Association of Personality on Changes in Weekday Sitting Time: Cross-Sectional and Prospective Evaluation

Chelsea Joyner[1], Stuart J.H. Biddle[2], Paul D. Loprinzi[1],*

[1]Department of Health, Exercise Science and Recreation Management, The University of Mississippi, University, MS, USA, [2]Physically Active Lifestyles Research Group (USQ PALs), Institute for Resilient Regions, University of Southern Queensland, Springfield Central, QLD, Australia

Background: The purpose of this study was to examine the prospective association of personality typology on changes in sitting (sedentary) time.
Methods: Young adults (N = 126; M_{age} = 21.6 yrs) completed self-report assessments of personality and sitting time at baseline and at an approximate 5-month follow-up. At baseline, personality was assessed via the Neuroticism-Extraversion-Openness Five Factor Inventory (NEO-FFI) questionnaire. At both baseline and the follow-up period, sitting time was self-reported using the International Physical Activity Questionnaire (IPAQ) short form.
Results: Both extraversion (β = −5.8; 95% CI: −11.7, 0.21; p = 0.05) and conscientiousness (β = −5.7; 95% CI: −11.3, −0.2; p = 0.04) were inversely associated with baseline sitting time. Regarding the prospective results, the only personality trait associated with changes in sitting time was openness to experience. Independent of changes in physical activity as well as other potential confounders, for every 1 unit increase in openness to experience, there was an associated 6.6 min/day increased change score in sitting time over the 5-month follow-up period (β = 6.6; 95% CI: 0.13, 13.0; p = 0.04).
Conclusion: Personality was differentially associated with sitting time based on the study design, with the personality trait of openness to experience being prospectively associated with increases in sitting time.

Key Words: Epidemiology, Exercise, Sedentary behavior

INTRODUCTION

The five-factor personality model incorporates 5 distinct personality traits, including *extraversion* (e.g., outgoing/energetic), *neuroticism* (sensitive/nervous), *openness*

to *experience* (inventive/curious), *agreeableness* (e.g., friendly/compassionate), and *conscientiousness* (e.g., efficient/organized). There is clear evidence that personality influences physical and mental health [1]. A 2006 meta-analysis demonstrated that extraversion and conscientiousness were positively associated with self-reported physical activity, whereas neuroticism was inversely associated with self-reported physical activity (with null findings for agreeableness and openness) [2]. In a prospective design, conscientiousness and openness predicted subsequent increases in physical activity, whereas agreeableness predicted subsequent decreases in physical activity [3], Recent work [4] demonstrates that extraversion, agreeableness and conscientiousness are positively associated with *objectively-measured*

physical activity, whereas neuroticism is inversely associated with objectively-measured physical activity; this latter point is also in alignment with other work [5]. The relationship between personality and physical activity is thought to occur via social cognitions (e.g., personality-related attitudes) [2]. Additionally, other work demonstrates that extraversion is positively associated with muscle strength, whereas neuroticism is inversely associated with muscle strength [6]; this has also been supported by other research [7]. This personality-muscle strength relationship is thought to be partially mediated via physical activity [6].

Although the relationship between personality and physical activity has been extensively examined, the relationship between personality and sedentary behavior has been far less investigated. Such an examination is noteworthy based on the suggestive evidence that sedentary behavior may influence adult health outcomes somewhat independent of physical activity [8]. Regarding the emerging work examining the relationship between personality and sedentary behavior, evidence suggests that introversion is associated with more overall internet use in college samples [9,10]; high neuroticism predicts motivation to watch high levels of television and sedentary behavior among men [11,12]; low social extraversion predicts sedentary behavior [11]; high internet use is associated with decreased agreeableness and those who use the internet a great deal tend to be more open to new experiences [9,10]; and extraversion is negatively associated with total sitting time [13]. A recent meta-analysis supports these findings by concluding that, among 26 evaluated studies, neuroticism was positively associated with sedentary behavior and conscientiousness was inversely associated with sedentary behavior [14]; this is also in agreement of a 2016 meta-analysis on this topic evaluating 16 studies [15]. In the 2017 meta-analysis, non-significant associations were generally observed for extraversion, openness and agreeableness; however, the association of neuroticism and extraversion with sedentary behavior was moderated by the measurement of sedentary behavior, whereas the effects of openness and agreeableness on sedentary behavior was moderated by participant age and gender [14].

Given the paucity of research evaluating the association between personality and sedentary behavior, coupled with the majority of these studies employing cross-sectional designs (24/26 studies were cross-sectional in the 2017 meta-analysis [14]), the purpose of the present study was to examine the cross-sectional and prospective association of personality trait characteristics on total weekday sitting time. Herein we focus on weekday sitting time given the recent interest in developing workday interventions [16,17], as well as emerging work suggesting that breaking up weekday sitting time may result in favorable changes in health outcomes [18].

MATERIALS AND METHODS

1. Design and participants

This was a prospective study, approved by the authors' institutional review board. Recruitment of individuals included 200 undergraduate and graduate students from a university in the south of the United States for baseline assessments. As we have described elsewhere [19], participants were recruited via a convenience-based sampling approach. When participants arrived at the laboratory, they were asked to complete an informed consent. Then, participants completed surveys assessing personality and sitting behavior (along with the below noted covariates). All baselines parameters were assessed via paper-and-pencil surveys. Baseline assessments occurred between June 2015 and October 2016. After approximately five months from the participant's baseline visit, all participants were reassessed. To minimize potential common method bias among the evaluated parameters [20], baseline assessments (with the exception of measured body mass index) occurred in our laboratory via a paper-and-pencil survey, whereas the follow-up participants completed the survey via an on-line portal (Qualtrics) that was sent to them via e-mail. Additionally, a random 10% sample from the baseline 200 participants were asked to complete a one-week test-retest reliability assessment of the surveys.

Among the 200 participants who were recruited, all 200 participants provided complete baseline data on the study variables (no missing values). Among these 200 participants, 126 provided complete data for the follow-up assessment (63% response rate), with these 126 participants constituting our analytic sample. When comparing the analyzed sample (N = 126) to the sample lost to follow-up (N = 74), there

were no differences in gender (p = 0.61), age (p = 0.72), ethnicity (p = 0.62), education (p = 0.07), perceived health status (p = 0.50), neuroticism (p = 0.64), extraversion (p = 0.71), openness (p = 0.95), agreeableness (p = 0.59), conscientiousness (p = 0.75) or sitting time (p = 0.92) assessed at baseline.

2. Measurement of personality

To assess personality, the Neuroticism-Extraversion-Openness Five Factor Inventory (NEO-FFI) questionnaire was used. The inventory consists of five 12-item scales (60 items total) that measure each domain of five factors (Neuroticism, Extroversion, Openness, Agreeableness, Conscientiousness). A sample item assessing conscientiousness is "*I keep my belongings clean and neat*;" A sample item assessing extroversion is "*I like to have a lot of people around me*;" A sample item assessing openness to experience is "*I am intrigued by the patterns I find in art and nature*;" A sample item assessing neuroticism is "*When I'm under a great deal of stress, sometimes I feel like I'm going to pieces*;" and lastly, a sample item for agreeableness is "*I would rather cooperate with others than compete with them.*" Response options range from zero to four, with zero being strongly disagree and four being strongly agree. The NEO-FFI provides a quick, reliable, and accurate measure of the five domains of adult (ages 17 years and older) personality [21]. In our sample, internal consistency, as measured by Cronbach's alpha, was 0.85 (neuroticism), 0.75 (extraversion), 0.75 (openness), 0.76 (agreeableness), and 0.84 (conscientiousness). The test-retest reliability (ICC) assessment of our 10% random sample was 0.92 (neuroticism), 0.95 (extroversion), 0.93 (openness), 0.98 (agreeableness), and 0.96 (conscientiousness).

3. Measurement of weekday sedentary behavior

Sedentary behavior was assessed from the sitting question in the short-form International Physical Activity Questionnaire (IPAQ) [22]. That is, participants were asked, "*During the last 7 days, how much time in total did you usually spend sitting on a week day?*" The test-retest reliability (ICC) assessment of our 10% random sample for this sitting variable was, ICC = 0.86 (p < 0.001). This IPAQ sitting item has demonstrated some evidence of validity in an independent cohort by positively associating (ICC up to 0.80) with an objective measure of posture (ActiReg) [23].

4. Data analysis

All analyses were performed in Stata (v. 12). A single multivariable linear regression analysis was used to examine the association between personality and baseline weekday sitting time (outcome variable). In this model, the independent variables included each of the 5 personality variables, along with baseline MVPA (moderate-to-vigorous physical activity) as measured from the IPAQ, age, gender, race-ethnicity, education, self-perceived health status (i.e., excellent, very good, good, fair or poor), and measured baseline body mass index (kg/m^2) using the anthropometric procedures adopted by the National Health and Nutrition Examination Survey.

A single multivariable linear regression analysis was used to examine the association of personality on changes in weekday sitting time. The outcome variable was changes in weekday sitting time, which was expressed as the change score across the two-time points (i.e., $SED_{time2} - SED_{time1}$). Notably, other models, such as follow-up weekday sitting time as the outcome variable with baseline sitting time as a covariate, was evaluated, but the results from this model were similar to the "change score" model; thus, the change score model was employed herein. In this change score model, independent variables included each of the 5 personality variables, along with MVPA change score (i.e., $MVPA_{time2} - MVPA_{time1}$) as measured from the IPAQ, age, gender, race-ethnicity, education, self-perceived health status (i.e., excellent, very good, good, fair or poor), measured baseline body mass index (kg/m^2), and follow-up duration (months; follow-up minus baseline). Notably, there was no multicollinearity in this model, as the highest variance inflation factor was 1.91 and the mean variance inflation factor was 1.40.

Given the recent work suggesting that the relationship between personality and sedentary behavior may be moderated by age and gender [14], we also conducted interaction models to see if, indeed, age and/or gender moderated the relationship between individual personality traits and sitting time. To evaluate this, we created a cross-product term (e.g., neuroticism*age) and included this cross-product term,

along with its main effect, and the covariates, in a multivariable linear regression model. We also evaluated other interactions models, such as the potential interaction of personality and MVPA on changes in sitting time. For all analyses, statistical significance was set at a nominal alpha of 0.05.

RESULTS

Characteristics of the study variables are displayed in Table 1. Participants, on average, were 21.6 yrs of age.

Table 1. Characteristics of the study sample (N = 126)

Study variable	Mean/proportion	SD
Age, mean years	21.6	2.3
Gender, % female	61.9	
Education, % undergraduate students	81.0	
Ethnicity, percent non-Hispanic white	66.0	
BMI, mean kg/m^2	25.8	6.9
Extraversion, mean	43.3	5.9
Neuroticism, mean	30.9	8.6
Openness, mean	39.0	6.7
Agreeableness, mean	45.6	6.2
Conscientiousness, mean	46.8	6.4
Baseline MVPA, mean min/week	428.0	353.3
Follow-up MVPA, mean min/week	571.5	408.5
Baseline Sitting, mean min/day	331.1	169.2
Follow-up Sitting, mean min/day	296.9	193.1
Follow-up duration, mean days	159.6	24.4

BMI: Body mass index, MVPA: Moderate-to-vigorous physical activity, SD: standard deviation.

Table 2. Multivariable linear regression association between personality and baseline sitting time (N = 126)

Study variable	β	95% CI	p-value
Extraversion, 1 unit increase	−5.8	−11.7, 0.21	0.05
Neuroticism, 1 unit increase	−2.6	−6.7, 1.3	0.19
Openness, 1 unit increase	−1.7	−6.3, 2.8	0.45
Agreeableness, 1 unit increase	1.4	−4.2, 7.2	0.60
Conscientiousness, 1 unit increase	−5.7	−11.3, −0.2	0.04

A single multivariable linear regression analysis was used to examine the association between personality and baseline sitting. The outcome variable was sitting time (min/day) at baseline. In this model, independent variables included each of the 5 personality variables, along with baseline MVPA as measured from the IPAQ, age, gender, race-ethnicity, education, self-perceived health status (i.e., excellent, very good, good, fair or poor), and measured baseline body mass index (kg/m^2).

Participants were followed for an approximate 5-month period (M_{days} = 159.6; M_{months} = 5.3). The results examining the association of personality on baseline weekday sitting time are shown in Table 2. Both extraversion (β = −5.8; 95% CI: −11.7, 0.21; p = 0.05) and conscientiousness (β = −5.7; 95% CI: −11.3, −0.2; p = 0.04) were inversely associated with baseline weekday sitting time.

The results examining the association of personality on changes in weekday sitting time are shown in Table 3. The only personality trait associated with changes in sitting time was openness to experience. For every 1 unit increase in openness to experience, there was an associated 6.6 min/day increased change score in weekday sitting time over the follow-up period (β = 6.6; 95% CI: 0.13, 13.0; p = 0.04). Notably, none of the covariates were associated with changes in weekday sitting time (data not shown). Additionally, for each of the personality traits, there was no evidence that age or gender moderated the relationship between personality and changes in weekday sitting time (data not shown). We also considered a potential interaction effect of personality and changes in MVPA on changes in sitting time, but none of these interaction models were statistically significant (data not shown).

Table 3. Multivariable linear regression association between personality and changes in sitting time (N = 126)

Study variable	β	95% CI	p-value
Extraversion, 1 unit increase	0.08	−8.3, 8.5	0.98
Neuroticism, 1 unit increase	2.94	−2.7, 8.6	0.31
Openness, 1 unit increase	6.60	0.13, 13.06	0.04
Agreeableness, 1 unit increase	3.58	−4.4, 11.5	0.37
Conscientiousness, 1 unit increase	3.28	−4.4, 11.0	0.40

A single multivariable linear regression analysis was used to examine the association between personality and changes in sitting time. The outcome variable was changes in sitting time, which was expressed as the change score across the two-time points (i.e., SED_{time2} − SED_{time1}). In this model, independent variables included each of the 5 personality variables, along with MVPA change score (i.e., $MVPA_{time2}$ − $MVPA_{time1}$) as measured from the IPAQ, age, gender, race-ethnicity, education, self-perceived health status (i.e., excellent, very good, good, fair or poor), measured baseline body mass index (kg/m^2), and follow-up duration (months; follow-up minus baseline).

DISCUSSION

Sedentary behavior may influence adult health independent of physical activity. Additionally, fewer studies (compared to physical activity) have evaluated the association of personality on sedentary behavior, with nearly all of these studies being cross-sectional. The purpose of the present brief report, therefore, was to evaluate the cross-sectional and prospective association of personality on self-reported total weekday sitting time. The main findings were that extraversion and conscientiousness were inversely associated with baseline weekday sitting time, whereas openness to experience was prospectively associated with changes (increases) in weekday sitting time.

The literature regarding the relationship between personality on sedentary behavior is somewhat mixed. A 2017 meta-analysis suggested that the main personality traits associated with sedentary behavior are neuroticism (positive association) and conscientiousness (inverse association) [14]. Although not supported by our findings, neuroticism is thought to positively associate with sedentary behavior due to the emotionally instability effects of this personality trait (e.g., neuroticism has been linked with less emotional regulation ability and greater emotional ambivalence [24]), which is often associated with other negative health-related behaviors, such as smoking and alcohol consumption [25]. Conversely, conscientiousness is thought to inversely associate with sedentary behavior given the health conscientiousness of this personality type, which is often associated with health-enhancing behaviors, such as physical activity [2]. Our cross-sectional findings support this inverse association between conscientiousness and sitting time. We also observed a significant inverse association between extraversion and baseline sitting time, which supports other work demonstrating a positive association between extraversion and health behaviors, such as physical activity (not to suggest that physical activity and sitting are necessarily the inverse of each other) [2].

In the 2017 meta-analysis, age moderated the relationship between openness to experience and sedentary behavior in that those ≤ 24 years of age, openness to experience was non-significantly but positively associated with sedentary behavior, whereas it was significantly inversely associated with sedentary behavior among older adults. This partially aligns with the present study's prospective results as we observed a positive association between openness to experience and changes in sitting time, with the mean age of our sample being 21 years. Further, in alignment with the present prospective results, openness to experience has been shown to associate with greater internet use [9,10].

Eldesouky [26] recently reviewed the literature regarding the relationship between openness to experience and health. Similar to other personality traits, the relationship is mixed. This is likely a result of which individual personality facets are assessed. The openness to experience personality trait often consists of six facets, including actions, ideas, values, aesthetics, fantasy and feelings [26]. It is beyond the scope of this paper to detail the effects of these individual facets on health behaviors and outcomes, as these relationships are highly complex and context dependent. In brief, and as discussed elsewhere [26], the findings regarding openness to actions and health outcomes are mixed; openness to ideas and health outcomes are usually positively associated; few studies have examined the effects of openness to values and openness to aesthetics with health; openness to fantasy and health outcomes appears to be context-dependent; and with regard to openness to feelings and health, the potential beneficial effects depends significantly on cognitive appraisal and emotional regulation capacity [26]. Although speculative, our observed prospective positive association between openness to experience and changes (increases) in weekday sitting time suggest that those more inclined to be open to experiencing new things may be more susceptible to repeated behaviors that encourage sitting. For example, and although speculative, individuals with this personality trait may be more vulnerable to utilizing emerging social media opportunities (e.g., Apps), and thus, become innovators and early adopters of such new technologies [27,28]. If this prospective finding is replicated, then future work will need to identify the potential mechanisms of this relationship.

Strengths of this study include the study novelty, utilizing a test-retest sample, and employing a prospective (and cross-sectional) design, which allowed for the evaluation of changes in sitting time. Limitations of this study include the self-report assessment of weekday sitting, not evaluating the

context in which the sitting behaviors took place, not assessing specific facets of personality typology, and the relatively small sample size, which precluded the ability to evaluate sitting behavior patterns/clusters (e.g., high-high, high-low, low-high, and low-low sitting times across the two time-points).

In conclusion, the present study examined the cross-sectional and prospective associations of personality on self-reported overall weekday sitting time. In our cross-sectional analyses, we observed a significant inverse association of extraversion and conscientiousness with baseline sitting time. For our prospective analyses, we observed a significant positive association between the personality type openness to experience and increases in weekday sitting time over the follow-up period. Notably, the magnitude of our observed associations appeared to be relatively small. Taken together, these findings suggest that personality type may differentially influence baseline sitting and changes in sitting time. Before considering the potential implications of these findings, additional dual-design (cross-sectional and prospective) replicative work on this emerging line of inquiry is needed. Such work should aim to overcome the limitations of this study by evaluating the individual facets of personality type and employing objective and subjective measures of sedentary behavior (to determine context-specific sedentary behaviors), as sedentary behavior is a complex behavior encompassing multiple types of behavior and is influenced by a multitude of contextual factors.

CONFLICT OF INTERESTS

None to declare.

REFERENCES

1. Strickhouser JE, Zell E, Krizan Z. Does personality predict health and well-being? A metasynthesis. *Health Psychol* 2017;36:797-810.
2. Rhodes RE, Smith NE. Personality correlates of physical activity: a review and meta-analysis. *Br J Sports Med* 2006;40:958-65.
3. Allen MS, Magee CA, Vella SA, Laborde S. Bidirectional associations between personality and physical activity in adulthood. *Health Psychol* 2017;36:332-6.
4. Artese A, Ehley D, Sutin AR, Terracciano A. Personality and actigraphy-measured physical activity in older adults. *Psychol Aging* 2017;32:131-8.
5. Wilson KE, Das BM, Evans EM, Dishman RK. Personality correlates of physical activity in college women. *Med Sci Sports Exerc* 2015;47:1691-7.
6. Tolea MI, Terracciano A, Simonsick EM, Metter EJ, Costa PT, Jr., Ferrucci L. Associations between personality traits, physical activity level, and muscle strength. *J Res Pers* 2012;46:264-70.
7. Tolea MI, Terracciano A, Milaneschi Y, Metter EJ, Ferrucci L. Personality typology in relation to muscle strength. *Int J Behav Med* 2012;19:382-90.
8. Thyfault JP, Du M, Kraus WE, Levine JA, Booth FW. Physiology of sedentary behavior and its relationship to health outcomes. *Med Sci Sports Exerc* 2015;47:1301-5.
9. Landers RN, Lounsbury JW. An investigation of the Big Five and narrow personality traits in relation to Internet usage. *Comput Human Behav* 2006;22:283-93.
10. Servidio R. Exploring the effects of demographic factors, Internet usage and personality traits on Internet addiction in a sample of Italian university students. *Comput Human Behav* 2014;35:85-92.
11. Uijtdewilligen L, Singh AS, Twisk JW, Koppes LL, van Mechelen W, Chinapaw MJ. Adolescent predictors of objectively measured physical activity and sedentary behaviour at age 42: The Amsterdam Growth and Health Longitudinal Study (AGAHLS). *Int J Behav Nutr Phys Act* 2011;8:107.
12. Weaver JB. Individual differences in television viewing motives. *Pers Individ Dif* 2003;35:1427-37.
13. Burnett CM, Allen MS, Vella SA. Personality and sedentary behaviour in Australian adults. *Int J Sport Exerc Psychol* 2018;16:215-20.
14. Allen MS, Walter EE, McDermott MS. Personality and sedentary behavior: A systematic review and meta-analysis. *Health Psychol* 2017;36:255-63.
15. Sutin AR, Stephan Y, Luchetti M, Artese A, Oshio A, Terracciano A. The five-factor model of personality and physical inactivity: A meta-analysis of 16 samples. *J Res Pers* 2016;63:22-8.
16. Chu AH, Ng SH, Tan CS, Win AM, Koh D, Muller-Riemenschneider F. A systematic review and meta-analysis of workplace intervention strategies to reduce sedentary time in white-collar workers. *Obes Rev* 2016;17:467-81.
17. Shrestha N, Kukkonen-Harjula KT, Verbeek JH, Ijaz S, Hermans V, Bhaumik S. Workplace interventions for reducing sitting at work. *Cochrane Database Syst Rev* 2016;3:CD010912.
18. Karol S, Robertson MM. Implications of sit-stand and active workstations to counteract the adverse effects of sedentary work: A comprehensive review. *Work*

2015;52:255-67.

19. Joyner C, Rhodes RE, Loprinzi PD. The Prospective Association Between the Five Factor Personality Model With Health Behaviors and Health Behavior Clusters. *Eur J Psychol* 2018;14:880-96.

20. Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol* 2003;88:879-903.

21. Costa PT, McCrae RR. Revised NEO Personality Inventory (NEO-PI-R) and the NEO Five-Factor Inventory (NEO-FFI): Professional manual. Psychological Assessment Resources; Odessa, FL. 1992.

22. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003;35:1381-95.

23. Kurtze N, Rangul V, Hustvedt BE. Reliability and validity of the international physical activity questionnaire in the Nord-Trondelag health study (HUNT) population of men. *BMC Med Res Methodol* 2008;8:63.

24. Kokkonen M, Pulkkinen L. Extraversion and Neuroticism as antecedents of emotion regulation and dysregulation in adulthood. *Eur J Pers* 2001;15:407-24.

25. Freeman J. Smoking and neuroticism. *Lancet* 1971;2:1260.

26. Eldesouky L. Opennes to experience and health: A review of the literature. *Yale Rev Undergrad Res Psychol* 2012:24-42.

27. Constantiou D, Damsgaard J, Knutsen LA. Exploring perceptions and use of mobile services: user differences in an advancing market. *Int J Mob Commun* 2006;4:231-47.

28. Tuten T, Bosnjak M. Understanding differences in web usage: the role of need for cognition and the Five Factor Model of personality. *Soc Behav Pers* 2001;29:391-8.