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Sleep quality and anger expression: An examination of psychosocial mechanisms across the adult lifespan

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A B S T R A C T

Objective: Despite perceptions that older adults will “age out” of violent or aggressive behaviors, aggression remains a unique concern in late-life and can have severe implications for this age group. Emerging research has investigated a universal health behavior – sleep – as a risk and protective factor for aggressive behavior. However, little is known about how sleep and aggression may be linked in older adulthood or about the role of potential psychosocial mechanisms linking sleep and aggression. Consequently, the overall aim of the present study is to extend our understanding of the sleep—aggression link to older adulthood and to examine psychosocial factors as potential links of this association in a national sample of adults.
Methods: Data from national sample of 816 adults from the Midlife in the United States dataset, were used to link sleep quality to anger expressed outwards via psychosocial mediators. Age differences in these associations were also examined.
Results: Using moderated parallel mediation models, poorer sleep quality predicted the expression of anger outwards via emotional (angrier affect, 95% CI [0.040, 0.137]) and cognitive (poorer perceptions of solidarity with family [0.001, 0.025], and affective solidarity towards a spouse or partner [0.019, 0.068]) pathways. However, there were significant age differences in these pathways with anger expression for older adults less driven by angry affect and more so by perceptions of solidarity with a spouse or partner.
Conclusion: Sleep quality is tied to cognitive perceptions of relationships, although the target of these perceptions, and the subsequent links with anger expressions, depends on age. Therapeutic interventions for relational skills may need a different focus at different timepoints across the lifespan. Although angry affect emerged as a pathway for younger and middle-aged adults, managing anger may be less relevant than coping with perceptions of interpersonal relationships for older adults.

1. Introduction

Despite perceptions that older adults will “age out” of violent or aggressive behaviors, aggression remains a unique concern in late-life (Brewer et al., 1981; Ryan et al., 2006). The environmental and medical factors associated with aging can create distinct predispositions for aggression among those age 65+. For example, greater social isolation with aging can increase the risk for intimate partner violence with estimates ranging from 20 to 30% of older women experiencing domestic violence (Knight & Hester, 2016). Furthermore, cognitive and personality changes associated with dementia can predispose an older adult towards aggressive behaviors with 96% of patients with dementia having displayed at least one severely aggressive behavior (Keene et al., 1999; Ravyts et al., 2020). Aggression in late-life can have severe implications given the increased difficulty recovering from injury with age and the increased likelihood of assisted living placement following an injury. Consequently, despite misperceptions about its likelihood, aggression remains a significant, unique problem in late-life. Emerging research has investigated a universal health behavior – sleep – as a risk and protective factor for aggressive behavior. Despite experimental and observational research tying sleep to aggression, little is known about how sleep and aggression may be linked in older adulthood. Furthermore, the role of psychosocial factors as mechanisms linking sleep and aggression has yet to be examined in the same model or in older adults. Consequently, the overall aim of the present study is to extend our understanding of the sleep—aggression link to older adulthood and to examine psychosocial factors as potential links of this association in a national sample of adults. Given the prevalence and implications of aggression in older adulthood, there is a need to understand how a daily, universal, and modifiable behavior such as sleep functions in this age group and to assess potential psychosocial factors as intervention targets.

Previous research has highlighted an association between sleep and aggression. In particular, poor sleep quality and shorter sleep duration have been significantly associated with aggression, anger, and hostility in adult populations (Chester & Dzierzewski, 2020; Granö et al., 2008; Kamphius et al., 2012; Taub, 1977). Disrupted sleep has additionally been linked to delinquency, hostility, and intimate-partner violence

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(Kamphius et al., 2012; Krizan & Herlache, 2016; Rauer & El-Sheikh, 2012). Although sleep has been linked to higher rates of anger, aggression, and violence, research also highlights a bidirectional relation between sleep and anger, whereas proneness to anger can also impact sleep. In particular, adults with anger or individuals with a tendency to suppress angry feelings have reported worse sleep including difficulty falling asleep as well as unwanted awakening throughout the night (Ottoni et al., 2011; Shin et al., 2005). Individuals with more hostile views of others after interpersonal conflict also report greater difficulty with falling and staying asleep (Brissette & Cohen, 2002).

With evidence suggesting a viable connection among sleep and anger-related constructs, understanding which aspects of sleep contribute to anger, violence, and aggression is of value to investigate. Sleep disruption, defined as a significant deviation in sleep quantity, integration, or timing, is a valuable variable for assessing the influence of sleep on behavioral factors (Krizan & Herlache, 2016). Although previous experimental research has investigated how *total* sleep disruption, defined as skipping sleep cycles entirely, impacts anger and aggression, recent research has highlighted that other aspects of sleep deprivation such as sleep restriction (i.e., sleep limited to less than the needed nightly amount) and/or sleep fragmentation (i.e., awakenings while in bed) may be more valuable in investigate as approximately a third of the U.S. population reports sleeping less than 6 h a night or reports significant sleep problems (Bixler, 2009; Krizan & Herlache, 2016). Although total sleep deprivation tends to reduce psychomotor vigilance, lower energy and enthusiasm, and compromise executive functioning, partial, fragmented, or interrupted sleep disruption typically does not produce the extreme levels of fatigue, decreased motivation, and/or disengagement which can be a deterrent to aggressive behavior (Allhola & Polo-Kantola, 2007). As such, although *total* sleep deprivation can demonstrate potential consequences of severe sleep disruption on aggression, more commonly experienced aspects of sleep disruption such as poorer overall sleep quality are important to investigate to highlight how sleep disruption may influence aggression in daily life.

Given sleep's ties to negative outcomes such as aggression, anger, and violence, researchers have begun to examine underlying pathways that may link sleep disruption to aggression. Krizan and Herlache (2016) proposed a theoretical framework through which sleep may lead to aggression, anger, or violence via internal psychosocial pathways (see Fig. 1). First, sleep disruption may disturb *affective pathways* which may increase aggression. In particular, sleep disturbance is associated with higher levels of self-reported trait anger and negative affectivity across the lifespan (Krizan & Herlache, 2016; McCrae et al., 2008). Secondly, sleep disruption can also impact *social cognitive pathways* leading to impaired judgements of others. For example, poor sleep can weaken complex judgment and decision making (Kahn-Greene et al., 2006). Individuals with disrupted sleep tend to make more hostile interpretations of other's actions and can compromise mental flexibility in interpreting the actions of others (Tempesta et al., 2010). Lastly, sleep disruption can be connected to aggression through its ability to decrease *self-control*. Poor sleep, linked to impaired executive functioning (Nilsson et al., 2005), is associated with decreased cognitive and behavioral inhibition, alongside increased impulsivity (Peach & Gaultney, 2013; Pilcher et al., 2015).

It is well established that sleep changes throughout one's life course. Given the dynamic nature of sleep across the lifespan, the associations between sleep, psychosocial factors, and aggression may be similarly fluid and subject to change over time. Indeed, the target psychosocial factors of the present manuscript, angry affectivity, social cognitive perception, and self-control, are all individually evidenced to fluctuate as a function of aging. The Socioemotional Selectivity Theory (SST; Carstensen et al., 2003, 1999; Lang & Carstensen, 2002) offers a lens through which to conceptualize age-related differences across these identified mechanisms.

Individuals experience a range of emotions, including anger, across the lifespan and a large body of literature supports the decreased experience and expression of anger in older adulthood. For instance, SST posits that as individuals age, they have increased motivation to optimize positive emotional experiences and responses and decrease, or even avoid, negative experiences (Carstensen et al., 1999). SST theory posits that as individuals age, they are more aware of their mortality, and this increased awareness of remaining time influences a shift from information-seeking, characteristic of younger adults, towards maintenance and engagement in meaningful relationships. As a result, individuals' social networks decrease in size and individuals are more selective about who resides within these networks (Carstensen et al., 2003, 1999). The motivation to maintain close relationships while limiting exposure to negative emotional experiences may result in reduced negative affectivity, like anger. These differences as a function of age inform the importance of examining these processes across the lifespan.

Although sleep is empirically tied to aggression and anger expression, only recently has a comprehensive theoretical framework been proposed for understanding *how* sleep is linked psychosocially to aggression. Furthermore, little is known about differences in these associations across the adult lifespan. By understanding the emotional, social cognitive, and control processes tying sleep to aggression across the adult lifespan, we can identify potential targets for future prevention and intervention efforts with the goal of preventing and reducing aggression and violence in older adulthood. As such, the current paper had two primary aims:

(1) Identify the extent to which angry affect, social cognitive perceptions, and self-control serve to mediate the association between sleep quality and anger expression.

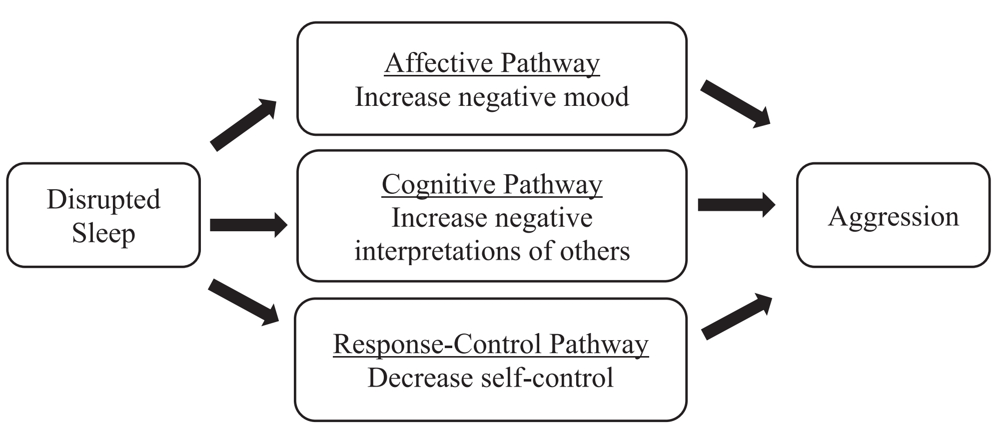

Fig. 1. Theoretical framework of pathways linking disrupted sleep to aggression.

(2) Investigate age differences in the mediation of the sleep quality—anger expression association across the adult lifespan.

2. Data and methods

2.1. Participants

An archival analysis was completed using data from the Midlife in the United States-II (MIDUS-II) dataset. MIDUS-II consists of five subprojects and the Biomarker Project, collected between 2004 and 2009, was used for the present study. The final sample used in the current study included 816 participants. Participants ranged in age from 34 to 83 ($M = 54.31$, $SD = 11.49$), were primarily male (50.37%), married (90.30%), college-educated (45.84% reported some type of College degree), and self-identified as white (83.82%). See Table 1 for additional participant characteristics.

2.2. Procedure

The Biomarker Project from MIDUS-II was selected for the current study as it provided information on sleep quality, anger expressions, and psychosocial mediators. The *Biomarkers Project* (Project 4) consisted of a two-day clinic visit and seven days of home monitoring carried out at one of three sites (UCLA, University of Wisconsin, or Georgetown University) based on the region (West Coast, Midwest, East Coast, respectively) in which participants lived. Ethical approval for the studies was obtained from the Institutional Review Board at each participating site.

Table 1
Demographic information for overall sample, $N = 816$.

	Count	%
Age (M, SD, Range) 54.31, 11.49, 34–83 years		
18–44	191	23.41
45–64	462	56.62
65+	163	19.98
Gender		
Female	405	49.63
Male	411	50.37
Race/ethnicity		
White	684	83.82
Black	13	15.11
Other	15	17.44
Multiracial	4	0.49
Native American or Aleutian Islander or Inuit	3	0.3
Missing	91	11.15
Refused	6	0.74
Education		
Less than HS	37	4.53
HS or equivalent	176	21.57
Some college	171	20.96
Associates	56	6.86
Bachelors	179	21.94
Masters work or Degree	157	19.24
Doctorate or Professional Degree	38	4.66
Missing	2	0.25
Marital status		
Married	737	90.30
Common-Law	23	2.80
Separated	8	1.00
Divorced	24	2.90
Widowed	2	0.20
Single (never married)	22	2.70
Physical health (*M*, *SD*, Range) 2.33, 0.93, 1–5		
Mental health (*M*, *SD*, Range) 2.06, 2.00, 1–5		
Median household total income (*Mdn*, *SD*, Range) $71,250.00, $61,985.18, $0–$300,000		
Sleep quality (*M*, *SD*, Range) 5.94, 3.53, 0–19		
Anger EXPRESSION OUTWARDS (*M*, *SD*, Range) 12.94, 3.24, 8–29		
Angry affect (*M*, *SD*, Range) 5.09, 1.66, 4–16		
Affective solidarity to friends (*M*, *SD*, Range) 3.55, 3.63, 2.38–4		
Affective solidarity to family (*M*, *SD*, Range) 3.45, 3.50, 2–4		
Affective solidarity to partner (*M*, *SD*, Range) 3.42, 3.50, 2–4		
Self-control scale (*M*, *SD*, Range) 4.93, 0.53, 1.3–6.4		

2.3. Measures

2.3.1. Sleep quality

The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) was used as a global measure of sleep outcomes. The PSQI is a self-report instrument that asks about sleep over the past month. The PSQI consists of 19 self-rated questions, which are grouped to form seven component scores: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of a sleeping medication, and daytime dysfunction. The component scores (ranging from 0 to 3) are then summed to yield a global sleep quality score. The total score can range from 0 to 21, with higher scores indicating worse sleep quality and a score of 5 or greater indicating poor sleep. The PSQI shows good internal consistency (Cronbach's $\alpha = 0.83$ for the seven components) and test-retest reliability ($r = 0.85$, $p < .001$ for global sleep quality; Buysse et al., 1989). Additionally, the PSQI global score shows good discriminant validity with a sensitivity of 89.6% and a specificity of 86.5% for differentiating between good and poor sleepers (Buysse et al., 1989).

2.3.2. Angry affect

Angry affect was assessed using the Spielberger Trait Anger Inventory (Spielberger, 2010). The Anger Inventory consists of 15 items which provide information on two dimensions of anger: angry temperament and angry reaction. The angry temperament items were used for the present study to reflect general angry affect. These items consisted of 4 statements such as feeling like you are quick tempered which were rated on a scale of 1 (almost never) to 4 (almost always). The items were summed to create an angry affect total score that could range from 4 to 16 with higher scores indicating angrier affect. These items show good validity (García-León et al., 2002; McCloskey et al., 2009) and reliability ($\alpha = 0.81$ for the current sample).

2.3.3. Affective solidarity with friends, family, or partner

The affective solidarity scale is a multi-item scale used to measure the perception of support and strain between friends, family, or partners. The scale was created for the initial MIDUS project (National Institute on Aging, P01-AG020166). and consists of 8 items to assess support and strain to friends, 6 items to assess support and strain to family members, and 12 items assessing support and strain to a spouse or partner. Sample topics include how much participants report really caring about their friends, criticizing friends, or understanding the way a spouse/partner feels about things. Participants responded on a 4-point scale ranging from 1 (a lot) to 4 (not at all) with mean scores calculated for each subscale. Possible scores could range from 1 to 4 for each of the 3 subscales. Reliability was moderate to acceptable for the current sample for the different affective solidarity measures with α ranging from 0.64–0.78.

2.3.4. Self-control

The self-control scale was created for MIDUS Project 4 based on existing items (Gross & John, 2003; Markus & Kitayama, 1991). The scale consists of 19 items assessing 3 subscales of self-control. In response to the prompt to indicate "your views of yourself," the cognition control subscale asked items such as "making myself do things I don't want to do," the emotion control subscale asked items such as "when I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm," and the burden consciousness subscale asked items such as "it is important to me that I not bother others." Participants were provided with 7 potential responses ranging from 1 (strongly disagree) to 7 (strongly agree). Mean scores were computed across all items for a potential score ranging from 1 to 7 with higher scores indicating greater self-control. Reliability was acceptable for the current sample (α = 0.72).

2.3.5. Anger expression outwards

The Spielberger Anger Expression Inventory (Spielberger, 2010) was used to assess the expression of anger outwards (external expression of angry feelings). Participants are asked about their general reaction on a scale from 1 (almost never) to 4 (almost always) for when they feel angry or furious. Eight items for the subscale address anger expressed outwards (e.g., slamming doors or arguing). Items are summed across the scale score for a potential range from 8 to 32 with higher scores indicated greater anger expression. The Anger Expression Inventory has demonstrated good validity (Forgays et al., 1997) and reliability with 0.77 for the current sample.

2.4. Data analysis

First a parallel mediation analysis was conducted using the SPSS PROCESS macro designed by Hayes (Hayes, 2017; see Fig. 2). Next, a moderated parallel mediation analysis was conducted. The models included the dependent variable of anger expression outwards with angry affect, affective solidarity towards friends, family, a spouse or partner, and self-control as parallel mediators. Age as a continuous variable was examined as a moderator of all model paths for this moderated mediation analyses. Moderations were interpreted using the mean and ±1.5 standard deviations around the age mean. Using PROCESS, we conducted a nonparametric bootstrapping procedure to compute a confidence interval around the indirect effect (e.g. social well-being as a mediator). If zero falls outside of the confidence interval, mediation is present. The final estimate of the indirect effect is represented by the mean indirect effect computed across 5000 bootstrap samples. Missing data was handled by listwise deletion. SPSS version 26 was used for all analyses. Power calculations using G*Power (Faul et al., 2009) showed that for a multiple regression analysis with twelve predictors, a sample size of at least 127 participants is needed to predict an R^2 of at least 0.15, at an alpha level of 0.05, with a power of 0.80.

3. Results

3.1. Age differences in study variables

Using one-way between participants ANOVA analyses, there were significant age differences among younger (less than 45 years), middle-aged (45–64 years), and older adults (65+ years) in anger expressed outwards $F(2, 813) = 129.97$, $p = .001$, angry affect $F(2, 813) = 6.68$, $p < .01$, and affective solidarity to friends, $F(2, 813) = 3.99$, $p = .019$. Given unequal sample sizes and violation of Levene's Test of equality of error variances, the Games-Howell post hoc test was used. Post hoc comparisons using the Games-Howell test indicated that mean anger expressed outwards was highest for younger adults ($M = 13.81$, $SD = 3.34$), followed by middle-aged adults ($M = 12.87$, $SD = 3.35$), and then older adults ($M = 12.11$, $SD = 2.49$; all differences significant $p < .01$). For angry affect, younger adults ($M = 5.46$, $SD = 1.99$) had significantly higher affect compared to middle-aged ($M = 5.02$, $SD = 1.57$, $p = .020$) and older adults ($M = 4.87$, $SD = 1.41$, $p = .003$). Middle-aged and older adults did not differ significantly in angry affect. Lastly, affective solidarity for friends was significantly higher for younger adults ($M = 3.58$, $SD = 0.31$) compared to older adults ($M = 3.49$, $SD = 0.31$).

3.2. Anger expressed outward

The mediation-only model was a significant predictor of anger expressed outwards, $R^2 = 0.33$, $F(6, 809) = 67.45$, $p < .001$. Angry affect 95% CI [0.040, 0.137], affective solidarity towards family [0.001, 0.025], and affective solidarity towards a spouse or partner [0.009, 0.050] were significant parallel mediators of the sleep quality—anger outwards expression association. Poorer sleep quality was tied to greater angry affect and lower affective solidarity towards family, spouse, or partner, which, in turn, was tied to greater expression of anger outwards.

These associations differed depending on age with angry affect a significant mediator for younger 95% CI [0.013, 0.107] and middle-aged [0.009, 0.081] adults but not older adults [−0.037, 0.083]. Also, affective solidarity for family was a significant mediator only for middle-aged adults 95% CI [0.000, 0.025]. Lastly, affective solidarity for a spouse or partner was a significant mediator for middle-aged 95% CI [0.009, 0.049] and older [0.003, 0.045], but not younger, adults [−0.001, 0.069]. (See Table 2.)

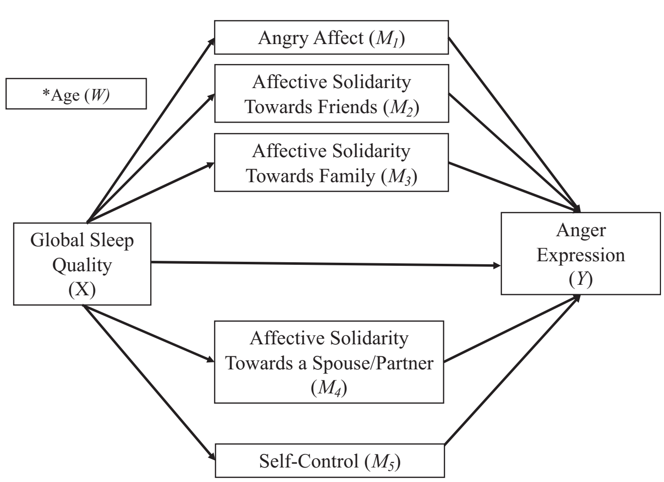

Fig. 2. Proposed model of global sleep quality predicting anger expressed outwards and inwards.
Note. *Age is examined as a moderator of all pathways.

4. Discussion

The aims of the current study were to identify the extent to which emotional, social cognitive, and self-control variables underlie the association between sleep quality and anger expression and to investigate age differences in this association. The results suggest that within this large sample of adults across the lifespan, poorer sleep quality does predict the expression of anger outwards via emotional (angrier affect) and cognitive (poorer perceptions of solidarity with family and partners) pathways. However, there were significant age differences in these pathways with anger expression for older adults less driven by angry affect and more so by perceptions of solidarity with a spouse or partner.

In terms of expressing anger outwardly across the entire sample, sleep quality did predict anger expression through emotional and cognitive pathways. Consistent with earlier research showing sleep predicts anger and angry affect predicts anger expression (Kamphius et al., 2012; Krizan & Herlache, 2016; Krizan & Herlache, 2016), individuals with worse sleep quality were more likely to report angrier affect (e.g., having a fiery temper) which in turn predicted external expressions of anger such as yelling or slamming doors. Additionally, consistent with a large body of research documenting the interpersonal consequences of poor sleep driven by cognitive misperceptions (Anderson & Bushman, 2002; Brissette & Cohen, 2002; Ben Simon & Walker, 2018), the present study found perceptions of affective solidarity to underlie the sleep—anger expression association. In particular, perceptions of support and strain within family and spouse/partner relationships were a significant link between sleep and anger expression. The stronger role for family and spousal relationships versus friendships may reflect greater frequency, closer proximity, more emotional connectedness, or higher expectations (Fingerman et al., 2004; Lang, 2001; O'Connor, 1995) for family/spouse relationships compared to

Table 2
Parallel mediation model results for anger expression inwards and anger expression outwards.

	Anger expression inwards (*Y*)		Anger expression outwards (*Y*)	
	Coefficient (*SE*)	0.95% CI	Coefficient (*SE*)	0.95% CI
Sleep Quality *(X)*	0.489 (0.182)**	0.132, 0.846	0.013 (0.131)	−0.245, 0.270
Angry Affect (M_1)	0.569 (0.383)	−0.183, 1.321	0.618 (0.276)*	0.076, 1.160
Affective Solidarity to Friends (M_2)	−4.326 (2.480)	−9.193, 0.542	0.884 (1.788)	−2.625, 4.393
Affective Solidarity to Family (M_3)	0.944 (2.359)	−3.687, 5.575	1.094 (1.700)	−2.248, 4.433
Affective Solidarity to Partner (M_4)	−0.099 (2.628)	−5.259, 5.060	−0.606 (1.895)	−4.326, 3.113
Self-control (M_5)	3.292 (1.247)**	0.844, 5.739	1.253 (0.899)	−0.513, 3.017
Age (*W*)	0.224 (0.196)	−0.161, 0.610	0.300 (0.142)*	−0.022, 0.577
X × W	−0.007 (0.003)*	−0.013, −0.000	−0.000 (0.002)	−0.005, 0.005
M1 × W	−0.004 (0.007)	−0.018, 0.009	0.006 (0.005)	−0.004, 0.016
M2 × W	0.052 (0.042)	−0.032, 0.135	−0.014 (0.031)	−0.074, 0.047
M3 × W	−0.033 (0.042)	−0.114, 0.049	−0.032 (0.300)	−0.910, 0.027
M4 × W	−0.036 (0.046)	−0.127, 0.054	−0.014 (0.033)	−0.079, 0.051
M5 × W	−0.038 (0.022)	−0.081, 0.005	−0.032 (0.16)*	−0.063, −0.001
	$R^2 = 0.218$ $F(13, 802) = 17.222, p < .001$		$R^2 = 0.36$ $F(13, 802) = 34.38, p < .001$	

* $p < .05$.
** $p < .01$.

friendships. As such, poor sleep may be more likely to impact perceptions of relationships with family and spouses which, in turn, is a stronger driver for anger expression. A surprising finding of the present study was the lack of support for self-control as an underlying link between sleep—anger expression. Previous research demonstrates the impact of sleep disruption on executive functioning as well as cognitive and behavioral inhibition (Nilsson et al., 2005; Peach & Gaultney, 2013; Pilcher et al., 2015). In the current study, self-control did not play a significant underlying role. A potential explanation for this finding is that although the self-control measure showed acceptable internal consistency, one of the three subscales – burden consciousness – may have been less relevant for the current project. This subscale assesses the extent that one perceives and tries to limit the burden they oppose on others (e.g., “I sometimes worry that I am a burden on others.”). Although these subscale items reflect self-control or inhibition, they may not tap into facets of control that are as relevant for anger expression as the emotional and cognitive control items (e.g., “I can control my thoughts and desires if I need to” or “When I am feeling negative emotions such as sadness or anger, I make sure not to express them.”).

Despite finding an overall role for emotional and cognitive pathways from sleep quality to anger expression, the study also uncovered significant age differences in these links, underlying the importance of considering age differences in anger expression. First, both the expression of anger and the experience of angry affect were highest for younger adults (< 44 years). Younger adults had higher expressions of anger outwards compared to middle-aged (45–64 years) and older adults (65+ years), and middle-aged adults had higher anger expressions compared to older adults. Younger adults also reported higher overall angry affect compared to middle-age and older adults. Overall, these findings support existing research documenting decreased expression of negative emotions with aging (Carstensen et al., 2003; Mather & Carstensen, 2005; Orgeta, 2011b; Phillips et al., 2008b).

Second, important age differences emerged in the cognitive perceptions of interpersonal relationships. Affective solidarity for friends, assessing how much people perceive they care for and make demands on their friends, was significantly greater for younger versus older adults. These heightened perceptions of both the support and strain perceived in friendships reflect key tenets in the socioemotional selectivity theory (Carstensen, 1995; Carstensen et al., 1999) suggesting a pruning of social networks with age. With a sense of limited time, older adults are more likely to engage in meaningful relationships and decrease their desire for novel experiences and information that may come from new relationships (Lang & Carstensen, 2002). Furthermore, with age and decreased social networks, older adults’ simply have a smaller pool of friends to be experiencing affective solidarity with, which could be reflected in these age differences.

Lastly, beyond age differences in individual anger and affective solidarity variables, the current study found significant age differences in the role of angry affect and affective solidarity as mechanisms underlying the overall sleep—anger expression association. As indicated above, the experience of angry affect was more relevant for younger and middle-aged adults and did not emerge as an underlying link for older adults for the expression of anger outwards. Additionally, perceptions of relationships with friends emerged as a significant link for younger and middle-aged adults while perceptions of relationships with family emerged as a significant link for middle-aged adults and partners emerged as a significant link for both middle-aged and older adults. These findings suggest an overall pattern where angry affect is less a driver for the expression of anger for older adults. Also, perceptions of partner relationships were stronger drivers for the expression of anger for older adults versus perceptions of friendships. It appears that despite known associations between anger and sleep (Kamphius et al., 2012; Krizan & Herlache, 2016; Krizan & Hisler, 2019), for older adults, angry affect is lowest of all age groups and not a factor linking sleep and aggression. As mentioned above, the positivity effect of older adulthood results in decreased negative emotionality with age (Carstensen, 1995; Orgeta, 2011a, 2011b; Phillips et al., 2006, 2008a; Phillips, Henry, Hosie, Milne, 2008b). The SAVI model of aging, however, suggests that when older adults do experience negative emotionality, it can be more disruptive than for younger adults given older adults difficulty returning to physical and emotional homeostasis. As such, although they may be less likely to experience anger, when they do, it could have an even greater effect resulting in more aggressive behavior. Nonetheless, the current findings did not find a role for anger in the expression of aggression in older adults.

Perceptions of family and partner relationships did emerge as mechanisms for older adults. There are several potential explanations for age differences in this finding. Relationships with family and partners can be more salient for this age group due to financial dependency on family members (Matthews & Rosner, 1988), receiving or providing caregiving to family or partner (Lee & Montelongo, 2016), and smaller overall social networks (English & Carstensen, 2014). Follow-up independent *t*-test analyses of age-group differences in perceptions of strain in family or partner relationships indicated that older adults experience significantly higher perceptions of strain in their relationships with their partners compared to middle-aged adults ($M = 2.11$ for older adults versus 1.96 for middle-aged adults, $p < .01$). These perceptions of strain were significantly predicted by sleep quality, 95% CI [0.111, 0.236], which can be worse in older adults due to biological, psychological, and social changes associated with aging (Vaz Fragoso & Gill, 2007). Consequently, perceptions of family and particularly partner relationships seem to be an important element for the development of anger expression in older adults given their greater salience for this age group and their potential vulnerability to perceived strain resulting from poorer sleep quality.

There are several notable implications of the current findings. Methodologically, this is the first study to concurrently explore multiple psychosocial pathways through which sleep may predict the expression of anger. As such, using a national sample of adults we provide support for the theory of internal psychosocial mechanisms tying sleep to aggression proposed by Krizan and Herlache (2016). Additionally, the current findings extend previous research which has focused on extreme experiences of poor sleep such as total sleep deprivation by showing that across a continuum of sleep quality, sleep remains an important predictor of the expression of anger. Clinical implications of the findings include highlighting sleep as a potential target for preventive interventions to reduce aggression and understanding which pathways to aggression are most relevant for different age groups. Despite perceptions of older adults as non-violent and passive (Brewer et al., 1981; Ryan et al., 2006), violence remains a considerable concern in older adulthood. Therefore, understanding *how* sleep leads to the expression of anger across the adult lifespan, creates new targets for prevention and intervention. Sleep appears to be tied to cognitive perceptions of relationships although the target of these perceptions, and the subsequent links with anger expressions, depends on age. Therefore, the consequences of poor sleep may be most felt on friendship for younger and middle-aged adults and family or spouse/partner for middle-aged and older adults. A potential clinical implication of these findings is that therapeutic interventions for relational skills may need a different focus at different timepoints across the lifespan. Also, the risk for relationship ruptures may differ across the lifespan. Although angry affect remained a pathway for younger and middle-aged adults, suggesting the importance of anger management skills, managing anger may be less relevant than coping with perceptions of interpersonal relationships for older adults.

Despite innovations and implications from the current study, there are limitations that preclude wide generalizability of the findings. The sample included a wide age-range of adults, however, the large majority of these adults identified as White, preventing the examinations of differences and similarities across racial and ethnic groups. The use of one time point, retrospective measures for each construct limits our understanding of these associations to broad, cross-sectional conclusions. Importantly, many of the observed associations are likely to be bidirectional. A daily process design is needed to identify directionality of the associations between sleep, potential mechanisms, and aggression and is particularly important for processes such as sleep and anger that change daily and within-daily. We also did not assess for positive affect which has known associations with sleep quality and may have buffered some of effects due to negative affectivity. Lastly, although we assessed for the expression of anger as our outcome, and this variable included aggressive behaviors such as slamming doors, striking out, arguing, and withdrawing, inclusion of more acute aggressive acts would allow us to extrapolate to other aggressive behaviors. Future research can expand our understanding of the dynamic associations between sleep, psychosocial mechanisms, and aggression by employing daily process designs to study the daily or within-day associations between these constructs. Also, the addition of an objective sleep measure such as actigraphy would complement the subjective, self-report measures employed in this study.

In summary, the present study identified cross-sectional associations between poorer overall sleep quality and the expression of anger in a national sample of adults. Furthermore, angry affect and social cognitive perceptions emerged as psychosocial mechanisms tying sleep and the expression of anger. However, the pattern of these overall findings differed depending on age. Angry affect was less a driver for the expression of anger for older adults. Also, perceptions of partner relationships were stronger drivers for the expression of anger for older adults versus perceptions of friendships. Sleep remains an important variable of study for understanding and preventing aggression and the current study sheds light on pathways by which sleep may exert its effects.

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