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ORIGINAL RESEARCH

Associations Between Social Media Use, Physical Activity, and Emotional Well-Being From the Midlife in the United States Refresher Daily Diary Study

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Only a small percentage of adults engage in regular physical activity, even though it is widely recommended as beneficial for well-being. Thus, it is essential to identify factors that can promote increased physical activity among adults of all ages. The current study examined the relationship of social media use to physical activity and emotional well-being. The sample is from the Midlife in the United States Refresher daily diary study, which includes 782 adults ages 25–75 years. Results showed that those who used social media less often engaged in more frequent physical activity, which, in turn, led to more positive affect. This relationship was found for midlife and older adults but not younger adults. The findings show the benefits of physical activity for well-being and suggest that social media use may dampen efforts to increase physical activity, especially among middle-aged and older adults.

Keywords: positive and negative affect, adulthood and aging, within- and between-person differences

According to the U.S. Department of Health and Services, adults should engage in moderate-intensity aerobic exercise for at least 150 min/week and muscle strengthening activities for at least 2 days per week (Woods, 2019). Although physical activity (PA) engagement has many benefits for physical and psychological health (Wiese et al., 2018), the majority of adults in the United States are physically inactive (Woods, 2019). The statistics from Centers for Disease Control show that as of 2018, only 54.2% of adults meet the minimum requirement of the PA guideline (U.S. Department of Health and Human Services, 2018). The prevalence of inactivity increases with older age as 25.7% of adults over the age of 50 reported an inactive lifestyle with no PA engagement outside of work (Centers for Disease Control and Prevention, 2019; Watson, 2016). Thus, more research is needed to examine ways to increase PA for midlife and older adults.

Social media platforms have been used as one way to encourage more active lifestyles. Intervention studies using social media have been effective in increasing PA for adults of all ages (Bort-Roig et al., 2014; Kernot et al., 2019; Todorovic et al., 2019). Social media platforms allow people to connect and share content online (e.g., Facebook, Twitter). Social media's wide accessibility and the increase in its daily usage among midlife and older adults (Pew Research Center, 2019b) can open many opportunities for promoting healthy behaviors, such as PA (Kernot et al., 2019; Northcott et al., 2021; Todorovic et al., 2019). Intervention studies using sites such as Instagram and Facebook to share educational posts and facilitate support groups have effectively promoted more active and healthy lifestyles to a broad audience (Goodyear et al., 2019; Kernot et al., 2019; Northcott et al., 2021).

Observational studies of passive social media users have also found that more social media (e.g., Facebook, Instagram) use was associated with more PA (Goodyear et al., 2019; Liu et al., 2021; Shimoga et al., 2019). However, this research has focused mainly on children, adolescents, and younger adults (Sandercock et al., 2016; Shimoga et al., 2019; Todorovic et al., 2019). Given that daily social media usage is increasing dramatically, especially among middle-aged and older adults (Pew Research Center, 2019b), more research is needed to explore its impact on PA in the context of their daily lives. It is noteworthy that the majority of people use social media for other daily activities, such as news or media consumption, connecting or reconnecting with social ties, and sharing or engaging with online communities (Newman et al., 2021), rather than for exercise-related activities. Although social media interventions have been beneficial for increasing PA in midlife and older adults, the question of how social media use (SMU) in their everyday life relates to PA remains.

SMU and Emotional Well-Being

Although older adults are increasingly using social media (Pew Research Center, 2019b), there continue to be mixed views on whether social media positively or negatively impacts emotional well-being (Leist, 2013; Weinstein, 2018). Emotional well-being is broadly defined as an individual's feeling of positive emotions and moods, positive functioning, and the absence of negative emotions (Ryff & Keyes, 1995). Because of the subjective nature of emotional well-being, it is often assessed with self-report measures that ask individuals for their positive and negative affect (POV and NA; Ryff & Keyes, 1995). Past literature shows that SMU negatively impacts adolescents' and young adults' well-being (Dhir et al., 2018; LaRose et al., 2014) but provides benefits for older adults' well-being (Hunsaker & Hargittai, 2018; Leist, 2013). However, these studies only focused on one age group rather than directly comparing age differences in the same study. The mixed literature on social media's impact on well-being by age also makes it important to expand the scope by directly examining potential mechanisms.

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PA as a Mediator

PA can be one mechanism in the relationship between SMU and well-being. PA engagement has shown many benefits for one's emotional well-being (McAuley & Rudolph, 1995; Wiese et al., 2018). More PA has consistently been shown to predict better well-being in cross-sectional studies (McAuley & Rudolph, 1995), interventions (Zubala et al., 2017), and meta-analyses (Wiese et al., 2018) for midlife and older adults. However, less work has been done observing this relationship at the daily level. Moreover, PA can be increased with automated internet-based social media platforms (e.g., Facebook, Instagram) that interact with users and remind them regularly to engage in healthy lifestyles, which can, in turn, increase the user's PA and well-being (Hurling et al., 2007). Observational studies with adolescents have shown that more SMU (e.g., Facebook, Twitter, Instagram) is associated with more PA, which, in turn, leads to better emotional well-being (Shimoga et al., 2019). However, the role of PA in the relationship between SMU and emotional well-being across adulthood is yet to be explored, especially given the increase in SMU and the lower PA engagement observed for midlife and older adults (Woods, 2019).

Age Differences

Age differences have been found in SMU, PA level, and emotional well-being (Hyde et al., 2013; Pew Research Center, 2019a; Wolff-Hughes et al., 2015). Thus, the relationship among these variables may also vary by age. Although SMU among older adults has been increasing dramatically, younger adults use social media significantly more than older adults (Pew Research Center, 2019a). PA level decreases throughout the lifespan with a peak at adolescence and a well-documented decrease after emerging adulthood (Hyde et al., 2013; Wolff-Hughes et al., 2015). With regard to affect, results consistently show that older adults report better emotional well-being compared with younger adults (Hyde et al., 2013). Given the age differences in the variables of interest, that is, SMU, level of PA, and emotional well-being, the goal was to examine whether age moderated the hypothesized relationships among these variables.

The Current Study

Past work examining PA and SMU has focused on health-related social media interventions rather than broad SMU in the context of daily life (Bort-Roig et al., 2014; Kernot et al., 2019; Todorovic et al., 2019). Although social media interventions have been shown to increase PA (Goodyear et al., 2019; Kernot et al., 2019; Northcott et al., 2021), the question of how SMU in peoples' daily lives relates to PA remains unanswered. Although past work has typically compared people at one point in time, the nature of SMU, PA, and POV and NA can vary on a day-to-day basis (Kaziunas et al., 2015; Manuoğlu & Uysal, 2020; Steeves et al., 2018). Thus, it is important to expand the scope of research by exploring how these constructs vary on a within-person (intraindividual) level, especially given that most social media users visit these sites daily. Moreover, past social media studies have focused on adolescent and younger adults rather than midlife and older adults. The current study examined the associations between SMU, PA, and POV and NA with an 8-day daily diary study using the nationally representative sample from the Midlife in the United States (MIDUS) Refresher data set at both between- (individual differences) and within-person (intraindividual differences) levels. In addition, the study tested whether PA mediated the relationship between SMU and emotional well-being at between-person and within-person levels and whether age was a significant moderator.

Hypotheses

SMU was expected to be positively related to PA. It was expected that more SMU and greater increased PA would be associated with greater POV and less NA. It was also predicted that PA would mediate the relationship between SMU and affect. The same predictions were made for both the between-person and within-person levels. Finally, it was predicted that age would moderate these relationships.

Methods

The current study was determined by the Brandeis University Institutional Review Board to be exempt because it was a secondary data analysis using deidentified data available in the public domain. The original MIDUS Refresher study was approved by the University of Wisconsin-Madison's Institutional Review Board, and each participant in the study provided written informed consent. Participants ($N = 782$, age ranged from 25 to 75 years) were from the MIDUS Refresher cohort who participated in both the main refresher survey study and in the 8-day daily diary study conducted during 2011 to 2014 over the telephone. The main MIDUS refresher study included a mailed questionnaire with demographic and health measures. The daily diary study followed the same protocol as the MIDUS 2 National Survey of Daily Experiences (Brim et al., 2019). The covariates were taken from the main refresher data set, and the daily variables were from the daily diary data set.

Covariates

Covariates included age, sex, education, and health because of their previously recognized relationships with the dependent variables (Anderson et al., 2006; Vera-Villarroel et al., 2012). Age was a continuous variable. Sex was dummy coded with 1 = "male" and 2 = "female." Education was measured by years of education (6–12). Health consisted of Self-Evaluated Physical Health (single item asking: "In general, how would you rate your current physical health?" where 0 = "Worst" to 10 = "Best") and the total number of chronic health conditions (e.g., asthma, stroke) participants had experienced or treated in the last 12 months. Possible scores for health conditions ranged from 0 to 27 with higher scores indicating worse health or more conditions.

Daily Measures

Social Media Use

Each day, participants were asked for the time (in hours and minutes) they spent on social media (e.g., Facebook, Twitter, MySpace). The frequency of social media usage was calculated by converting hours to minutes to get a total social media usage time for each study day. Possible scores could range from 0 to 1,440 min/day. A higher score indicated more time (in minutes) spent on social media.

Physical Activity

Each day, participants self-reported the time (in hours and minutes) they spent engaging in vigorous PA or exercise (activities that would cause sweat) in the last 24 hr. PA was calculated by converting hours to minutes to get a total PA time for each study day. Possible scores could range from 0 to 1,440. Higher scores indicated more time (in minutes) spent on PA.

Positive and Negative Affect

The Positive and Negative Affect Schedule was used to measure participants' daily POV and NA, which consisted of a total of 26 items: 14 items from the original Positive and Negative Affect Schedule scale (Watson et al., 1988) and 12 items from the Positive and Negative Affect scale in Midlife Development Inventory (Mroczek & Kolarz, 1998). POV included participants' daily response to "how much of the time today did you feel in good spirit," "cheerful," "extremely happy," "calm and peaceful," "satisfied," "full of life," "close to others," "like you belong," "enthusiastic," "attentive," "proud," "active," and "confident"? NA consisted of participants' daily response to "nervous," "worthless," "so sad that nothing could cheer you up," "everything was an effort," "hopeless," "lonely," "afraid," "jittery," "irritable," "ashamed," "upset," "angry," and "frustrated." Daily POV and NA were measured by the average of all items to the following responses: "0 = none of the time," "1 = a little of the time," "2 = some of the time," "3 = most of the time," and "4 = all of the time." Daily scores ranged from 0 to 4 with higher scores indicating higher POV and NA. Cronbach's alpha indicated good reliability for POV ($\alpha = .96$) and NA ($\alpha = .89$), which were each averaged across days with 782 observations.

Analyses

First, the interclass correlation coefficients were calculated for each daily variable to ensure sufficient variation at a within-person level to allow for within-person analyses. Then, the Pearson bivariate correlation coefficients were computed for all between-person level variables, which consisted of each daily variable (social media usage, PA, and affect) averaged across the 8 days and all the covariates.

Multilevel structural equation modeling (MSEM) was tested in R (R Development Core Team, 2009) using the "lavaan" package predicting POV and NA in separate models (Figures 1 and 2). MSEM could separate the variance of Level 1 variables (day level) into between and within components, which could reveal how the relationships between the variables differed at both levels. The analyses corresponded to the 1–1–1 design (Preacher et al., 2010) wherein the daily variables SMU (predictor), PA (mediator), and affect (outcome) were assessed at Level 1, at a within-person level, while also simultaneously assessing the model at a between-person level at Level 2. Covariates were added at Level 2. Indirect effects were computed by the products of $a \times b$ at both the within and between level (a = coefficient estimate of the association between SMU and PA and b = the coefficient estimate of the relationship between PA and affect).

Age differences were tested by adding age interactions to the MSEM model to examine whether there were significant conditional direct or indirect effects of age in the relationships between SMU, PA, and affect. All conditional direct and indirect effects are presented in standardized estimates. Conditional direct effects were computed by the following equations at both the within- and between-person levels: $a + (a3 \times \text{age})$, where a is the coefficient estimate of the relationship between SMU and PA, and $a3$ is the product of Age × SMU on PA; $b + (b3 \times \text{age})$, where b is the coefficient estimate of the relationship between PA and affect, and $b3$ is the product of Age × PA on affect; and $c + (c3 \times \text{age})$, where c is the coefficient estimate of the relationship between SMU and affect, and $c3$ is the product of Age × SMU on affect. Conditional indirect effects of age in the relationships between SMU, PA, and affect were computed based on the equation $(a + a3 \times \text{age}) \times b$. If significant age differences were found, post hoc analysis was conducted wherein the interaction effect was multiplied by age at −1 *SD*, mean, and +1 *SD* (e.g., $a + [a3 \times$ age at −1 *SD*, mean, or +1 *SD*$]$) to determine the directionality of the age moderation.

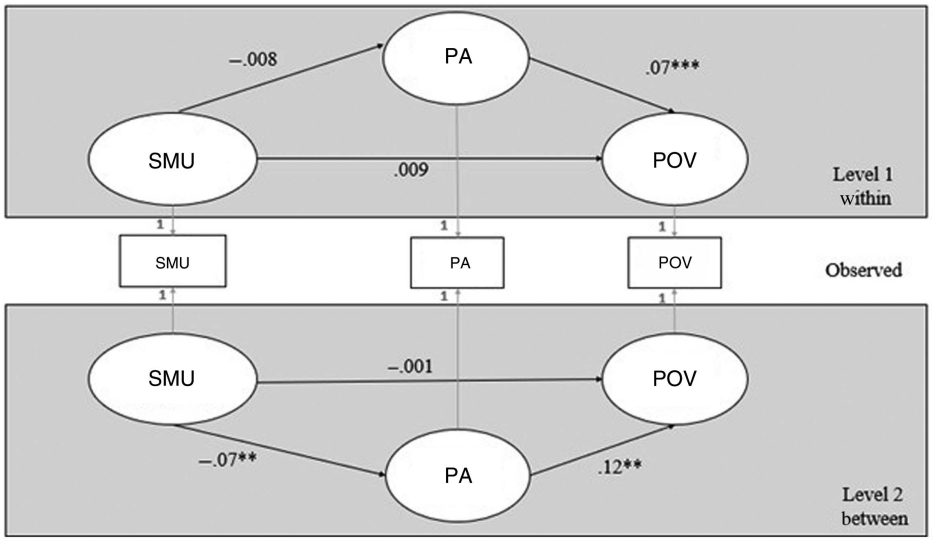

Figure 1 — MSEM (1–1–1) mediation model predicting POV. Standardized estimates are reported. Covariates include age, sex, education, health, and number of chronic conditions. For simplicity, covariate pathways are not depicted. SMU = social media use; PA = physical activity; POV = positive affect; MSEM = multilevel structural equation modeling. $^{**}p < .01$. $^{***}p < .001$.

Results

The interclass correlation coefficient value for each daily variable showed sufficient within-person variance for multilevel analyses: SMU varied 61%, PA varied 44%, POV varied 76%, and NA varied 56% within persons. Table 1 shows the means, *SD*s, and correlations of the Level 2 variables. Consistent with past research, correlations showed that compared with younger adults, older adults used social media less often ($r = -.07$, $p < .05$) and reported more POV ($r = .23$, $p < .01$) and less NA ($r = -.12$, $p < .01$). However, in contrast to prior work, older age was associated with engaging in more PA ($r = .08$, $p < .05$).

The MSEM model revealed adequate model fit predicting POV and NA (root mean square error of approximation = .04, standardized root mean square residual$_{within}$ = .00, and standardized root mean square residual$_{between}$ = .08). Standardized estimates and *p* values for all direct and indirect effects are presented in Tables 2 and 3. Standardized estimates and pathways predicting POV and NA at the within and between level are depicted in Figures 1 and 2.

When probing and plotting age differences in the relationships between the variables of interest, the interaction effect was multiplied by the sample's age at −1 *SD*, mean, and +1 *SD*. Age at −1 *SD* ($N = 177$) ranged from 25 to 36 years old (younger adults) with mean = 31.51 and *SD* = 2.67. Age at mean ($N = 457$) ranged from 37 to 61 years old (midlife adults) with mean = 47.96 and *SD* = 6.36. Age at +1 *SD* ($N = 148$) ranged from 62 to 75 (older adults) with mean = 67.35 and *SD* = 3.81.

SMU and Physical Activity

Between-Person Effects

The MSEM model results revealed that at the between-person level 2, the direct effect of SMU and PA was significant ($\beta = -0.07$, $p = .001$) but in the opposite direction of the prediction: less SMU

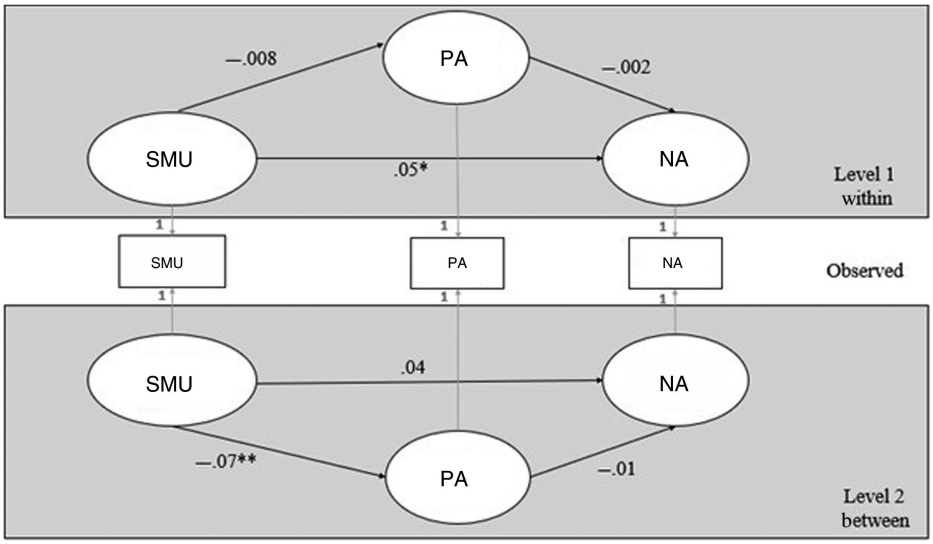

Figure 2 — MSEM (1–1–1) mediation model predicting NA. Standardized estimates are reported. Covariates include age, sex, education, health, and number of chronic conditions. For simplicity, covariate pathways are not depicted. SMU = social media use; PA = physical activity; NA = negative effect; MSEM = multilevel structural equation modeling. $^{*}p < .05$. $^{**}p < .01$.

Table 1 Means, *SD*s, and Intercorrelations Among Variables at the Between-Person Level ($N = 782$)

	M or %	*SD*	1	2	3	4	5	6	7	8
1. SMU (min)	24.76	48.48	—							
2. PA (min)	43.43	67.14	−.07[a]	—						
3. POV[c]	2.53	.75	−.05	.13[b]	—					
4. NA[c]	.23	.29	−.14[b]	−.03	−.47[b]	—				
5. Age (years)	47.91	12.67	−.07[a]	.08[a]	.23[b]	−.12[b]	—			
6. Sex (%female; 1 = male and 2 = female)	55.6	—	.06	−.12[b]	.01	.06	.02	—		
7. Education (years)	15.05	2.48	−.03	−.15[b]	−.03	−.09[a]	−.10[b]	−.13[b]	—	
8. Self-reported physical health[d]	7.30	1.67	−.14[b]	.10[b]	.31[b]	−.32[b]	.04	−.03	.23[b]	—
9. Number of chronic health conditions[e]	2.81	3.11	.12[b]	−.01	−.19[b]	.34[b]	. 13[b]	.13[b]	−.20[b]	−.44[b]

Note. SMU = social media use; PA = physical activity; POV = positive affect; NA = negative affect.
[a]Correlation is significant at .05 level (two-tailed). [b]Correlation is significant at .01 level (two-tailed). [c]Higher values on a 0 to 4 scale indicate greater POV or NA. [d]Possible scores for self-reported physical health ranged from 0 to 10 with a higher score indicating better physical health. [e]Possible number of chronic health conditions was from 0 to 27 with higher scores indicating worse health.

across the week was associated with more PA (Tables 2 and 3; Figures 1 and 2).

Age Differences. As predicted, conditional direct effects showed a significant age interaction for the relationship between SMU and PA (β = –0.06, $p = .03$). The conditional direct effect between SMU and PA was negative and significant for midlife (age at mean: β = –0.08, $p = .002$) and older adults (age at +1 *SD*: β = –0.13, $p = .008$) such that more SMU was associated with less PA, but the conditional direct effect of SMU and PA was not significant for young adults (age at –1 *SD*: β = –0.02, $p = .48$) (Figure 3).

Within-Person Effects

The MSEM model results showed that at the Level 1 within-person level, the direct effect of SMU on PA was not significant (β = –0.008, $p = .51$; Tables 2 and 3; Figures 1 and 2). Moreover, no age differences were found for this relationship (β = –0.02, $p = .15$).

SMU and Well-Being

Between-Person Effects

At the Level 2 between-person level, there was no significant relationship between SMU and POV (β = –0.001, $p = .97$) or NA (β = 0.04, $p = .34$) (Tables 2 and 3). Moreover, no significant Level 2 age interactions were found for the relationship between SMU and POV (β = –0.08, $p = .10$) or NA (β = –0.08, $p = .37$).

Table 2 Standardized Coefficients and Indirect Effects for 1–1–1 MSEM Predicting POV

	β	*Z* value	*p*
Level 1: Within-person effects			
SMU → PA	–0.008	–0.65	.51
SMU → POV	0.009	0.59	.56
PA → POV	0.07***	3.74	<.001
Indirect effect	–0.001	–0.65	.52
Level 2: Between-person effects			
SMU → PA	–0.07**	–3.2	.001
Age → PA	0.11**	2.97	.003
Sex → PA	–0.13**	–3.35	.001
Education → PA	–0.14**	–3.42	.001
Health → PA	0.05	1.51	.13
CHRON → PA	–0.007	–0.19	.85
SMU → POV	–0.001	–0.03	.97
PA → POV	0.12**	2.7	.007
Age → POV	0.23***	6.6	<.001
Sex → POV	0.02	0.42	.67
Education → POV	–0.003	–0.08	.94
Health → POV	.012**	2.77	.006
CHRON → POV	–0.20***	–4.16	<.001
Indirect effect	–0.008*	–2.38	.02

Note. Standardized estimates are reported. SMU = social media use; PA = physical activity; POV = positive affect; CHRON = number of chronic conditions; MSEM = multilevel structural equation modeling.
*$p < .05$. **$p < .01$. ***$p < .001$.

Within-Person Effects

At the Level 1 within-person level, the direct effect of SMU on NA was significant (β = 0.05, $p = .03$) but in the opposite direction of the prediction: Days with more SMU were associated with more NA (Table 3; Figure 2). However, social media was not associated with POV (β = 0.009, $p = .56$; Table 2; Figure 1).

Age Differences. As predicted, the within-person relationship between SMU and NA depended on age (β = –0.04, $p = .01$). The conditional direct effect between SMU and NA was positive and significant for young adults such that days with more SMU were associated with more NA for young adults (age at –1 *SD*: β = 0.075, $p < .001$), but the conditional direct effect of SMU and NA was not significant for midlife (age at mean: β = 0.03, $p = .14$) and older adults (age at +1 *SD*: β = –0.014, $p = .50$) (Figure 4). In other words, days with more SMU were associated with more NA for young but not for midlife and older adults. However, no age differences were found for the relationship between SMU and POV (β = 0.002, $p = .88$).

The Role of PA

PA and Well-Being

Between-Person Effects. As predicted, more PA across the week predicted more POV (β = 0.12, $p = .007$). However, PA did not predict NA (β = –0.01, $p = .74$) (Tables 2 and 3; Figures 1 and 2). No significant Level 2 age interactions were found for the relationship between PA and POV (β = 0.04, $p = .30$) or NA (β = –0.02, $p = .73$).

Table 3 Standardized Coefficients and Indirect Effects for 1–1–1 MSEM Predicting NA

	β	*Z* value	*p*
Level 1: Within-person effects			
SMU → PA	–0.008	–0.67	.51
SMU → NA	0.05*	2.22	.03
PA → NA	–0.002	–0.11	.92
Indirect effect	0.000	0.92	.10
Level 2: Between-person effects			
SMU → PA	–0.07**	–3.13	.002
Age → PA	0.11**	2.85	.004
Sex → PA	–0.13**	–3.36	.001
Education → PA	–0.14**	–3.41	.001
Health → PA	0.05	1.57	.11
CHRON → PA	–0.009	–0.25	.80
SMU → NA	0.04	0.96	.34
PA → NA	–0.01	–0.34	.74
Age → NA	–0.14***	–4.12	<.001
Sex → NA	0.06	1.57	.12
Education → NA	–0.08*	–1.99	.05
Health → NA	–0.18***	–3.63	<.001
CHRON → NA	0.36***	6.24	<.001
Indirect effect	0.001	0.34	.74

Note. Standardized estimates are reported. SMU = social media use; PA = physical activity; NA = negative affect; CHRON = number of chronic conditions.
*$p < .05$. **$p < .01$. ***$p < .001$.

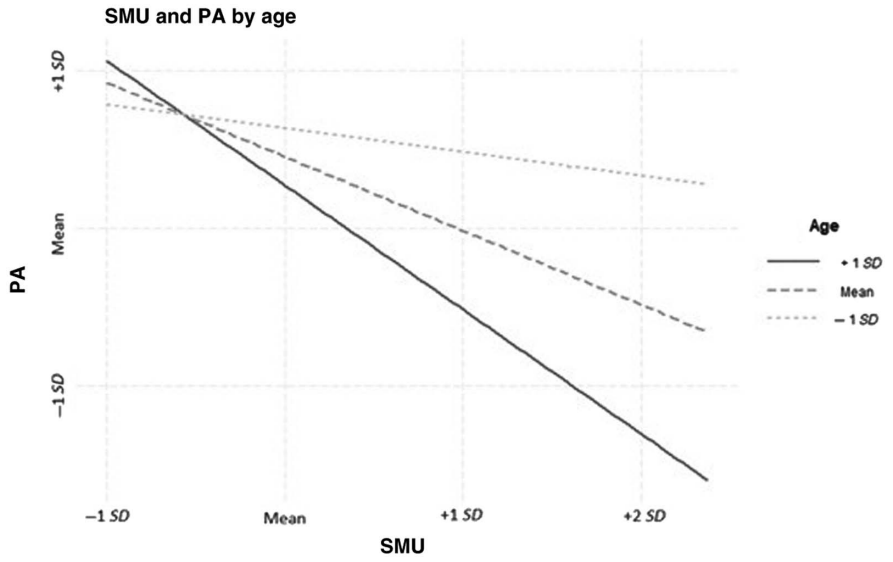

Figure 3 — The between-person relationship (Level 2) between SMU and PA depended on age. The conditional direct effect between SMU and PA was negative and significant for midlife (age at mean: $\beta = -0.08$, $p = .002$) and older adults (age at +1 *SD*: $\beta = -0.13$, $p = .008$) such that more SMU was associated with less PA, but the conditional direct effect of SMU and PA was not significant for young adults (age at −1 *SD*: $\beta = -0.02$, $p = .48$). SMU = social media use; PA = physical activity.

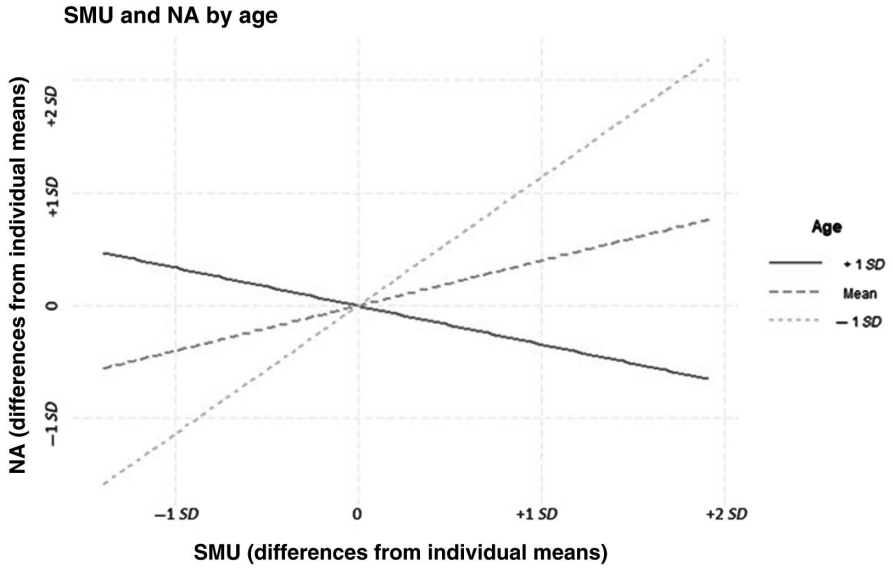

Figure 4 — The within-person relationship (Level 1) between SMU and NA depended on age. The conditional direct effect of SMU on NA at the within-person level was positive and significant for young adults only. In other words, days with more SMU were associated with more NA for young adults (age at −1 *SD*: $\beta = 0.075$, $p < .001$) but not for middle-aged (age at mean: $\beta = 0.03$, $p = .14$) or older adults (age at +1 *SD*: $\beta = -0.014$, $p = .5$). All conditional direct effects are standardized estimates. SMU = social media use; NA = negative effect.

Within-Person Effects. The MSEM model results showed that at the Level 1 within-person level, the direct effect of PA on POV was significant ($\beta = 0.07$, $p < .001$) and as predicted: Days with more PA were associated with more POV (Table 2; Figure 1). However, PA did not predict NA ($\beta = -0.002$, $p = .92$; Table 3; Figure 2). No age differences were found between PA and POV ($\beta = -0.005$, $p = .77$) or NA ($\beta = 0.005$, $p = .80$).

PA as a Mediator

Between-Person Effects. There was a significant Level 2 indirect effect between SMU and POV mediated by PA ($\beta = -0.008$, $p = .02$). That is, less average SMU across the week was associated with more PA and, in turn, more POV (Table 2; Figure 1). Contrary to prediction, no significant indirect effects of PA were found predicting NA (Table 3; Figure 2).

Age Differences. The indirect effects of PA in the relationship between SMU and POV were significant at different levels of age: It was negative and significant for midlife (age at mean: $\beta = -0.008$, $p = .02$) and older adults (age at +1 *SD*: $\beta = -0.01$, $p = .03$) but not for younger adults (age at −1 *SD*: $\beta = -0.002$, $p = .47$). The result suggests that the indirect effect of PA (less SMU leads to more PA, which, in turn, leads to more POV) was present in midlife and older adults but not in younger adults.

Within-Person Effects. The MSEM model results showed that at the Level 1 within-person level, PA did not mediate the relationship between SMU and POV or NA. Moreover, no age differences were found for indirect effects (Tables 2 and 3).

Discussion

The present study extends previous research and contributes to the literature in a number of ways. First, the relationships between general SMU, PA, and affect were examined in a daily context rather than in a health-targeted intervention study. Second, the current study expanded the focus beyond just adolescents and younger adults and included midlife and older adults using a nationally representative sample. Third, PA was tested as a mechanism that explains the relationship between SMU and well-being. Finally, age differences across adulthood were considered in these relationships at both the between- (averaged across the week) and within-person (daily) levels.

SMU and Physical Activity

The current study contributed to the literature by using a nationally representative sample of adults varying in age to examine the relationship between general SMU and PA beyond the scope of health-related SMU. Results showed that those who used social media more across the week engaged in less PA. Follow-up analyses by age showed that the negative relationship between SMU and PA was significant only for the middle-aged and older adults. This finding contrasts with previous intervention work, which showed that more SMU (e.g., Facebook, Instagram) could increase PA in various age groups (Bort-Roig et al., 2014; Kernot et al., 2019; Shimoga et al., 2019; Todorovic et al., 2019). One possible difference is that some studies have involved social media interventions (e.g., support groups, providing educational training) specially designed to increase PA rather than investigating the relationship between naturally occurring daily SMU and PA "in the wild." The current findings suggest that more time spent on social media may take away from time potentially spent engaging in PA (Hall et al., 2019; Vilhelmson et al., 2018). Thus, those who spent less time on social media, which is typically a sedentary activity, would presumably have more time to spend on PA. It is noteworthy that SMU did not show a negative relationship with PA for the younger adults. Although it is not clear from the present findings why this would be the case, it is possible that younger adults are more likely than older adults to multitask when using social media (Carrier et al., 2009). For example, younger adults may use social media while they also engage in healthy behaviors such as PA (Hwang et al., 2014).

SMU and Well-Being

The findings showed that days with more SMU were associated with more NA. Age differences revealed that this within-person relationship was present in younger adults but not in midlife and older adults. This finding is in line with several other studies (Dhir et al., 2018; Weinstein, 2018) that show a negative association between SMU and well-being for young adults. One possible explanation is that younger adults are more prone to excessive social comparisons derived from social media content, which can have a negative impact on their emotional well-being (Dhir et al., 2018). Another possible explanation is the positivity effect in which younger adults may react more than older adults to negative social media content than to positive stimuli, which could increase their NA (Reed & Carstensen, 2012; Yuen et al., 2019). The direct within-person relationships suggest variations within person from day-to-day. It also suggests the importance of studying individuals at a daily level with multiple time points rather than solely focusing on cross-sectional data.

The Role of PA

PA and Well-Being

The current study also contributed to the literature in showing the intra- and interindividual variability in the relationships between PA and affect. Consistent with previous research (McAuley & Rudolph, 1995; Wiese et al., 2018) and as predicted, the findings revealed that days with more PA were associated with more POV. The findings also suggest that those who engaged in more PA, on average, also reported better well-being. This positive relationship at both the daily and between-person levels provides further evidence for the immediate and more cumulative benefits of PA on well-being. Contrary to the hypotheses, PA did not predict NA at either the within- or between-person levels. The benefits of PA engagement include reducing fatigue and releasing serotonin, which can improve one's mood (Young, 2007). Moreover, engaging in PA may make the experience of positive feelings more salient than the reduction of negative ones (Van Cappellen et al., 2018). This suggests that PA may play a more central role in increasing one's positive well-being rather than alleviating NA (Schwerdtfeger et al., 2010).

PA as a Mediator

The daily diary design provides an opportunity to move beyond a single snapshot to probe daily variations in PA as a mechanism in the association between SMU and well-being at both a within- (daily) and between-person (averaged across the week) level. Results revealed that SMU is linked to POV through PA but only at the between-person level. That is, those who engage in less SMU across the week engage in more PA, which, in turn, leads to more POV. Age differences revealed that this indirect effect of PA was found in midlife and older adults but not in younger adults. This finding suggests that midlife and older adults who spent less time on social media, which is typically a sedentary activity, would have more time to spend on PA, and increased activity can, in turn, lead to more POV. Whereas past work has focused on the effects of social media on PA and well-being for younger adults, the present findings raised concerns regarding the negative consequences of SMU on PA for midlife and older adults, suggesting that everyday SMU can directly interfere with their time spent engaging in PA, which can reduce their positive well-being. Although SMU can provide social support and decrease loneliness for the older population (Leist, 2013), it is also vital for older adults to stay physically active. Therefore, with the increase of SMU for the older population, it is crucial for public policies to inform and raise awareness to

the general public regarding the decrease in PA engagement and the associated worsening of positive well-being tied to less PA engagement.

Age Differences

Consistent with the literature, the correlational results showed that older age was associated with less SMU, more POV, and less NA. However, contrary to the literature that suggests PA level declines with age (Hyde et al., 2013; Wolff-Hughes et al., 2015), the correlation results from the current study sample showed that older adults engaged in more PA compared with younger adults. One explanation is that older adults may have more time to engage in PA if they are no longer working or caring for children, whereas younger and midlife adults are engaged in more work-related or caregiving responsibilities (Chung et al., 2009; Infurna et al., 2020).

Within and between-person age differences found in the current study add to the understanding of the age variations in the role of social media for PA and well-being. At the within-person level, days with more SMU were directly associated with negative well-being for younger adults. At the between-person level, SMU was related to positive well-being through PA for midlife and older adults such that those who used less social media, on average, engaged in more PA, which, in turn, led to more POV. The age differences in these relationships are consistent with past research, which depicted the influence of SMU on younger adults' NA and older adults' POV (Dhir et al., 2018; LaRose et al., 2014; Leist, 2013; Weinstein, 2018). However, in contrast to past work that found benefits of SMU for older adults' positive well-being (Leist, 2013), the current study presented evidence of a drawback of spending more time on social media. The current study suggests that increased SMU can lessen older adults' time spent on PA and, in turn, have a detrimental impact on their positive well-being. This finding calls for more research to investigate PA as a mechanism between SMU and well-being in midlife and older adults, particularly because past observational research has largely focused on children and adolescents (Goodyear et al., 2019; Shimoga et al., 2019). Furthermore, although the current study was conducted before the COVID-19 pandemic, the pandemic has made it more common for adults of all ages to use social media to maintain social connections, which could have long-term effects on their activity levels (Moore & Hancock, 2020). Thus, more research is needed on how increased SMU during the pandemic may impact midlife and older adults' PA level and well-being.

Limitations of the current study include the use of self-reports for SMU and PA, which may not be as accurate as objective assessments. Another limitation is that the study did not include assessments of the specific social media platforms that participants used or what types of vigorous PA (e.g., swimming, running) participants engaged in. In contrast, previous intervention and observational studies targeted a specific social media site (e.g., only Facebook or only Instagram) or PA type (e.g., running, brisk walking). Nevertheless, the strengths of the current study include the use of a large national sample of adults varying in age and utilization of the daily diary approach. Future studies can consider using a more objective measurement of time for SMU by having participants with a smartphone to utilize the "screen time" function, which informs the users of the exact hours and minutes they spent on each social networking app daily. This consideration may be particularly constructive for studies targeting daily patterns of smartphone usage given that Americans of all ages (37%) are accessing the internet with their smartphones more often rather than using home broadband (Pew Research Center, 2019a). Future studies can also utilize fitness tracking tools for more objective PA measures rather than basing it on self-report duration.

The current study was limited in that it only included eight days of diary data. In the future, it would be informative to include more time points to capture a more representative sample of daily behavior. Another consideration is that the study data were collected from 2011 to 2014, and much has changed since then with regard to social media and exercise behavior. Thus, it is not clear to what extent the current results are generalizable to current day circumstances. For example, new social media platforms have continued to emerge in recent years (e.g., Tik Tok), and Facebook has become the most widely used social media platform for all ages (Pew Research Center, 2021). Only 20% of adults ages 65 years or older used Facebook in 2012, whereas 50% of older adults reported using Facebook in 2021 (Pew Research Center, 2021). In addition, compared with the pre-pandemic period, more people have been relying on social media during the pandemic for communication, entertainment, and health-related purposes (Kaya, 2020). Future studies are needed to explore whether there have been changes over time in the relationships between SMU, PA, and well-being.

Conclusions

To our knowledge, the current study is the first to examine PA as a mediator of the relationship between SMU and emotional well-being across adulthood at both the intra- and interindividual levels using a national sample. Although age differences exist in the degree of influence of SMU on POV and NA, findings of the current study suggest that more SMU has negative consequences for adults of all ages. At the within-person level, examining daily fluctuations, days with more SMU were associated with more NA for younger adults. At the between-person level, examining individual differences, those who reported spending more time on social media also engaged in less PA, which, in turn, was associated with lower positive well-being in midlife and older adults. Although the mediation model provided evidence for the associations between SMU, PA, and well-being, further work is needed to test alternative models. Longer term longitudinal studies or experimental designs can potentially provide more conclusive evidence for directional or causal effects. Nevertheless, the findings of the current study offer a significant advancement showing PA as a mechanism that is involved in the relationship between SMU and one's emotional well-being over time. As the trends in SMU change, it will be essential to consider the implications for PA, health, and well-being across the adult years.

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