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Linked Lives: Exploring Gender and Sedentary Behaviors in Older Adult Couples

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Abstract

Objectives: We explored associations between co-habiting partners for sedentary behavior (type and time, via accelerometry and self-report), gender, and a surrogate health measure (inflammatory biomarker: C-reactive protein, CRP). **Methods:** Participants completed activity questionnaires and the Timed Up and Go (mobility), wore an accelerometer for 7 days, and provided samples for high-sensitivity (hs) CRP. We used multilevel modeling (partners within couples) to investigate associations between independent variables and (a) sedentary behavior and (b) hsCRP. **Results:** 112 couples (50% women) provided sedentary data and hsCRP. Sedentary behavior was significantly correlated (r = .440, $p < .001$) between women and men, but there were significant differences in sedentary time (women < men) and light activity (women > men). Gender, moderate to vigorous physical activity (MVPA), and mobility estimated 37% of the modeled variance in sedentary time, while body mass index (BMI) and MVPA estimated 10% of the modeled variance in hsCRP. **Discussion:** Despite differences in how activity was accumulated, there were no significant differences between women's and men's health biomarker.

Keywords

screen time, sitting time, couples, family, health behaviors, inflammation

Introduction

There is a growing body of evidence for too much sitting and increased risk for mortality and morbidity (Patterson et al., 2018). Sedentary behavior (activities ≤1.5 metabolic equivalents of task [MET] in a sitting, lying, or reclining position; Tremblay et al., 2017), is a modifiable factor contributing to the development of poor health outcomes (de Rezende, Rey-Lopez, Matsudo, & do Carmo Luiz, 2014). TV time is the sedentary behavior most frequently studied and is associated with increased risk for morbidity and early mortality (Dunstan et al., 2010; Grace et al., 2017). In a meta-analysis of over one-million participants, the negative consequences of self-reported TV viewing were not attenuated by moderate to high daily physical activity (Ekelund et al., 2016). Engagement in computer time could affect health, possibly by limiting time to engage in physical activity, but less is known about health consequences for older adults.

Population-level studies report a significant association between sedentary time (Henson et al., 2013) and breaks from sedentary time (Henson et al., 2013; Yates et al., 2012) with elevated inflammatory biomarkers, but more recent studies suggest an indirect pathway (Stamatakis & Hamer, 2012). Biomarkers are important intermediary or surrogate outcomes that use objective metrics to represent health (Biomarkers Definitions Working Group, 2001; Wirth et al., 2017). There are several notable system-level inflammatory markers such as interleukin (IL) 6, tumor necrosis factor alpha (TNFα), and C-reactive protein (CRP). TV time is associated with chronically elevated inflammatory biomarkers (Grace et al., 2017), either directly or via associated negative behaviors (e.g., excessive or poor nutrition).

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Accumulation of low-grade inflammation is thought to promote the development of cardiometabolic dysregulation (Guarner & Rubio-Ruiz, 2015) and premature aging (Franceschi & Campisi, 2014). Contributing to the underlying pathophysiology are increasing age (Zhang et al., 2016), ethnicity (Allison, Jensky, Marshall, Bertoni, & Cushman, 2012), obesity (Chung et al., 2009), sex (Casimir, Lefevre, Corazza, Duchateau, & Chamekh, 2018), smoking (Rom, Avezov, Aizenbud, & Reznick, 2013), and lack of physical activity (Kasapis & Thompson, 2005). In a recent study describing factors associated with different biomarkers (including CRP, IL, and TNFα), CRP was associated with more factors than other biomarkers (Navarro et al., 2016). In addition to age, body mass index (BMI), sex, and smoking, CRP was also associated with hormone replacement therapy for women and some dietary factors, but not medication use (Navarro et al., 2016). Overall, there are very few studies using inflammatory biomarkers to discern the association between too much sitting and health (Wirth et al., 2017), and specifically if prolonged sedentary time is associated with inflammatory markers considering age, and gender or sex.

Emerging evidence (Harvey, Chastin, & Skelton, 2015; Rhodes, Mark, & Temmel, 2012; Santos et al., 2012; Zusman et al., 2019) underscores differences between older women and men for sedentary behavior and physical activity. Older women engage in less higher intensity physical activity (Colley et al., 2011), while older men engage in more sedentary time (Harvey et al., 2015; Santos et al., 2012; Zusman et al., 2019). Conceptually, there are known differences between the constructs gender and sex (McGregor, Choo, & Becker, 2015); however, little is known on the contribution of gender ("socially constructed roles") or sex (biology) (McGregor et al., 2015) for older adults' observed sedentary behavior. An international consensus for sedentary time in older adults confirmed the evidence gap (Dogra et al., 2017). However, there are some gender-based correlates for sedentary behavior; for example, older women were significantly more active with household maintenance (Bellettiere et al., 2015). But most likely, it is the interaction between gender-based behavior and sex-based factors contributing to overall health.

The social environment (including social support) plays an important role for adoption and maintenance of physical activity, especially for women (Vrazel, Saunders, & Wilcox, 2008). Although marital status is positively associated with physical activity in older couples (Pettee et al., 2006), less is known about this dyadic relationship and sedentary behavior. Repeated daily life assessments allow for granular assessment of couples as they engage in their connected daily life routines (Bolger & Laurenceau, 2013). Using this approach, we recently showed that physical activity and sedentary time is strongly linked between older spouses (Pauly et al., 2020). To our knowledge, there is only one published study to date (Harada, Masumoto, & Kondo, 2018) that investigated sedentary behavior in older couples, and they did not use repeated daily life assessments. However, Canadian population-level data identified the following correlates of sedentary behavior in adults (Huffman & Szafron, 2017): increased social support for men (but not women) increased their sitting time, and TV watching time (for women and men) was unrelated to social support (Huffman & Szafron, 2017). Based on Canadian data, women spent more time reading and men had more computer time, but there were no differences between gender for TV time (Herman & Saunders, 2016). These data suggest there may be differences between gender on the type and duration of screen time, but more research is needed to understand the specificity of sedentary behaviors (Rhodes et al., 2012), especially in cohabiting couples.

Sedentary behavior is an important and emerging activity frequently associated with adverse health outcomes (Dogra et al., 2017; Ku, Steptoe, Liao, Hsueh, & Chen, 2018; Patterson et al., 2018). Few data describe age, gender (Dogra et al., 2017), and dyadic relationships with sedentary behavior(s) and health. Our aim was to (a) describe and explore sedentary behavior (type and amount) for older women and men within couples and (b) determine factors associated with sedentary behavior and health using systemic inflammation (high-sensitivity [hs] CRP). This unique opportunity will extend the current research field to understand how community-dwelling older women and men accumulate sedentary behavior, and describe the relation between sedentary behavior and health in older cohabiting couples.

Method

These were baseline findings from a prospective study of community-dwelling older couples (aged 60 years+) who enrolled in Linked Lives, a longitudinal cohort study based in Vancouver, Canada. The primary objective for Linked Lives was to examine everyday health dynamics in older couples. We previously published different results from this dataset, using repeated daily assessments to understand activity between partners (Pauly et al., 2020 and Pauly, Michalowski, et al., 2019). For the purpose of the present study, we used basic demographic information and participants' in-person assessments and blood collection. Participants used a tablet to complete questionnaires. This study was approved by the University Ethics Board (H12-01854), and participants provided written consent.

Demographic information: We used a self-report questionnaire to collect basic demographic information including age, ethnicity, gender, years living together, current smoking status, and measured BMI, and mobility using the Timed Up and Go (TUG; average of two trials) (Podsiadlo & Richardson, 1991).

Sedentary behavior and physical activity: Participants completed the Community Healthy Activities Model Program for Seniors (CHAMPS) Questionnaire (Stewart et al., 2001); we measured (a) computer and TV time (sedentary behavior) and (b) light household activity with a subset of CHAMPS questions that asked participants if they engaged in an activity and if yes, the hours/week for each activity. Participants wore a waist-mounted accelerometer (GT3X; ActiGraph, Pensacola, FL) for 7 days for measuring sedentary behavior, light activity, step counts, and moderate to vigorous physical activity (MVPA), expressed as average daily minutes standardized to 13-hr days (Herrmann, Barreira, Kang, & Ainsworth, 2013).

Accelerometry: We included accelerometry data from participants with three or more valid days (10 hr/day) of wear time (Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005). We considered >90 min of continuous zeros as non-wear time (Chudyk, McAllister, Cheung, McKay, & Ashe, 2017). We used a cut point of ≤100 counts/min as sedentary time (Matthews et al., 2008), 101–1951 counts/min for light physical activity, and ≥1952 counts/min for MVPA (Freedson, Melanson, & Sirard, 1998). We used ActiLife (Version 6 software; ActiGraph, Pensacola, FL) to analyze accelerometry data.

hsCRP: We requested participants provide a 10-hr fasting sample of blood (5 ml) obtained at a local private medical laboratory. Samples were analyzed for CRP (mg/L), using a wide-range high-sensitivity technique (ADVIA Chemistry Systems; Siemens Healthcare Diagnostics Inc., Munich, Germany); it is able to detect CRP in serum and plasma using a latex-enhanced immunoturbidimetric assay. In a subgroup analysis, we explored data from participants whose CRP values were 10 mg/L or less, as elevated values may indicate an active infection (Adelstein & Baker, 2014; Ridker, 2003). Some participants had extremely low values ($n = 11$), and we coded these as 0.09 to distinguish them from the next lowest value (0.10). We log transformed CRP values because of the distribution of model residuals and were not able to code these data as zero.

Statistical Analysis

We report data from participants with valid accelerometry data ($n = 224$) and/or subgroup when health was included and the hsCRP values were 10 mg/L or less ($n = 210$). We provide descriptive data as means (standard deviations), median (25th, 75th percentiles), mode, or number (percentage). We determined the number (percentage) of women and men who had (a) less than 540 min/day of sedentary behavior (Ku et al., 2018) and (b) more than or equal to 30 min/day of MVPA. We calculated between partner difference for sedentary behavior and physical activity (men's minus women's accelerometry values), and used a scatterplot to visualize differences. We examined associations between variables of interest using Pearson correlations regardless of variable type (Norman, 2010) for both the full dataset ($n = 224$) and only participants whose hsCRP was 10 mg/L or less ($n = 210$).

We used multilevel modeling for partners nested within couples to explore if gender was related to total hours/week for two screen time variables: computer use and watching TV. We also used mixed effects linear regression, with a focus on fixed effects, to explore separate associations for the dependent variables (a) sedentary time and (b) inflammation (hsCRP), and included independent variables based on significant correlations or biology (age). Although smoking is associated with inflammation (Rom et al., 2013), we did not adjust for this variable due to the low number of participants who smoked ($n = 5$). We report marginal R-squared values and intraclass correlation coefficient (ICC). Marginal R-squared values are generated from multilevel models (Nakagawa & Schielzeth, 2013), and provide an estimate of the modeled variance (Snijders & Bosker, 1994). The ICC represents the degree of relatedness within the hierarchical (nested) dataset: It indicates the proportion of variability attributable to the individual or couple level. In other words, it is the association between the values of two partners in any randomly drawn couple. However, the ICC only represents the outcome variables without any included explanatory variables (e.g., unconditional or "empty" models). We applied a log 10 transformation to hsCRP as residuals were highly skewed, and thus we present exponentiated regression coefficients to facilitate meaningful estimates. We interpreted the exponentiated coefficients as a percentage change in the variable of interest. We considered $p < .05$ as significant (two-tailed) and used SPSS Version 23 (IBM, Armonk, New York) and R (R Foundation for Statistical Computing, Vienna, Austria) for multilevel modeling, and the R package MuMIn (Barton, 2018) to compute marginal R-squared values.

Results

There were 129 couples ($n = 258$) who enrolled into the study between March 2013 and February 2015, but nine couples ($n = 18$) left before finishing the study: These data were not included in the analyses. We only included both partners (within couples) who had outcomes for accelerometry and hsCRP ($n = 224$). We also explored data from participants who had an hsCRP less than or equal to 10 mg/L ($n = 210$). Table 1 provides a summary of participant demographic information for the full data set. Couples were together for longer than 40 years, on average. Only five participants reported they currently smoked (one woman and four men), and their BMI (26.0) was just over the cut point of overweight category (25.0-29.9). From the subsample of participants ($n = 210$) with hsCRP values 10 mg/L and lower, the average value was 1.5 (1.9) mg/L; this included 36 participants (17 women and 19 men) with hsCRP 3 to 10 mg/L.

Time Spent in Sedentary Behavior and Physical Activity

Participants spent almost 9 hr/day in sedentary behavior, consistent with population-level data for older Canadians (Colley et al., 2011): only 35 (31%) women and 61 (54.5%) men accumulated 540 min (9 hr)/day or more sedentary time. There were 107/109 (98%) of women, and 92/108 (85%) of men, who self-reported completing light housework. For light

Table 1. Descriptive Variables for Study Participants, Presented as *M* (*SD*), Unless Stated Differently Following Variable Name.

	Entire sample, *n* = 224	Women, *n* = 112	Men, *n* = 112
Age, years	71.1 (5.9)	69.9 (5.5)	72.3 (6.2)
Body mass index	26.0 (4.8)	25.6 (4.9)	26.5 (4.7)
Range	16.0-47.1	16.0-47.1	16.0-44.7
Ethnicity, self-reported (*n* [%]; *n* = 223)			
White	134 (60%)	68 (61%)	66 (59.5%)
Asian	77 (35%)	37 (33%)	40 (36%)
Other	12 (5%)	7 (6%)	5 (4.5%)
Years married, years (*n* = 222)	41.0 (13.3)		
Timed Up and Go, seconds (*n* = 223)	9.8 (2.2)	9.4 (2.1)	10.2 (2.2)[a]
Sedentary time/13-hr day, minutes	533.7 (64.7)	517.1 (59.0)	550.4 (66.1)
Light physical activity/13-hr day, minutes	217.7 (57.8)	236.9 (52.1)	198.6 (57.2)
MVPA/13-hr day, minutes	27.6 (19.4)	25.5 (19.2)	29.7 (19.4)
Step count, steps/day	7,169 (3,010)	7,216 (3,018)	7,122 (3,016)
High-sensitivity C-reactive protein, mg/L (*n* = 210)	1.5 (1.89)	1.5 (1.8)	1.6 (2.0)
Range	0.09-10	0.09-7.8	0.09-10

Note. MVPA = moderate to vigorous physical activity.
[a]*n* = 111.

housework hours/week, (a) the mode response was 2 (1-2.5 hr/week) for women and men and (b) women reported a median of 3 (2, 4) (3-4.5 hr/week), and men reported 2 (2, 3) (1-2.5 hr/week). For light activity (based on accelerometry), women accumulated 237 (52) min/day and men accumulated 199 (57) min/day. Participants were active compared with Canadian population-level data (using accelerometry) (Colley et al., 2011). There were 38 (34%) women and 53 (47%) men who accumulated 30 min or more per day of MVPA.

Supplementary Figure 1 is a scatterplot based on partner differences (men's minus women's values) for accelerometry-recorded sedentary behavior and MVPA, $n = 224$. The correlations between partners were $r = .440$ ($p < .001$) and $r = .483$ ($p < .001$) for sedentary behavior and physical activity, respectively. The mean difference between partners (without controlling for any explanatory variables) was 33.4 (66.5) min/day for sedentary behavior and 4.2 (19.6) min/day for MVPA. For the group $n = 210$, when data were viewed based on meeting less than 540 min/day of sedentary behavior and 30 min/day of MVPA, there were four groups: (a) 70 participants (33%; $n = 30$ women and $n = 40$ men) who did not meet any recommendations, (b) 56 participants (27%; $n = 41$ women and $n = 15$ men) who met sedentary behavior recommendations only (<540 min/day), (c) 17 participants (8%; $n = 2$ women and $n = 15$ men) who met MVPA recommendations only (30+ min/day), and (d) 67 participants (32%; $n = 32$ women and $n = 35$ men) who met cut points for both sedentary behavior and MVPA.

Type of Sedentary Behavior: Screen Time

Computer time. There were 101/109 women (93%) and 102/107 men (95%) who reported using a computer. For both women and men, the mode for computer time was 6 (*9 or more hr/week*): 35/101 (35%) women and 59/102 (58%) men reported 9 or more hours/week of computer time. There were no significant correlations between computer time and BMI, or hsCRP (for the full cohort or subgroup; Supplementary Tables 1 and 2). Using multi-level models to explore computer time and gender, there was a statistically significant association for gender and computer time (men > women: marginal R^2 values = .06, $p < .001$, $n = 224$ and $n = 210$): Almost all the variation in computer time was at the individual level (for the full and subgroups); hence, there were no significant association between partners' outcomes (ICC = 0% at the couple level).

TV time. There were 99/108 women (92%) and 99/105 men (94%) who reported watching TV. For both women and men, the mode for TV time was 6 (*9 or more hours/week*): 49 (48.5%) women and 54 (52%) men reported 9 or more hours/week of watching TV. In the bivariate analyses ($n = 224$, or subgroup $n = 210$), there was a significant association between BMI and TV time, but no associations between total hours watching TV and log hsCRP (Supplementary Tables 1 and 2). Using multilevel models to explore TV time and gender, there were no statistically significant associations for the full group (marginal R^2 value = .003, $p = .37$, ICC = 22% at the couple level) or subgroup (marginal R^2 value = .004, $p = .34$, ICC = 18% at the couple level).

Time Spent in Sedentary Behavior and Health (hsCRP)

Supplementary Tables 1 and 2 present correlations between variables of interest for the full cohort ($n = 224$) and

Table 2. Estimates From Multilevel Modeling Exploring Variables Associated With Sedentary Time, $n = 210$.

Independent variable	Unstandardized coefficients		
	B	*SE*	*p*
Intercept	548.0	5.25	<.0001
Age	1.5	0.81	.076
BMI	1.22	0.87	.161
Gender	−31.96	6.72	<.0001
Years Married	0.60	0.34	.079
MVPA	−1.03	0.18	<.0001
Mobility (TUG)	3.70	1.76	.038
Marginal R^2		.37	
ICC		32% (couple level)	

Note. ICC = intraclass correlation coefficient; BMI = body mass index; MVPA = moderate to vigorous physical activity; TUG = Timed Up and Go.

Table 3. Estimates From Multilevel Modeling Exploring Variables Associated With Systemic Inflammation (C-Reactive Protein), $n = 210$.

Independent variable	Unstandardized coefficients		
	B	*SE*	*p*
Intercept	−0.39	0.09	<.001
BMI	0.08	0.02	.0006
MVPA	−0.01	<0.00	.020
Marginal R^2		.10	
ICC		6% (couple level)	

Note. ICC = intraclass correlation coefficient; BMI = body mass index; MVPA = moderate to vigorous physical activity.

participants who had an hsCRP value 10 mg/L or less (n = 210). In the full cohort, hsCRP was positively associated with BMI and sedentary time, but negatively associated with MVPA. For the group with hsCRP 10 mg/L or less (n = 210), sedentary time was no longer significantly associated.

Tables 2 and 3 present results from multi-level models for sedentary time, and hsCRP for the subgroup analyses (n = 210). For both analyses, we explored associations between the outcome (dependent) variable of interest with independent variables that were significantly correlated. For sedentary behavior, 37% of the modeled variance in sedentary time was explained by gender, mobility, and MVPA (ICC = 32% at the couple level). Specifically, in the model, men engaged in 32 more minutes of sedentary time/day; for every minute of MVPA, there was a one-minute reduction in sedentary time; and for every additional second to complete the TUG (mobility), there were approximately four more minutes of sedentary time/day. For hsCRP, only 10% of the modeled variance was explained by BMI and MVPA (ICC = 6% at the couple level; Table 3). When we entered age into the model, the modeled variance and ICC remained the same (Table 4). Specifically, for one-unit increase in BMI, there was approximately 8% increase in hsCRP.

Table 4. Estimates From Multilevel Modeling Exploring Variables Associated With Systemic Inflammation (C-Reactive Protein), $n = 210$.

Independent Variable	Unstandardized coefficients		
	B	*SE*	*p*
Intercept	−0.39	0.09	.0001
Age	0.00	0.02	.8554
BMI	0.08	0.02	.0007
MVPA	−0.01	<0.00	.0314
Marginal R^2		.10	
ICC		6% (couple level)	

Note. ICC = intraclass correlation coefficient; BMI = body mass index; MVPA = moderate to vigorous physical activity.

Discussion

This cohort of older Canadian couples engaged in moderate to high levels of sedentary time (Ku et al., 2018) with concurrent engagement in higher physical activity compared with reported norms for Canadian (Colley et al., 2011) and American (Matthews et al., 2008) contemporaries. We highlight >30-min difference in sitting time between women and men, and extend evidence by reporting similar numbers of women and men who use a computer, but a higher number of older men spending longer periods on a computer. We did not identify a difference between gender for TV use or time. We further identified gender, MVPA, and mobility as significantly associated with sedentary behavior, but neither sedentary behavior nor gender was associated with the health biomarker for systemic inflammation (hsCRP). Conversely, there were significant associations between hsCRP and body composition (Dulloo & Montani, 2012), but there was a low association between partners for their observed hsCRP (health biomarker). Taken together, these data suggest that there were similarities in sedentary behavior between partners, but the time and type of sedentary behaviors differed. In particular, computer time was an individual behavior, with more husbands spending longer time on a computer. In contrast, wives and husbands exhibited somewhat similar time watching TV, supported by a higher ICC, and the lack of significance between women and men based on multilevel models. What remains to be determined is if partners watched TV together. Regardless, the patterns (type and amount) of sedentary behavior were not significantly related to the health biomarker (hsCRP). Overall, this research generates hypotheses on acquisition of sedentary behavior, and health outcomes between genders within cohabiting older couples.

To our knowledge, ours is one of only two published studies (Harada et al., 2018) that investigated sedentary behavior in older couples, and our study included more and older participants. Similar to the previous study (Harada et al., 2018), we noted (a) significant associations between partners for sedentary behavior, possibly implicating the shared physical and social environments (Smith & Zick, 1994), and (b) older men accumulated more daily sedentary behavior (Harada et al., 2018). We further observed a higher number of older men with longer computer time, while more women reported more hours of light housework (and had a higher mean for objectively measured light physical activity). These data share similarities with population-level Canadian data (Arriagada, 2018). Based on time survey data, older men spend more time using technology, and older women complete more household activities (Arriagada, 2018).

Type of Sedentary Behavior: Screen Time

Older adults' computer usage and health is relatively novel research area, with few data from previous cohorts of aging adult couples. In this study, we do not know the reason for men's computer time, specifically whether the primary purpose was using the Internet, reading, or communicating (which may confer positive benefits via social support). However, we found that computer time was not associated with BMI or hsCRP, unlike TV time which was associated with BMI, as per previous literature (Rhodes et al., 2012). Overall, these data suggest possible future research steps, such as reducing men's screen time and/or to discuss couple's shared daily life activities and time allocation decisions. In addition, these data also suggest that computer-based interventions to reduce sedentary behavior and increase physical activity may be an ideal delivery-mode (especially for older men), as computer time was not associated with physical activity (Vandelanotte, Sugiyama, Gardiner, & Owen, 2009) or health.

Although previous studies highlight that prolonged sitting can impact health, irrespective of the amount of daily physical activity (Proper, Singh, van Mechelen, & Chinapaw, 2011), more recent research suggests that there may be ways of offsetting this amount of prolonged sedentary time (Ekelund et al., 2016). In a harmonized meta-analysis of one-million adults who engaged in prolonged periods of sitting, participants who engaged in 60 to 75 min/day of MVPA were able to compensate for some of the deleterious consequences of sitting (Ekelund et al., 2016). Our study participants were active and, on average, engaged in approximately 27 min/day of MVPA (using accelerometry). In contrast, Canadian norms show that older adults engage in an average of between 12 and 17 min/day of MVPA (Colley et al., 2011). A recently published analysis suggests that as few as 27 min/day of MVPA may be sufficient to moderate the relationship between sedentary behavior and frailty in older adults (Mañas Bote et al., 2018). Thus, the participants in our study may have been able to dissipate some of the negative consequences of prolonged sitting through engaging in daily physical activity.

Time Spent in Sedentary Behavior and Health (hsCRP)

We did not identify a statistically significant association between sedentary behavior(s) and health (hsCRP). There are plausible explanations for the observed difference between our results and previous literature that found direct associations between sedentary behavior and inflammation (CRP; Henson et al., 2013; Yates et al., 2012), such as gender, target age group (exclusively older adults, average 71 [6] years), participants' moderate levels of MVPA, explanatory variables included in statistical models, and our decision to exclude hsCRP data $\geq$10 mg/L. However, by including participants with higher hsCRP levels, this is possibly indicative of an active infection requiring rest (and not represent their usual activities). Generally, women across ethnicities have higher levels of inflammatory markers (Allison et al., 2012), and older adults have higher levels of systematic inflammation (Franceschi & Campisi, 2014). In our study, participants were relatively active (exceeding population-level norms) and this may attenuate the hsCRP, either directly via possible longer term MVPA anti-inflammatory responses (Kasapis & Thompson, 2005) or indirectly via body composition (Dulloo & Montani, 2012). In other studies, results were attenuated once BMI was controlled for (Yates et al., 2012) and/or CRP values were excluded over 10 mg/L (Henson et al., 2013) similar to our findings. Furthermore, other studies suggest BMI mediates the association between sedentary behavior and inflammation (Stamatakis & Hamer, 2012), but it was not appropriate to conduct this type of analysis in our study (because of the lack of correlation between hsCRP and sedentary behavior in the subgroup analyses). There is accumulating evidence supporting the relation between adipose tissue and inflammation (Chung et al., 2009). Literature highlights an increase in macrophages associated with obesity (Weisberg et al., 2003); in turn, accumulation of macrophages creates a pro-inflammatory environment (Devisscher, Verhelst, Colle, Van Vlierberghe, & Geerts, 2016).

In our study, there were no differences between women and men for hsCRP. This is contrary to previous literature that women have higher levels of inflammation (Casimir et al., 2018). However, women engaged in less MVPA (but more light activity and less sedentary behavior) compared with men. This may have been because, on average, women had a BMI (25.9) considered just over the "overweight" range (25.0-29.9; Expert Panel on the Identification, Evaluation, and Treatment of Overweight in Adults, 1998), and or BMI does not adequately capture adiposity (Neeland & de Lemos, 2016). Alternatively, women's health may have been influenced by their activity patterns. For the first time, the new U.S. physical activity guidelines highlighted the benefits of light activity, and the importance of including all activities across the day, beyond MVPA, regardless of bout length (Piercy et al., 2018). Or men's higher average sedentary behavior offsets the benefits of their high amount of MVPA. Thus, the older women and men in this study may have used different pathways to maintain health. Collectively, these results generate interesting hypotheses, based on biology (sex) and behavior (gender), and that the path to healthy aging needs to address contextual factors to include preferences and ability, among other factors.

Strengths and Limitations

This study has many strengths including a comprehensive dataset of older women and men within couples, and their activity and health outcomes. Second, we used objective measures of sedentary behavior and physical activity (via accelerometry), and were able to compare behavior with a biomarker (hsCRP). Furthermore, we used robust methods to collect, clean, and analyze our data. We also note some limitations. First, our study participants were active with (on average) a BMI just considered overweight, and may not represent all older adults. Thus, our finding of no significant association between sedentary behavior and CRP may be influenced by the highly active nature, and body composition, of our study participants. Second, this was a cross-sectional study, and we are unable to look at causal pathways due to the nature of the study design. Third, in our analyses, we did not control for chronic conditions, diet, or medications, and this may affect the results; however, we only reported the hsCRP from participants whose hsCRP values were 10 mg/L or less (indicating no acute health condition).

In summary, we provide a detailed description of older couples' sedentary behavior, and observed computer time and household tasks as possible reasons to explore gender-related differences in daily activities, in future studies. Despite differences in how activity was accumulated, there were no significant differences between women and men in the health biomarker. We further observed a significant association between BMI and inflammation. While this is a cross-sectional study, and by its very nature no causal effects are implied, the results generate hypotheses for future testing. Moreover, these results support older adults' minimization of prolonged sitting, and emphasize engagement in higher level intensities of movement throughout the day.

Authors' Note

Maureen C. Ashe and Victoria I. Michalowski contributed equally to the manuscript.

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Supplemental Material

Supplemental material for this article is available online.

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