practical support, emotional support, and advice to adult children and aging parents and collected saliva samples four times a day for 4 days. **Results:** Midlife adults experienced steeper cortisol awakening responses and steeper declines in cortisol (favorable cortisol functioning) on days when they provided support to children. Yet, they experienced higher overall cortisol levels (unfavorable cortisol functioning) on days when they provided support to aging parents. **Discussion:** Providing daily support to children may be rewarding to midlife adults, but support to parents may be associated with physiological stress. Findings advance understanding of midlife

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adults' helping behaviors to multiple generations and carry implications for older adults' well-being by encouraging effective support strategies.

Keywords
intergenerational relationships, daily support, cortisol, biomarkers, health

Midlife adults frequently provide support to generations above and below (i.e., aging parents and adult children). Providing support to different generations may have differential impacts on these midlife adults' health. For example, providing support to grown children influences midlife adults' psychological well-being such that they report better daily mood, whereas midlife adults helping aging parents report negative mood (Fingerman, Kim, Tennant, Birditt, & Zarit, 2016). Nevertheless, it is unclear whether the associations between providing daily support and psychological health also holds true for midlife adults' physiological health. This study draws on daily reports to examine the physiological implications of midlife adults' helping behaviors to different generations within one family.

Exposure to demands activates the hypothalamic–pituitary–adrenal (HPA) axis—a complex series of physiological responses and adaptations that regulates the body under stress (Fries, Dettenborn, & Kirschbaum, 2009). Activation of the HPA axis results in the release of the hormone cortisol. Cortisol follows a distinct diurnal rhythm characterized by an increase in cortisol levels within 20 to 30 min after awakening in the morning (i.e., cortisol awakening response [CAR]), followed by a steady decline until bedtime (i.e., daily decline [DEC]). Steeper diurnal cortisol slopes serve as important indicators of better health (Adam & Kumari, 2009), whereas flatter CARs and DECs are associated with repeated or chronic stress and poorer health (Miller, Chen, & Zhou, 2007). In addition, the accumulated cortisol level over the course of the day or daily total output is measured as the area under the curve (i.e., AUC). Higher levels of daily total output can be physiologically taxing and are linked to negative physical and mental health outcomes overtime such as poorer cardiovascular functioning and depression (Messerli-Bürgy et al., 2012; Steptoe, 2007).

Research examining the physiological implications of providing support on a daily basis has focused on family caregiving. In general, this work suggests that in situations where providing daily support to a relative is intensive and stressful, diurnal cortisol may become dysregulated (Klein et al., 2014). For example, Liu and colleagues found that dementia family caregivers showed blunted CAR and flatter morning decline on days when they provided active care (Liu, Almeida, Rovine, & Zarit, 2018). Savla and colleagues (2013) found that on days when caregivers self-reported mood disturbances of their spouses with mild cognitive impairment, they also experienced a flatter cortisol rhythm with elevated daily total output. Yet, the physiological implications of providing everyday support that is less intensive (e.g., emotional support, advice, help with daily tasks) is not clear.

Midlife adults provide a variety of types of everyday support to family members. In the current study, we examined practical support, emotional support, and advice. Practical support includes helping with household tasks or errands (Fingerman et al., 2016). Emotional support refers to listening to someone's concerns or being available when someone is upset (Suitor, Pillemer, & Sechrist, 2006). Advice refers to offering information or suggestions (Feng & Feng, 2018). Prior research shows that providing practical support and assistance may be considered physiologically stressful because it could be costly in terms of having fewer resources such as time, money, and energy (Konrath & Brown, 2013). In addition, providing emotional support has been found to be a double-edged sword with differential implications for physiological stress and daily mood (Bangerter et al., 2018). People providing emotional support to others may have decreased cortisol levels (Priem & Solomon, 2015), yet such support can itself be a source of stress due to the fact that it may involve exposure to others' pain. Regarding advice, however, it is less clear whether providing this form of support is associated with midlife adults' diurnal cortisol regulations. Studies have shown that giving advice may create stress because individuals may struggle between wanting to help (Batson, 2011) and imposing on the recipients' autonomy (Rafaeli & Gleason, 2009).

Overall, a general distillation of the literature suggests that providing support is both favorable and unfavorable for midlife adults' well-being (Birditt, Hartnett, Zarit, Fingerman, & Antonucci, 2015; Fingerman et al., 2016). These patterns may differ by generation. On the one hand, providing support to adult children may promote a sense of purpose, generativity, and satisfaction (Birditt et al., 2015; Giarrusso, Feng, & Bengtson, 2005). The flow of intergenerational support is typically downstream, whereby midlife parents provide frequent support to adult children (Fingerman et al., 2011). Such support may often be considered normative for midlife parents (Fingerman et al., 2012). Furthermore, the developmental stake hypothesis posits that parents view younger generations as a continuation of their lives and tend to be more invested in their children than in their parents (Birditt et al., 2015; Giarrusso et al., 2005). Thus, providing support to grown children on a daily basis may relate to favorable diurnal cortisol regulations.

On the other hand, based on the stress process model and the family system's perspective, providing support to aging parents can impose stress and burden on midlife adults (Fingerman et al., 2016; Pearlin, Mullan, Semple, & Skaff, 1990). Aging parents' health conditions and needs may call for help from midlife adults and may occur in ways that are inconvenient or taxing. Therefore, midlife adults' provision of support to aging parents on a daily basis can be a stressor and relate to unfavorable diurnal cortisol regulations. For example, prior research examining the link between everyday support and diurnal cortisol has revealed that when midlife adults give support to aging parents with health problems, they exhibit higher total cortisol output on the following day (Bangerter et al., 2018). Furthermore, prior research has linked providing help to aging parents with poor psychological health among midlife adults (Garand, Dew, Eazor, DeKosky, & Reynolds, 2005; Pinquart & Sörensen, 2006).

We also considered the following covariates of diurnal cortisol regulation that are commonly examined in prior studies: participants' gender and age, education, employment status, neuroticism, and physical health. Women are more likely to report interpersonal stressors and tend to be more reactive to such stressors than men both emotionally (Almeida, 2005) and physiologically (Saxbe, Repetti, & Nishina, 2008). Prior research demonstrates that young and middle-aged adults report greater frequency of stressors and perceive stressors as more severe than older adults (Almeida & Horn, 2004); increasing age may also relate to a greater cortisol concentration in the first waking sample and the awakening response (Clow, Thorn, Evans, & Hucklebridge, 2004). In addition, low socioeconomic status has been associated with salivary cortisol levels (Kunz-Ebrecht, Kirschbaum, Marmot, & Steptoe, 2004) and we controlled for education. This study also included employment status. Individuals with lower grade employment show an increase in some aspects of the awakening response (Kunz-Ebrecht et al., 2004). Personality variables such as neuroticism have also been shown to be associated with dysregulated salivary cortisol responses (Hauner et al., 2008). Furthermore, self-reported health is an important factor associated with elevated cortisol levels (Miller et al., 2007). We also included variables commonly associated with cortisol dysregulation such as wake time, weekend versus weekday, sleep quality, smoking, and medication use (Hansen, Sato, & Ruedy, 2012; Matta, Fu, Valentine, & Sharp, 1998; Stawski, Cichy, Piazza, & Almeida, 2013; Williams, Magid, & Steptoe, 2005).

In sum, the current study examined the physiological implications (i.e., diurnal cortisol) of midlife adults' everyday support to younger and older generations including giving practical support, emotional support, and advice. The primary benefit of the daily diary method is that it permits examination of relationship events and experiences in their ecological context and reduce the likelihood of retrospective reporting bias (Bolger, Davis, & Rafaeli, 2003). The current study contributes to the existing literature by highlighting how providing everyday support may be associated with midlife adults' diurnal cortisol rhythms and daily total output. Because there can be lingering effects of everyday support on the stress system (Bangerter et al., 2018), we considered midlife adults' same-day and prior-day support provision to their adult children and their aging parents in examining cortisol regulation. We proposed the following hypotheses:

Hypothesis 1: Midlife adults would experience favorable same-day and next-day diurnal cortisol rhythms and output (steeper rhythms, lower daily total output) on days when they provided support to adult children.
Hypothesis 2: Midlife adults would experience unfavorable same-day and next-day diurnal cortisol rhythms and output (flat rhythms, higher daily total output) on days when they provided support to aging parents.

Method

Sample and Procedure

Midlife adults participated in the *Family Exchanges Study* Wave 2 conducted in 2013. Participants were recruited from the Philadelphia Metropolitan Statistical Area for Wave 1 in 2008. In Wave 2, after completing a 1-hr main survey, a random selection of eligible participants was invited to participate in a diary study consisting of brief telephone interviews each day for 7 days. Of the 270 midlife adults invited to complete the diary study, 248 completed the daily interviews. Of those 248 participants who participated in the daily diary interviews, 81% (n = 203) completed the 4-day saliva component of the study. Nine participants were excluded from the analysis (night shift workers n = 2; participants who did not have any valid saliva samples n = 7), resulting in 194 participants. We also selected midlife adults who had at least one living child and one living parent; therefore, a total of 151 participants (M_{age} = 55.65) were analyzed.

Participants completed five to seven daily diary interviews with a mean of 6.87 interviews (SD = 0.37) and provided saliva on average 3.99 (SD = 0.07) of the diary days. Given that waking up in the late afternoon is associated with cortisol output (Federenko et al., 2004; Granger, Hibel, Fortunato, & Kapelewski, 2009), we excluded the days in which participants woke up in the afternoon (n = 5). Thus, of the total 563 valid days, 5 days were removed from the analysis, resulting in a total of 558 days.

For the saliva component, participants received collection kits with salivettes and an instruction manual via mail after they completed the main survey and scheduled their first diary call. The kits included salivettes, test tubes color-coded by time and day, an instruction booklet with photographs and written at the eighth grade level, and paid return Fed Ex envelope. Interviewers also asked participants about difficulties collecting their samples during the daily interviews. Saliva samples were provided (a) upon waking, before they got out of bed; (b) 30 min after waking; (c) at noon; and (d) before bed. Participants were instructed to not eat or drink anything other than water 30 min prior to providing saliva samples as these products alter cortisol concentrations. Participants were also instructed to not brush their teeth prior to providing the 30 min after waking sample. Participants recorded the time of each sample collection and whether they had any problems. Participants stored the samples in the refrigerator and were given instructions to return the samples via overnight mailing. Participants received $50 for completing the diary surveys and all four saliva days.

Measures

Support. During each daily interview, participants reported whether they had provided practical support, emotional support, and advice for each parent and each child on that day. We generated variables to measure whether midlife participants had provided each type of support to any parent and any child each day—that is, 3 types × 2 generations = 6 variables. We drew on the social support literature (Vaux, 1988) to define (a) practical help as fixing something around the house, running an errand, or providing a ride; (b) emotional support as listening to concerns or being available when the other is upset; and (c) advice as providing information or suggestions about things they could do or helping with a decision.

Cortisol. Saliva samples were stored at −80°C until assay. After thawing, salivettes were centrifuged at 3,000 rpm for 5 min, which resulted in a clear supernatant of low viscosity. Salivary concentrations, reported in nmol/L, were measured using commercially available chemiluminescence immunoassay with high sensitivity (IBL International, Hamburg, Germany).

Standard procedures in analyzing cortisol data were followed (Adam & Kumari, 2009). Cortisol values were examined on a daily basis and removed if participants did not complete a daily interview, participants did not indicate time of sample collection, at least one cortisol value was over 60 nmol/L (indicating contamination of the sample; Steptoe, Siegrist, Kirschbaum, & Marmot, 2004), participants were awake for less than 12 hr or more than 20 hr, or woke up past 12:00 noon. The entire day was excluded if there was less than 15 min or more than 60 min between the waking cortisol sample and the 30-min cortisol sample. The skew and kurtosis of each cortisol value was assessed. Due to the non-normal distribution of the cortisol levels, the natural log was calculated for all cortisol values and used for all analyses.

CAR. The CAR was calculated for each day by subtracting the first salivary cortisol measure of the day (immediately upon waking) from the second measure (30 min after waking) and then dividing the difference scores by the time interval between the two measures (Fries et al., 2009).

Cortisol DEC. The DEC was calculated for each day by subtracting the second salivary cortisol measure of the day (30 min after waking) from the last measure of the day (before bed) and then dividing the difference scores by the time interval between the two measures (Fries et al., 2009).

AUC. Accumulated cortisol levels over the course of the day or daily total output were calculated as AUC based on all four saliva samples using the trapezoidal method (Pruessner, Kirchbaum, Meinlschmid, & Hellhammer, 2003).

Covariates. We included participants' gender (0 = *female*, 1 = *male*), age, education, employment status, neuroticism, and physical health as covariates of diurnal cortisol regulation. Participants reported their years of education. Participants also indicated their employment status (0 = *not employed full-time*, 1 = *employed full-time*). Neuroticism was assessed during the main interview using a personality measure from the national MIDUS study assessing the extent to which four characteristics described them (i.e., moody, worrying, nervous, calm; $\alpha = .68$) on a 5-point scale ranging from 1 (*not at all*) to 5 (*a great deal*) (Lachman & Weaver, 1997). We averaged ratings of these four items to calculate neuroticism. Participants also rated their physical health during the past 12 months on a 5-point scale from 1 (*poor*) to 5 (*excellent*; Idler & Kasl, 1991).

We included daily level control variables as well. Previous research has shown that cortisol can vary by wake time (Williams et al., 2005). Thus, we controlled for the time participants woke up in all models. We included day of week to determine whether the data were collected on a weekend day. In each daily interview, participants reported whether they smoked cigarettes and rated their sleep quality on the preceding night from 1 (*poor*) to 5 (*excellent*). Finally, participants indicated whether they had taken any of the following medications that day: over the counter/prescription allergy medication, steroid inhaler, other steroid medication, medications/creams containing cortisone, birth control pills, other hormonal medications, or antidepressants/antianxiety medication.

Analytic Strategy

We analyzed associations between support provision and diurnal cortisol regulation each day. We used multilevel modeling to handle multiple observations nested within/reported by each participant (e.g., multiple days, multiple within-day cortisol assessments). Specifically, we estimated two-level multilevel models with random intercepts using SAS PROC MIXED (Littell, Milliken, Stroup, & Wolfinger, 1996). Models examined whether support provisions influenced three measurements of diurnal cortisol regulation: rhythms (i.e., CAR, DEC), and daily total output (i.e., AUC). The first level was day (i.e., daily salivary patterns) and the second level was participant. Thus, daily salivary patterns (*Level* 1) are nested within participants (*Level* 2).

We controlled for midlife adults' gender, age, neuroticism, physical health status, wake time, weekend versus weekday, sleep quality, smoking, and medication use. We entered four predictor variables in each model: prior-day support provision to any child and any parent, and same-day support provision to any child and any parent. We entered these independent variables separately for each type of support: practical, emotional, and advice. In other words, for each of the three outcomes, we had three models reflecting the three types of support (nine models in total).

Results

Preliminary Analysis

We first examined different types of support midlife adults provided to adult children and older parents across the study week. With regard to support to children, midlife adults were most likely to provide advice (approximately 2 days), followed by emotional support (average of 1-2 days) and practical support on an average of 1 day during the 4-day study week. As for support to parents, midlife adults reported providing practical support, emotional support, and advice to parents on an average of 1 day during the 4-day study week. Descriptive statistics regarding support were presented in Table 1.

Most participants experienced a typical diurnal cortisol rhythm characterized by a rise in the morning and a decline over the course of the day. Findings showed that cortisol increased between the first cortisol sample (upon waking;

Table 1. Sample Characteristics.

	M	*SD*	Range	Proportion
Female	—	—	—	.54
Age	55.65	4.58	45-65	—
Years of education	14.56	2.03	10-17	—
Employment status[a]	—	—	—	.65
Neuroticism[b]	2.59	0.74	1-5	—
Health status[c]	3.33	0.94	1-5	—
Weekend day[d]	0.82	0.84	0-2	—
Sleep quality night before[e]	2.82	0.75	1-5	—
Smoking[f]	0.46	1.22	0-4	—
Medication day[g]	0.49	1.26	0-4	—
				Proportion of days
Practical support to children[h]				.16
Practical support to parent[h]				.20
Emotional support to children[h]				.39
Emotional support to parent[h]				.29
Advice to children[h]				.46
Advice to parent[h]				.23
Practical support to both child and parent[i]				.04
Emotional support to both child and parent[i]				.09
Advice to both child and parent[i]				.09

Note. Participants $N = 151$; $N = 558$ days.
[a]Employment status was coded 0 = *not working full-time*, 1 = *employed full-time*.
[b]Neuroticism was calculated averaging ratings of four items (e.g., moody, worrying, nervous, calm) from 1 = *not at all* to 5 = *a great deal*.
[c]Health status was rated from 1 = *poor* to 5 = *excellent*.
[d]Weekend day was coded 0 = *weekday*, 1 = *weekend day* and refers to the number of weekend days.
[e]Sleep quality night before was rated from 1 = *poor* to 5 = *excellent*.
[f]Smoking was coded 0 = *no*, 1 = *yes* and refers to the number of days participants smoked.
[g]Medication day was coded 0 = *no*, 1 = *yes* and refers to the number of days participants took any medication.
[h]Support to parent or child was coded 0 = *no support given*, 1 = *support given*.
[i]Support to both child and parent was coded 0 = *no support given to both child and parent*, 1 = *support given to both child and parent*.

$M = 24.57$, $SD = 22.48$) and the second cortisol sample (30 min after waking; $M = 32.75$, $SD = 20.75$). In addition, cortisol declined between the second cortisol sample (30 min after waking) and the fourth cortisol sample (bedtime; $M = 5.83$, $SD = 12.89$). See Table 2 for the cortisol values at each time point.

Table 2. Descriptives for Cortisol Patterns Among Participants.

	Time		Cortisol (nmol/L)			Cortisol (natural log)	
Occasion	*M*	*SD*	*M*	*SD*	Median	*M*	*SD*
Wake	6:47 a.m.	82 min	24.57	22.48	20.11	3.00	0.61
30 min after wake	7:31 a.m.	82 min	32.75	20.75	32.75	3.36	0.51
Noon	1:06 p.m.	96 min	10.24	10.89	10.24	2.07	0.70
Bedtime	11:03 a.m.	75 min	5.83	12.89	5.83	1.31	0.80

Note. Participants $N = 151$.

We assessed whether providing support to adult children and aging parents was associated with midlife adults' same-day and next-day diurnal cortisol rhythms and output. Midlife adults showed steeper CARs (favorable cortisol functioning) on days in which they provided practical support (CAR; $B = 0.35$, $p = .007$; see Table 3) to adult children. In addition, midlife adults experienced steeper cortisol declines (favorable cortisol functioning) when they provided advice (DEC; $B = -0.01$, $p = .04$; see Table 5) to adult children on the prior day. Midlife adults' cortisol daily total output (i.e., AUC) was not associated with provision of any of the three types of support. Providing emotional support to adult children was not associated with midlife adults' diurnal cortisol rhythms and output (see Table 4).

In contrast, midlife adults experienced higher cortisol daily total output (unfavorable cortisol functioning) when they provided practical support (AUC; $B = 2.50$, $p = .04$; see Table 3) and advice (AUC; $B = 2.24$, $p = .03$; see Table 5) to aging parents on the prior day. Midlife adults' CARs and DECs were not associated with provision of any of the three types of support. Providing emotional support to aging parents was not associated with midlife adults' diurnal cortisol rhythms and output (see Table 4).

Post Hoc Tests

We also reran the models with all three types of support entered simultaneously in post hoc tests. Midlife adults showed steeper CARs (favorable cortisol functioning) on days in which they provided practical support (CAR; $B = 0.35$, $p = .01$) to adult children, controlling for other types of support on the same day and prior day. We did not observe any other significant effects regarding support to a parent or to a grown child and diurnal cortisol (results not shown).

Table 3. Daily Practical Support Predicting Midlife Adults' Diurnal Cortisol.

	CAR		DEC		AUC	
Variable	*B*	*SE*	*B*	*SE*	*B*	*SE*
Fixed effects						
Intercept	0.58	0.85	−0.05	0.06	47.87***	8.46
Same-day support provision						
Practical support to children[a]	0.35**	0.13	−0.00	0.01	−1.52	0.91
Practical support to parent[a]	0.07	0.18	0.02	0.01	1.99	1.25
Prior-day support provision						
Practical support to children[a]	0.07	0.12	−0.01	0.01	0.11	0.86
Practical support to parent[a]	−0.09	0.17	−0.00	0.01	2.50*	1.18
Control variables						
Gender[b]	−0.17	0.11	0.01	0.01	2.02	1.12
Age	0.03*	0.01	−0.00	0.00	0.15	0.12
Years of education	0.01	0.03	−0.00	0.00	−0.52	0.29
Employment status[c]	−0.00	0.00	0.00	0.00	0.07	0.04
Neuroticism[d]	0.06	0.08	−0.01	0.01	−1.62	0.82
Health status[e]	−0.07	0.06	−0.00	0.00	−1.08	0.60
Wake time	−0.19***	0.05	−0.00	0.00	−1.98***	0.37
Weekend day[f]	0.08	0.14	0.00	0.01	−0.83	0.98
Sleep quality night before[g]	−0.00	0.06	−0.00	0.00	0.35	0.46
Smoked this day[h]	0.08	0.17	0.03*	0.01	2.39	1.69
Medication day[i]	−0.05	0.17	−0.01	0.01	−0.08	1.67
Random effects						
Intercept VAR	28.20***	5.46	0.00***	0.00	27.01***	5.25
Residual VAR	33.81***	3.31	0.00***	0.00	33.61***	3.26
−2 log likelihood	2,426.6		−1,094.6		2,427.7	

Note. Participants $N = 151$; $N = 558$ days; CAR = cortisol awakening response; DEC = daily decline; AUC = area under the curve; VAR = variance.
[a]Support was coded 0 = *no support given*, 1 = *support given*.
[b]Gender was coded 0 = *female*, 1 = *male*.
[c]Employment status was coded 0 = *not working full-time*, 1 = *employed full-time*.
[d]Neuroticism was calculated averaging ratings of four items (e.g., moody, worrying, nervous, calm) from 1 = *not at all* to 5 = *a great deal*.
[e]Health status was rated from 1 = *poor* to 5 = *excellent*.
[f]Weekend day was coded 0 = *weekday*, 1 = *weekend day*.
[g]Sleep quality night before was rated from 1 = *poor* to 5 = *excellent*.
[h]Smoked this day was coded 0 = *no*, 1 = *yes*.
[i]Medication day was coded 0 = *no*, 1 = *yes*.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 4. Daily Emotional Support Predicting Midlife Adults' Diurnal Cortisol Patterns.

	CAR		DEC		AUC	
Variable	*B*	*SE*	*B*	*SE*	*B*	*SE*
Fixed effects						
Intercept	0.80	0.86	−0.05	0.06	48.47***	8.60
Same-day support provision						
Emotional support to children[a]	0.03	0.12	−0.00	0.01	0.16	0.87
Emotional support to parent[a]	−0.03	0.14	0.00	0.01	−0.05	0.98
Prior-day support provision						
Emotional support to children[a]	0.13	0.12	−0.00	0.01	0.35	0.83
Emotional support to parent[a]	0.14	0.14	−0.00	0.01	1.13	1.00
Control variables						
Gender[b]	−0.20	0.11	0.01	0.01	2.13	1.15
Age	0.03	0.01	−0.00	0.00	0.16	0.13
Years of education	0.02	0.02	−0.00	0.00	−0.63*	0.30
Employment status[c]	−0.00	0.02	0.00	0.00	0.07	0.04
Neuroticism[d]	0.06	0.08	−0.01	0.01	−1.73*	0.84
Health status[e]	−0.08	0.06	−0.00	0.00	−1.15	0.63
Wake time	−0.20***	0.05	−0.00	0.00	−1.88***	0.37
Weekend day[f]	0.05	0.14	0.00	0.01	−1.02	1.01
Sleep quality night before[g]	−0.01	0.06	−0.00	0.00	0.37	0.47
Smoked this day[h]	0.08	0.17	0.01*	0.01	2.20	1.72
Medication day[i]	−0.11	0.17	−0.00	0.01	0.55	1.70
Random effects						
Intercept VAR	0.01	0.06	0.00***	0.00	28.63***	5.48
Residual VAR	1.08***	0.10	0.00***	0.00	34.08***	3.31
−2 log likelihood	1,106.2		−1,090.2		2,436.8	

Note. Participants $N = 151$; $N = 558$ days; CAR = cortisol awakening response; DEC = daily decline; AUC = area under the curve; VAR = variance.
[a]Support was coded 0 = *no support given*, 1 = *support given*.
[b]Gender was coded 0 = *female*, 1 = *male*.
[c]Employment status was coded 0 = *not working full-time*, 1 = *employed full-time*.
[d]Neuroticism was calculated averaging ratings of four items (e.g., moody, worrying, nervous, calm) from 1 = *not at all* to 5 = *a great deal*.
[e]Health status was rated from 1 = *poor* to 5 = *excellent*.
[f]Weekend day was coded 0 = *weekday*, 1 = *weekend day*.
[g]Sleep quality night before was rated from 1 = *poor* to 5 = *excellent*.
[h]Smoked this day was coded 0 = *no*, 1 = *yes*.
[i]Medication day was coded 0 = *no*, 1 = *yes*.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 5. Daily Advice Predicting Midlife Adults' Diurnal Cortisol.

	CAR		DEC		AUC	
Variable	*B*	*SE*	*B*	*SE*	*B*	*SE*
Fixed effects						
Intercept	0.66	0.85	−0.05	0.05	47.29***	8.52
Same-day support provision						
Advice to children[a]	0.09	0.11	0.00	0.01	−0.20	0.82
Advice to parent[a]	−0.20	0.14	0.01	0.01	0.73	0.99
Prior-day support provision						
Advice to children[a]	0.13	0.11	−0.01*	0.01	0.15	0.77
Advice to parent[a]	0.04	0.15	0.00	0.01	2.24*	1.01
Control variables						
Gender[b]	−0.20	0.11	0.01	0.01	2.09	1.12
Age	0.03*	0.01	−0.00	0.00	0.15	0.13
Years of education	0.02	0.03	−0.00	0.00	−0.58	0.20
Employment status[c]	−0.00	0.00	0.00	0.00	0.07	0.04
Neuroticism[d]	0.06	0.08	−0.01	0.01	−1.64*	0.83
Health status[e]	−0.08	0.06	−0.00	0.00	−1.09	0.61
Wake time	−0.20***	0.05	−0.00	0.00	−1.83***	0.37
Weekend day[f]	0.09	0.14	−0.00	0.01	−1.08	0.99
Sleep quality night before[g]	−0.02	0.06	−0.00	0.00	0.40	0.47
Smoked this day[h]	0.09	0.18	0.03**	0.01	2.45	1.69
Medication day[i]	−0.08	0.17	−0.01	0.01	0.41	1.66
Random effects						
Intercept VAR	0.00	0.06	0.00***	0.00	27.22***	5.35
Residual VAR	1.08***	0.10	0.00***	0.00	34.20***	3.33
−2 log likelihood	1,104.5		−1,096.8		2,433.1	

Note. Participants $N = 151$; $N = 558$ days; CAR = cortisol awakening response; DEC = daily decline; AUC = area under the curve; VAR = variance.
[a]Support was coded 0 = *no support given*, 1 = *support given*.
[b]Gender was coded 0 = *female*, 1 = *male*.
[c]Employment status was coded 0 = *not working full-time*, 1 = *employed full-time*.
[d]Neuroticism was calculated averaging ratings of four items (e.g., moody, worrying, nervous, calm) from 1 = *not at all* to 5 = *a great deal*.
[e]Health status was rated from 1 = *poor* to 5 = *excellent*.
[f]Weekend day was coded 0 = *weekday*, 1 = *weekend day*.
[g]Sleep quality night before was rated from 1 = *poor* to 5 = *excellent*.
[h]Smoked this day was coded 0 = *no*, 1 = *yes*.
[i]Medication day was coded 0 = *no*, 1 = *yes*.
*$p < .05$. **$p < .01$. ***$p < .001$.

In addition, we examined whether providing support to both an adult child and an aging parent on the same day influenced midlife adults' diurnal cortisol rhythm and output. We created three interaction terms representing whether midlife adults provided each type of support to both an adult child and an aging parent that day (0 = *no*, 1 = *yes*). Midlife adults experienced higher cortisol daily total output (unfavorable cortisol functioning) when they provided practical help (AUC; $B = 4.01$, $p = .03$) and advice (AUC; $B = 2.94$, $p = .02$) to both an adult child and an aging parent on the prior day. Midlife adults also showed flatter cortisol awakening (unfavorable cortisol functioning; CAR; $B = -0.45$, $p = .01$) and flatter cortisol declines (unfavorable cortisol functioning; DEC; $B = 0.02$, $p = .02$) on days in which they provided advice to both an adult child and an aging parent (results not shown).

Furthermore, support provision requires contact with family members, whereas having contact does not always involve support. It is possible that contact, per se, influences midlife adults' diurnal cortisol patterns. Thus, we considered whether having contact with parents and grown children predicts midlife adults' diurnal cortisol regulation. We reran all models examining midlife adults who had contact with an adult child or a parent on a given day. Having contact with an adult child or a parent on a given day was not associated with midlife adults' CARs or DECs (results not shown). Midlife adults showed higher cortisol daily total output (unfavorable cortisol functioning) when they had contact (AUC; $B = 2.46$, $p = .01$) with their parents on the prior day.

Discussion

Providing support to family members on a daily basis is a common occurrence for midlife adults. As such, there has been increasing interest aimed at understanding whether individuals benefit or suffer from providing such support. Previous research has established that providing support is linked with midlife adults' psychological well-being. The current findings extend prior research by showing that providing support to adult children and parents have important implications for midlife adults' physiological well-being (i.e., diurnal cortisol regulation).

The current study examined whether providing support to generations above and below on an everyday basis is differentially associated with midlife adults' diurnal cortisol rhythms and output. Prior work has shown that providing everyday support to different generations has a differential impact on midlife adults' psychological well-being, with support to parents generating stress (Fingerman et al., 2016). This study confirms these findings at the physiological level. Providing practical support and advice to adult children was associated with positive influences on midlife adults' diurnal cortisol regulation. Consistent with solidarity theory and the intergenerational stake hypothesis, midlife adults often desire to help adult children (Birditt et al., 2015; Giarrusso et al., 2005). Thus, supporting children generates positive feelings and also positive physiological responses in the form of optimal diurnal cortisol regulation.

Yet, midlife adults appear to suffer physiologically when they provide practical assistance and advice to their parents. These results parallel prior studies showing that giving support to parents contributes to negative psychological well-being (e.g., poor daily mood, anxiety, depression; Fingerman et al., 2016) and poor diurnal cortisol regulation (e.g., AUC; Bangerter et al., 2018; Klein et al., 2014).

As expected, results imply that giving everyday support to parents may be more challenging and stressful for midlife adults than giving support to grown children. Indeed, parents are frequently involved in supporting their adult children and the majority of them view such helping behaviors as normative (Fingerman et al., 2012). By contrast, support to the older generation may be provided less often and only when the midlife adults are called upon. It is possible that midlife adults readily supply help when parents experience a health crisis (Zarit & Edwards, 2008). Providing support to aging parents may generate distress for midlife adults because they may be putting their own emotional and physical well-being at risk (see Vitaliano, Zhang, & Scanlan, 2003).

Moreover, providing support (particularly to aging parents) exposes midlife adults to greater levels of stress hormones. Extended hormone exposure can be damaging and has been linked with a number of negative health consequences, including increased risk of diabetes and hypertension (Kelly, Mangos, Williamson, & Whitworth, 1998; Rosmond & Björntorp, 2000). It should be noted, however, that although providing support to an aging parent may have negative health implications, support provision to parents may also have positive implications in other ways. For instance, support has been shown to result in increased gratification and the development of a closer relationship (Cheng, Mak, Lau, Ng, & Lam, 2016).

The current study also revealed that providing support to both generations above and below on the same day was associated with unfavorable cortisol functioning among midlife adults. This is in line with research suggesting that one's capacity for providing support is a limited resource that can be exhausted (Strohschein, Gauthier, Campbell, & Kleparchuk, 2008). Previous work reveals that midlife adults who experience more demands will provide less to any given child (Davey, Janke, & Savla, 2004; Downey, 1995; Fingerman, Miller, Birditt, & Zarit, 2009; Fingerman et al., 2016). Under these circumstances, midlife adults may struggle to meet competing demands from multiple grown children and parents (Fingerman et al., 2011; Grundy & Henretta, 2006). Taken together, providing support to generations above and below appears to deplete midlife adults' resources and in turn can disrupt biological processes.

In addition, support provision requires contact; we extend prior research by examining the effect of having contact with family members. Post hoc tests suggest that providing support to adult children has beneficial outcomes for midlife adults' diurnal cortisol that are more lasting than merely having contact with children. Furthermore, contact with parents on one day was associated with poorer cortisol regulation the following day, and providing support to aging parents may exacerbate the effect of having contact.

Limitations and Potential Directions for Future Research

This study has limitations which warrant cautious interpretation of findings. Although we controlled for many individual-level characteristics (e.g., neuroticism), it is important to explore other factors that moderate and mediate the relationship between providing support and diurnal cortisol regulation. Potential factors include constructs related to whether midlife adults view providing support as stressful or rewarding and the need for support (Bangerter, Kim, Zarit, Birditt, & Fingerman, 2015). Additional factors, such as missing demographics plus work stress level, historical relationship with parents (negative or positive), and other personal factors not accounted for in this study, may have affected the results. For example, future research should consider how parent–child relationship history may influence daily interactions and the support midlife adults provide to multiple generations.

The measurement of cortisol was also limited in that saliva samples were collected across 4 days, a common period of time to gather samples to assess diurnal cortisol regulation (Adam & Kumari, 2009). Support is likely to vary over time and change based on other needs, resources, and events. Examining more days would provide a more comprehensive understanding of support provision. Furthermore, although we measured various types of support—we did not capture several dimensions of support. For example, it is possible that there may be costs to midlife adults based on the amount of time spent supporting each generation. Future research should also examine other ways in which providing support may have downstream effects for midlife adults' biological processes including immune regulation and cardiovascular functioning. For instance, providing support to both adult children and aging parents may weaken midlife adults' immune systems and in turn increase susceptibility to disease. Finally, future studies should examine the physiological implications of daily encounters for support receivers.

In sum, this study investigated how diurnal cortisol unfolds as a function of daily support exchanges across multiple generations. The findings suggest that providing support to grown children and aging parents on a daily basis differentially influences midlife adults' physiological health. Providing daily support to adult children may be rewarding for midlife adults at a biological level, whereas providing daily support to aging parents may exert a physiological toll on midlife adults. By examining the influence that family responsibilities in everyday situations have on diurnal cortisol, we may be able to advance the development of effective strategies to improve the consequences of midlife adults' helping behaviors.

Author's Note

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