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Running head: PURPOSE AND PHYSICAL ACTIVITY

Purpose in life and accelerometer-measured physical activity among older adults

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Abstract

Objective: Purpose in life is associated with engagement in physical activity and better cognitive health. The present study examines the association between purpose in life and patterns of physical activity measured with an accelerometer and whether these patterns mediate the association between purpose and episodic memory among older adults.

Methods and Measures: This research is a secondary analysis of data from the accelerometry sub-study of the National Health and Aging Trends Study. Participants (*N*=747; mean age=79.20) reported on their purpose, wore an accelerometer for eight days, and completed an episodic memory task.

Results: Purpose in life was associated with healthier patterns of physical activity, including higher total activity counts (β=.10, *p*=.002), more active bouts per day (β=.11, *p*=.003), less activity fragmentation (β=-.17, *p*<.001), and more sedentary fragmentation (β=.11, *p*=.002). These associations were generally similar across age, sex, race, and education. Higher total activity counts and less activity fragmentation were associated with better episodic memory and accounted for part of the association between purpose and episodic memory.

Conclusion: Purpose in life is associated with healthier patterns of physical activity measured through accelerometry among older adults and such patterns may be one factor in the pathway from purpose to healthier episodic memory.

Keywords: Purpose in life; Meaning in life; physical activity; accelerometry; episodic memory

Purpose in life is the feeling that one's life is goal-oriented and has direction (McKnight & Kashdan, 2009). It has emerged as an important psychological factor for health outcomes, particularly cognitive health. Individuals who report more purpose (and the related construct of meaning), for example, tend to have better cognitive function (Windsor et al., 2015), report fewer cognitive complaints (Sutin, Aschwanden, et al., 2023), and are at lower risk of developing Alzheimer's disease and other dementias (Sutin, Luchetti, et al., 2023). One pathway through which purpose may support healthier cognitive outcomes is through physical activity (Sutin et al., 2021). And, indeed, purpose is associated consistently with engaging in more physical activity measured both through self-report (Kim et al., 2020; Ugwueze et al., 2021; Yemiscigil & Vlaev, 2021; Zhang & Chen, 2021) and objectively through accelerometer (Hooker & Masters, 2016; Sutin, Luchetti, et al., 2021a). The purpose of the present research is to examine the association between purpose in life and patterns of physical activity and whether such patterns account for part of the association between purpose and better episodic memory.

There are theoretical reasons why purpose in life is associated with greater physical activity. Greater activity, for example, is within the definition of purpose in life: To pursue one's goals and interests usually requires some amount of activity (Hooker & Masters, 2016). This activity may be other than physical, such as social, cognitive, or voluntary activity, but many of these activities may result in being more physically active at the same time. In addition, individuals higher in purpose value their health and may thus engage in behaviors that help preserve it (McKnight & Kashdan, 2009). Purpose, for example, is associated with greater use of preventative services, such as cholesterol and cancer screenings (Kim et al., 2014). Individuals higher in purpose also enjoy physical activity and recognize the benefits of engaging in it, and these motivations are one reason for why individuals higher in purpose maintain their physical activity over time (Sutin, Luchetti, et al., 2022).

The literature on purpose in life and physical activity as measured by accelerometer has thus far been limited to two studies and to measures of moderate to vigorous physical activity and overall activity (Hooker & Masters, 2016; Sutin, Luchetti, et al., 2021a). This literature is consistent with the self-report literature on purpose and physical activity that shows purpose is associated with greater engagement in physical activity (Kim et al., 2020; Ugwueze et al., 2021; Yemiscigil & Vlaev, 2021; Zhang & Chen, 2021) and less sedentary behavior (Sutin, Luchetti, et al., 2022). These accelerometer studies show, in particular, that purpose is associated with more time spent in moderate-to-vigorous physical activity, with associations somewhat stronger than overall activity. Yet, there are other ways to conceptualize patterns of physical activity. There is evidence, for example, that fragmentation of physical activity, defined as transitions from active to sedentary behavior (activity fragmentation) or from sedentary to active behavior (sedentary fragmentation) throughout the day, is critical for consequential health outcomes among older adults. Greater activity fragmentation, for example, is associated with incident frailty (Wanigatunga, Chiu, et al., 2022), concurrent cognitive complaints (Del Pozo Cruz & Del Pozo-Cruz, 2021), and increased risk of premature mortality (Wanigatunga et al., 2019). Even among those with high mean levels of physical activity, more fragmented activity patterns are associated with fatigue (Palmberg et al., 2020). Furthermore, the amount and intensity of physical activity decrease across older adulthood (Berkemeyer et al., 2016), and activity patterns may become more fragmented (Liu et al., 2021). For older adults, fragmentation of physical activity may better represent functional abilities than previously used summary measures of moderate-to-vigorous or overall physical activity (Schrack et al., 2019).

Purpose may also be related to these patterns of physical activity, and, further, these patterns may contribute to the healthier cognition associated with it. Purpose is associated with healthier cognitive outcomes, from better episodic memory and verbal fluency (Sutin, Luchetti, Stephan, et al., 2022) to lower risk of incident dementia (Sutin, Luchetti, et al., 2023). Previous research on dementia risk has found that physical activity is one behavioral factor that accounts for a small part of the association between purpose and cognitive outcomes (Boyle et al., 2010; Sutin et al., 2018). In this work, physical activity tends to be included as one factor among a list of behavioral and clinical risk factors and tends to be measured with a broad overall measure of activity. Research on physical activity and episodic memory in particular has shown that more engagement in physical activity is associated with better episodic memory (Stenling et al., 2022), whereas the relation between sedentary behavior and episodic memory is more mixed (Dillon et al., 2022). Given that physical activity is dynamic, and that activity fragmentation has been associated with aspects of cognitive health, such as cognitive complaints and impairment (e.g., Del Pozo Cruz & Del Pozo-Cruz, 2021; Wanigatunga, Liu, et al., 2022), a more nuanced approach to patterns of physical activity may help better identify how purpose is associated with better cognitive function, such as episodic memory.

The current study addresses whether purpose in life is associated with patterns of physical activity and whether such patterns are one mechanism that supports better episodic memory. We address these aims with secondary data analysis of a large subsample of participants from the National Healthy Aging Trends Study (NHATS) who were part of the

NHATS accelerometer sub-study. Based on the literature on purpose in life and physical activity reviewed above, including that purpose is associated with both greater physical activity and less sedentary behavior (Sutin, Luchetti, et al., 2022) we expect that higher purpose will be associated with healthier patterns of physical activity (e.g., more total movement, less unhealthy fragmentation). We test whether these associations are moderated by age, sex, race, or education to evaluate generalizability across sociodemographic groups. A second aim of this research is to examine whether physical activity mediates that association between purpose in life and episodic memory. Given previous research on purpose and better episodic memory (Sutin, Luchetti, Stephan, et al., 2022) and physical activity and better episodic memory (Stenling et al., 2022), we expect that both purpose in life and healthier patterns of physical activity will be associated with better episodic memory, and that individuals higher in purpose in life will have better episodic memory in part because they also have healthier patterns of physical activity.

Method

Participants and procedure

Participants were from NHATS, a large longitudinal study of adults over the age of 65 (Freedman & Kasper, 2019). Participants reported on their purpose in life and completed several cognitive tasks through the main NHATS assessment administered to all active participants in Round 11. A subset of participants from NHATS was selected from the overall sample at Round 11 to participate in an ancillary study on physical activity measured through accelerometry for eight consecutive days. See Schrack and colleagues (2022) for detailed information on the accelerometer sub-study. In brief, a total of 1000 NHATS participants were selected for accelerometry, and 872 were eligible to participate (i.e., still alive and active in NHATS). A total of 747 participants had usable data. Reasons for exclusion from the accelerometry sub-study were refused to participate (*n*=58), returned no usable data (*n*=25), did not complete the interview (*n*=36), and did not return watch (*n*=6). The overall compliance rate for the accelerometer study was thus 85.7%. Of participants who returned usable data, 99.5% (*n*=743) wore the accelerometer for the full 8 days; the other four participants had 6 or 7 days of valid wear time. Of these participants, *n*=731 reported on their purpose in life at the same wave as the accelerometer (reported on before participating in the accelerometer sub-study). The remaining 16 participants reported on their purpose in a previous wave of NHATS (up to four years prior to the accelerometer sub-study). These participants were retained in the analysis to make use of all available accelerometer data and reduce bias due to missing data. Results were similar if these participants were excluded from the analysis. Participants were, on average 79.20 years old (SD=5.93), 54.4% female, 80.5% white, 7.9% Black, and 11.6% otherwise identified (Table 1). The Johns Hopkins Institutional Review Board provides review and ethical oversight of NHATS. Participants provide written informed consent before participating. The current analysis was based on deidentified public data from NHATS.

Measures

Purpose in life. Purpose in life was measured with the item, “My life has meaning and purpose.” The rating was made on a scale from 1 (*agree a lot*) to 3 (*agree not at all*) and reverse-scored in the direction of greater purpose. Although a single item, it has been shown to have similar associations with outcomes of interest, including cognitive function, as multi-item purpose in life scales (e.g., Sutin, Luchetti, et al., 2021b).

Physical activity. Physical activity was measured with the Actigraph CentrePoint Insight Watch that was worn on the wrist for up to 8 days (7 target days and the day of the interview). See Schrack and colleagues (2022) for detailed information about wear methodology, validity of defined times, and data processing. Briefly, participants were instructed to wear the watch on their non-dominant wrist and only remove it for swimming or bathing for more than 30 minutes. Valid wear time was defined as at least 1,296 minutes per day (>90% of the day) (Schrack et al., 2014; Wanigatunga et al., 2021). The raw accelerometry data were processed through the Johns Hopkins Accelerometry Resource using the R ARCTOOLS package. The 24-hour wear protocol did not differentiate sleep from wake, and data were imputed for non-wear time (see Karas et al., 2021; Schrack et al., 2022). Activity count was a metric of physical activity volume. An active minute was defined as an activity count that meets a specified threshold (the default threshold in NHATS is ≥1853 counts per minute), whereas a sedentary minute was an activity count below this threshold (Koster et al., 2016) that also included sleep (Schrack et al., 2022). An active bout was one or more consecutive minutes of activity, whereas a non-active bout was one or more consecutive minutes of non-activity. Activity fragmentation was defined as the probability of transitioning from an active state to a sedentary state (Schrack et al., 2019). Sedentary fragmentation was defined as the probability of transitioning from a sedentary state to an active state (Wanigatunga, Cai, et al., 2022). Our primary variables of interest were total activity count, number of active bouts per day, activity fragmentation, and sedentary fragmentation. In supplemental analyses, we also analyzed number of active minutes per day, mean length of active bouts, mean length of non-active bouts, and maximum activity counts in 10 consecutive minutes, 30 consecutive minutes, and 60 consecutive minutes.

Episodic memory. Episodic memory was measured with a standard word-list recall task validated in the Health and Retirement Study (Ofstedal et al., 2005). Participants were read a list of 10 words and were asked to recall the words immediately and after a brief delay. The episodic memory score was the sum of correct words recalled over the two conditions (possible range 0-20).

Sociodemographic covariates. Sociodemographic characteristics were age (in years), sex (female=1, male=0), race (Black=1 and otherwise identified=1 both compared to white=0), and education (reported on a scale from 1=no schooling completed to 9=master's, professional or doctorate degree).

Analytic Strategy

Participants had full data available for all analytic variables, except for education (n=16 with missing data) and episodic memory (n=14 with missing data); values were imputed with multiple imputation for these missing data (results were the same if listwise deletion was used). Linear regression was used to examine the association between purpose in life and physical activity. Specifically, purpose in life was regressed on total activity count, number of active bouts per day, activity fragmentation, and sedentary fragmentation in separate regressions with each physical activity measure included in the analysis as the outcome and controlling for the sociodemographic covariates (age, sex, race, education). We then tested whether the association between purpose and these measures was moderated by the sociodemographic covariates by testing for an interaction between purpose and age, sex, race (Black and otherwise identified, both compared to white), and education and including the main effects. Finally, we tested whether physical activity mediated the association between purpose and episodic memory using the PROCESS macro model 4 (Hayes, 2018), controlling for the sociodemographic covariates. The measure of total activity counts was too highly correlated with the other physical activity dimensions to be included in the same model and thus two mediation models were run (one with total activity counts as mediator [Model 1] and one with number of active bouts, activity fragmentation, and sedentary fragmentation as simultaneous mediators [Model 2]).

Results

Descriptive statistics for all study variables are in Table 1; correlations among all study variables are in Table S1. Table 2 reports the results of the linear regressions. As expected, greater purpose in life was associated with greater engagement in physical activity: Participants with more purpose had more total activity counts (β=.10, p=.002) and more active bouts each day (β=.11, p=.003). Purpose was also associated with fragmentation: Greater purpose was associated with a lower probability of transitioning from active to sedentary behavior (β=-.17, p<.001) and a greater probability of transitioning from sedentary to active behavior (β=.11, p=.002). Across 20 interactions that tested moderation by the sociodemographic factors, only two were significant: the negative association between purpose and activity fragmentation was stronger among males than females (β=.20, p<.001) and the association between purpose and total activity count was stronger among participants with higher education than lower education (β=.08, p=.019). These interactions, however, should be interpreted with caution until replicated given the large number of interactions tested. Finally, purpose was associated positively with the other metrics of physical activity: minutes of activity per day, mean length of active bouts, and maximum activity counts in 10 minutes, 30 minutes, and 60 minutes

(Supplementary Table S2). The one exception was that purpose was unrelated to the mean length of non-active bouts; note that none of the covariates was associated with this metric.

We next tested physical activity as a mediator of the association between purpose in life and episodic memory (Table 3; Figure 1). As expected from previous research (Sutin, Luchetti, Stephan, et al., 2022), purpose was associated with better episodic memory ($b=.14$, $p<.001$). In addition, greater total activity count was associated with better episodic memory, whereas greater activity fragmentation was associated with worse episodic memory. There was support for the mediational model for these two metrics of physical activity: There were small indirect effects of purpose in life on episodic memory through total activity counts and activity fragmentation. These dimensions accounted for about 7% and 14%, respectively, of the association between purpose and episodic memory. The direct effect of purpose in life on episodic memory remained significant after accounting for the small indirect effects, which indicated that the markers of physical activity were partial mediators of the purpose-episodic memory association. Number of active bouts and sedentary fragmentation were unrelated to episodic memory and thus could not mediate the association with purpose. The results were similar when each mediator in Model 2 was tested separately instead of simultaneously.

Discussion

The present study examined the association between purpose in life and metrics of physical activity derived from accelerometers worn for eight days. Higher purpose was associated with greater total activity as measured by accelerometer. Expanding previous work on patterns of physical activity (Hooker & Masters, 2016; Sutin, Luchetti, et al., 2021a), the present study suggests that purpose is also associated with healthier patterns of fragmentation that indicate fewer transitions to sedentary behavior and more transitions to being active throughout the day. We also tested whether these patterns of physical activity mediated the association between purpose and episodic memory based on previous research that both purpose (Sutin, Luchetti, Stephan, et al., 2022) and physical activity (Stenling et al., 2022) are associated with episodic memory and that physical activity may be one pathway between purpose and healthier cognitive outcomes (Boyle et al., 2010; Sutin et al., 2021). And, indeed the present findings indicate that more physical activity and less activity fragmentation are associated with better episodic memory, and these patterns mediated the association between purpose and episodic memory. This result suggests that these aspects of physical activity may be mechanisms in the pathway between purpose and better episodic memory function.

Purpose in life and patterns of physical activity

There is now a substantial literature that purpose in life is associated with greater engagement in physical activity. There is consistent evidence that purpose is associated with physical activity measured with self-report (Kim et al., 2020; Sutin, Luchetti, et al., 2022; Ugwueze et al., 2021; Yemiscigil & Vlaev, 2021; Zhang & Chen, 2021), and growing evidence that this association extends to physical activity measured through accelerometry (Hooker & Masters, 2016; Sutin, Luchetti, et al., 2021a). These latter studies on primarily younger and middle-aged samples have also found that purpose is associated with engagement in greater intensity of physical activity. The present study replicates and builds on this foundational work with a sample of older adults to show that purpose is also associated with healthier patterns of activity fragmentation. That is, recent work has highlighted that greater activity fragmentation is associated with worse health-related outcomes, such as mortality (Wanigatunga et al., 2019), whereas greater sedentary fragmentation is associated with better outcomes, such as lower risk of frailty (Wanigatunga, Cai, et al., 2022). Purpose in life is also associated with these patterns of physical activity.

There are several reasons that purpose may be associated with healthier patterns of physical activity. Individuals higher in purpose enjoy physical activity and value its health benefits (Sutin, Luchetti, et al., 2022). Purpose is also associated with greater social integration (Sutin, Luchetti, Aschwanden, et al., 2022), which may have a component of activity to it (e.g., interacting with other people may involve some amount of physical activity; Kikuchi et al., 2017). Individuals higher in purpose are also healthier (e.g., have fewer chronic diseases; Musich et al., 2018) and maintain their health longer into older adulthood (Boyle et al., 2022) than individuals lower in purpose. Better physical health is likely to facilitate greater engagement in physical activity and less fragmented physical activity patterns, especially at older ages. Finally, activity is inherent in the definition of purpose (Hooker & Masters, 2016) and thus a positive association with greater activity is proof of concept for the construct of purpose. These mechanisms were not tested in the current study; it would be worthwhile to test such mechanisms in future research.

The data used in the present work is cross-sectional and thus cannot address the temporal ordering of purpose and physical activity. There is some evidence from longitudinal studies that suggests bidirectional associations between purpose and physical activity: Greater purpose, for example, is associated with increases in physical activity over time, and greater engagement in physical activity is also associated with increases in purpose over time (Pfund et al., 2022; Yemiscigil & Vlaev, 2021); although not all find this pathway (Zhang & Chen, 2021).

With such bidirectional effects, the association between purpose and physical activity may become self-reinforcing over time: Feeling purposeful may facilitate greater physical activity, and physical activity may strengthen feeling purposeful. Future research would benefit from testing these bidirectional pathways with longitudinal assessments of physical activity measured through accelerometry in addition to self-report. Experimental approaches are also needed to test causal pathways from purpose to physical activity (and vice versa).

Physical activity as a mechanism of purpose and episodic memory

The present findings suggest that physical activity may be one behavioral factor in the pathway between purpose and episodic memory. Similar to previous research (Sutin, Luchetti, Stephan, et al., 2022), purpose was associated with better episodic memory in this sample. Greater overall physical activity and less activity fragmentation were likewise associated with better episodic memory. Activity fragmentation has been characterized as a useful metric that may capture underlying functional decline that is not reflected in standard measures of physical activity and sedentary behavior. For example, two people may have the same level of physical activity, but one may need to break up the activity with periods of rest, whereas the other person may have the strength to do the same amount of physical activity at one time (Schrack et al., 2019; Wanigatunga, Liu, et al., 2022). This measure has been associated with cognitive complaints (Del Pozo Cruz & Del Pozo-Cruz, 2021) and found to differentiate individuals with cognitive impairment from individuals with normal cognitive function (Wanigatunga, Liu, et al., 2022). The present findings suggest that it may also be one factor that contributes to the association between purpose and episodic memory.

Physical activity may play a key role in the pathway between purpose in life and better physical health outcomes, as well as better cognitive outcomes. Individuals with greater purpose tend to have better health, including better physical function (Kim et al., 2017) and fewer chronic diseases (Musich et al., 2018) that may culminate in lower risk of premature mortality (Cohen et al., 2016). The benefits of purpose in life specifically for healthier cognitive aging has also been highlighted recently (Sutin, Luchetti, & Terracciano, 2021). Physical activity may be one pathway through which purpose is associated with these outcomes, given that greater engagement in physical activity tends be a protective factor against poor health, including lower risk of Alzheimer's disease (Norton et al., 2014), and is likewise associated with greater longevity (Ekelund et al., 2019). Purpose may provide the motivation and enjoyment for physical activity that sustains engagement in it over the long term (McKnight & Kashdan, 2009). Such engagement, in turn, may buffer against the development of chronic disease.

It is important to note that the total activity count variable was highly correlated with the other metrics of physical activity, particularly activity fragmentation, and thus could not be tested in the same model. As a result, it is unclear whether activity fragmentation is worse for episodic memory than fewer total activity counts or whether this fragmentation primarily reflects overall less engagement in physical activity. In the present sample, it was not possible to tease apart these two metrics. Future research will need to better differentiate total physical activity from activity fragmentation to address this issue. In addition, sedentary behavior was not separated from sleep in the calculation of fragmentation. In the context of the current work, the results suggest that greater physical activity – defined either as more total activity counts or less activity fragmentation – is associated with both greater purpose in life and better episodic memory performance.

The present study had several strengths, including a relatively large sample of older adults with accelerometer-measured physical activity. There are also several limitations to consider when evaluating the results. First, as mentioned previously, the data are cross-sectional. As such, we were unable to test the directionality of the associations. And, importantly, it may be the case that older adults who are the most physically active are the ones with the physical and mental resources to maintain greater purpose and better episodic memory. Future research would benefit from longitudinal data to evaluate the temporal ordering of purpose and physical activity measured with accelerometry, particularly in relation to episodic memory. Experimental approaches, such as randomized trials, could be informative on whether interventions on purpose can have an impact on physical activity, or vice versa. Second, the measure of purpose in life was a single item. Although not ideal, the association with consequential outcomes tends to be similar for single items as with longer multi-item measures of purpose (Sutin, Luchetti, Stephan, et al., 2022; Sutin, Luchetti, et al., 2021b). Third, the physical activity measures were averaged across the day for overall measures of activity and fragmentation. Future research would benefit from a more fine-grained approach to look at more specific periods throughout the day. Finally, the sample was limited to older adults in the United States. Although the advanced age of this sample is also a strength, given the previous focus on younger and middle-aged adults, the generalizability of the current results may be limited to older adults and/or individuals in the United States. Of note, however, previous research has found purpose to be associated with physical activity in a range of populations (e.g., Sutin, Luchetti, et al., 2022; Ugwueze et al., 2021; Zhang & Chen, 2021). Future work will need to confirm whether the associations between purpose and accelerometer measured activity, particularly patterns of fragmentation, also extend to other populations.

Despite these limitations, the present research supports the association between purpose in life and greater engagement in physical activity, as measured objectively by accelerometer. It also suggests that physical activity may be one pathway between purpose and episodic memory. Given that purpose is also malleable and can be changed through intervention (Park et al., 2019), it may be a promising target to increase both physical activity and reduce risk of poor cognitive outcomes in older adulthood.

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Conflict of Interest

The authors have no conflicts of interest to report.

Data Availability Statement

The data that support the findings of this study are available publicly from the National Health and Aging Trends Study at nhats.org.

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Table 1

Descriptive Statistics for All Study Variables

Variable	Mean (SD) or % (n)
Age (years)	79.20 (5.93)
Age range	71-100
Sex (female)	54.4% (406)
Race (Black)	7.9% (59)
Race (Otherwise identified)	11.6% (87)
Education[a]	5.94 (2.22)
Purpose in life[b]	2.78 (.48)
Episodic memory[c]	9.22 (3.57)
Accelerometer	
Total activity counts	1671372.02 (636850.78)
Active bouts/day	87.90 (21.30)
Activity fragmentation	.29 (.10)
Sedentary fragmentation	.08 (.03)
Active minutes/day	338.72 (128.80)
Mean length of active bouts	3.81 (1.21)
Mean length inactive bouts	17.87 (74.36)
Max activity counts in 10 consecutive minutes	6154.55 (1744.47)
Max activity counts in 30 consecutive minutes	4727.37 (1504.83)
Max activity counts in 60 consecutive minutes	3842.24 (1307.64)

Note. *N*=747. Data were imputed for missing values on education (*n*=16) and episodic memory (*n*=14); some participants (*n*=16) reported on their purpose up to four years prior to the accelerometer wave. [a] Education was reported on a scale with the options of 1 (no schooling completed; n=1), 2 (1st-8th grade; n=40), 3 (9th-12th grade [no diploma]; n=53), 4 (high school graduate [high school diploma or equivalent]; n=188); 5 (vocational, technical, business, or trade school certificate or diploma [beyond high school level]; n=51), 6 (some college but no degree; n=120), 7 (associate’s degree; n=36), 8 (bachelor’s degree; n=115), and 9 (master’s, professional or doctorate degree; n=143). [b] Purpose in life was a scale from 1 (agree not at all) to 3 (agree a lot). [c] Episodic memory was the sum of correct words recalled across immediate and delayed recall trials, with a possible range of 0-20.

Table 2

Linear Regression Predicting Physical Activity from Purpose in Life and Covariates

Predictors	Total activity counts		Number active bouts		Activity fragmentation		Sedentary fragmentation	
	β	p	β	p	β	p	β	p
Age	-.27	<.001	-.12	<.001	.21	<.001	-.16	<.001
Sex	.22	<.001	.04	.219	-.23	<.001	.11	.002
Race (Black)	.02	.549	.12	<.001	.10	.005	.12	.001
Race (Otherwise identified)	.12	<.001	.02	.566	-.04	.288	.06	.083
Education	.11	.003	.05	.177	-.06	.095	.07	.066
Purpose wave	-.10	.004	-.12	.001	.10	.003	-.12	.001
Purpose in life	.10	.002	.11	.003	-.17	<.001	.11	.002

Note. *N*=747. Coefficients are standardized beta coefficients from linear regression.

Table 3

Indirect Effects of Purpose in Life on Episodic Memory Through Physical Activity

	Purpose to Physical Activity (path a)		*Physical Activity to Episodic Memory (path b)*		*Indirect Effect (axb)*		*Total Effect (path c)*	*Direct Effect (path c')*
	b (95% CI)	p	b (95% CI)	p	b (95% CI)	p	b (95% CI)	b (95% CI)
Model 1								
Physical Activity							.14 (.08, .20)	.13 (.06, .19)
Total activity counts	.10 (.04, .17)	.002	.12 (.05, .19)	<.001	.01 (.003, .025)	.025	p<.001	p<.001
Model 2								
Physical Activity							.14 (.08, .20)	.11 (.05, .18)
Number of active bouts	.11 (.04, .18)	.001	-.04 (-.25, .18)	.746	.00 (-.03, .02)	.758	p<.001	p<.001
Activity fragmentation	-.17 (-.24, -.10)	<.001	-.11 (-.20, -.03)	.009	.02 (.003, .04)	.024		
Sedentary fragmentation	.12 (.05, .19)	.001	.05 (-.18, .28)	.653	.01 (-.02, .03)	.669		

Note. All variables were standardized before analysis; betas can thus be interpreted as standardized. 95% CI=95% bias corrected confidence interval. Analyses controlled for age, sex, race, education, and purpose wave.

Figure 1

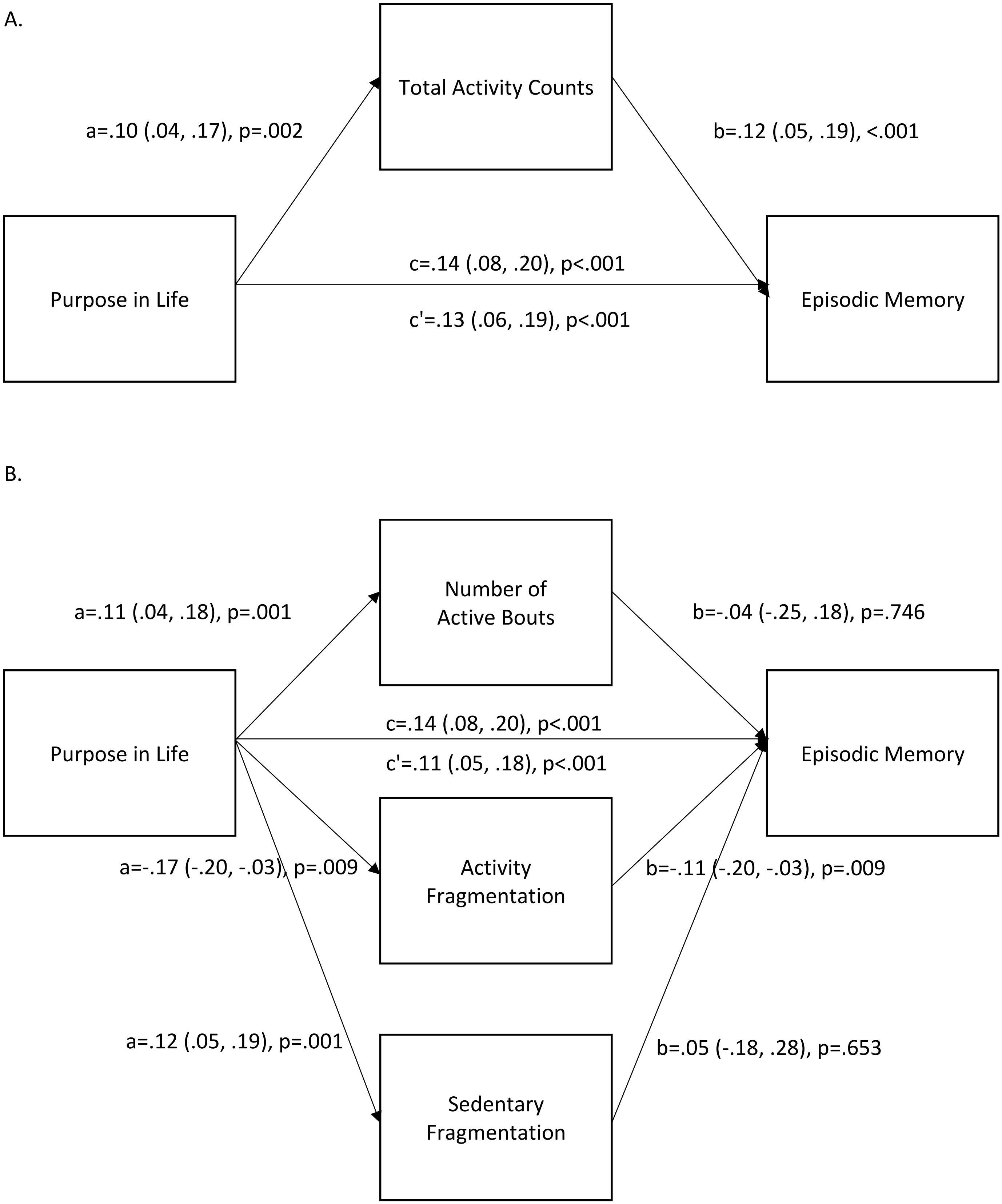
A.
Total Activity Counts
a=.10 (.04, .17), p=.002
b=.12 (.05, .19), <.001
Purpose in Life
c=.14 (.08, .20), p<.001
c'=.13 (.06, .19), p<.001
Episodic Memory
B.
Number of Active Bouts
a=.11 (.04, .18), p=.001
b=-.04 (-.25, .18), p=.746
Purpose in Life
c=.14 (.08, .20), p<.001
c'=.11 (.05, .18), p<.001
Episodic Memory
Activity Fragmentation
a=-.17 (-.20, -.03), p=.009
b=-.11 (-.20, -.03), p=.009
a=.12 (.05, .19), p=.001
b=.05 (-.18, .28), p=.653
Sedentary Fragmentation

Figure Caption

Figure 1. Mediation model of the association between purpose in life on episodic memory through total activity counts (A) and number of active bouts, activity fragmentation, and sedentary fragmentation (B).

Table S1

Correlations among all study variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Age	--									
2. Sex	.11**	--								
3. Race (Black)	-.03	-.07	--							
4. (Otherwise)	-.02	-.05	-.11**	--						
5. Education	-.12**	-.10**	-.19**	-.21**	--					
6. Purpose in life	-.11**	.03	.08**	.00	.09*	--				
7. Episodic memory	-.32**	.12**	-.12**	-.11**	.34**	.19**	--			
8. Total activity counts	-.28**	.16**	-.01	.08*	.11**	.15**	.26**	--		
9. Active bouts/day	-.15**	.01	.12**	-.01	.05	.14**	.10**	.57**	--	
10. Activity fragmentation	.22**	-.20**	.11**	-.02	-.10**	-.20**	-.27**	-.79**	-.30**	--
11. Sedentary fragmentation	-.18**	.07	.10**	.03	.06	.15**	.15**	.78**	.94**	-.48**
12. Active minutes/day	-.23**	.17**	.00	.07	.08*	.16**	.23**	.97**	.64**	-.81**
13. Mean length of active bouts	-.21**	.22**	-.09**	.09*	.07	.12**	.23**	.85**	.16**	-.89**
14. Mean length inactive bouts	.06	-.01	-.02	-.02	-.01	.00	-.01	-.20**	-.30**	.56**
15. Max activity counts 10 minutes	-.32**	.10**	-.08*	.10**	.16**	.15**	.30**	.77**	.33**	-.71**
16. Max activity counts 30 minutes	-.30**	.12**	-.08*	.09*	.16**	.17**	.29**	.82**	.34**	-.74**
17. Max activity counts 60 minutes	-.31**	.12**	-.07	.08*	.16**	.16**	.28**	.86**	.37**	-.77**

Table S1 Continued

	11.	12.	13.	14.	15.	16.	17.
11. Sedentary fragmentation	--						
12. Active minutes/day	.84**	--					
13. Mean length of active bouts	.41**	.83**	--				
14. Mean length inactive bouts	-.24**	-.21**	-.21**	--			
15. Max activity counts 10 minutes	.46**	.68**	.68**	-.22**	--		
16. Max activity counts 30 minutes	.50**	.73**	.72**	-.21**	.97**	--	
17. Max activity counts 60 minutes	.53**	.78**	.78**	-.20**	.94**	.98**	--

Table S2

Linear Regression Predicting Other Metrics of Physical Activity from Purpose in Life and Covariates

Predictors	Active minutes		Mean length active bouts		Mean length inactive bouts		Max activity counts over consecutive minutes					
							10 minutes		30 minutes		60 minutes	
	β	p	β	p	β	p	β	p	β	p	β	p
Age	-.22	<.001	-.22	<.001	.06	.121	-.30	<.001	-.29	<.001	-.29	<.001
Sex	.22	<.001	.26	<.001	-.02	.555	.16	<.001	.17	<.001	.18	<.001
Race (Black)	.03	.454	-.06	.114	-.02	.538	-.05	.177	-.04	.207	-.03	.372
Race (Otherwise identified)	.10	.005	.11	.002	-.02	.589	.14	<.001	.13	<.001	.12	<.001
Education	.09	.018	.06	.083	-.01	.792	.14	<.001	.14	<.001	.14	<.001
Purpose wave	-.11	.002	-.07	.044	.01	.758	-.10	.005	-.10	.004	-.09	.007
Purpose in life	.12	<.001	.07	.037	.01	.817	.10	.005	.11	.001	.11	.001

Note. *N*=747. Coefficients are standardized beta coefficients from linear regression.