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Leisure-time physical activity moderates the longitudinal associations between work-family spillover and physical health

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Abstract

Previous research has documented cross-sectional associations between negative and positive work-family spillover and physical health. Using an effort-recovery model, the study tested the hypothesis that engagement in greater leisure-time physical activity would facilitate recovery processes that buffer the negative health effects of increasing work-family spillover. Employed adults (N = 1,354) completed two waves of the National Survey of Midlife Development in the United States (MIDUS). Results indicated that an increase in negative work-family spillover across nine years was associated with decreased physical health and increased number of chronic conditions at Time 2. Moreover, more time spent on moderate leisure-time physical activity buffered many of the associations between increasing negative spillover and declining health. Implications of the findings are discussed.

Keywords

leisure-time physical activity (LTPA); work-family spillover; MIDUS; physical health

With over 60% of married women in the labor force (U.S. Bureau of Labor Statistics, 2012), it is becoming increasingly less likely that any one adult member of the family consistently

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stays at home to manage family concerns. Thus, work-family balance has become increasingly important for adults (Mainiero & Sullivan, 2005). Work and family experiences co-occur within individuals, whereby the experiences in one domain influence experiences in the other domain, and combine to shape health outcomes above and beyond each life domain's individual effect (Grzywacz & Marks, 2000a; Grzywacz & Marks, 2000b). Specifically, work and family domains interact bidirectionally, generating work-family spillover defined as instances when moods, emotions, stress, and behaviors spill over across work and family domains (e.g., Mennino, Rubin, & Brayfield, 2005). For example, tensions resulting from work strains could spill over from work to family, as when one brings work irritations home, or from family to work, as when a family illness intrudes on one's ability to be productive at work. These spillover experiences are known to exacerbate or improve health in different ways (Barnett & Hyde, 2001; Greenhaus & Beutell, 1985; Greenhaus & Powell, 2006).

Based on research regarding the health implications of work-family spillover, researchers have been advocating for interventions that help people better manage their work-family lives, that would eventually benefit workers and employers (e.g., Kossek & Hammer, 2008; Hammer, Kossek, Anger, Bodner, & Zimmerman, 2011). While these scholars mostly focused on workplace interventions, there can also be individual-level efforts to lessen the negative impact or enhance the positive impact of work-family spillover on health. One potential intervention target is the degree of physical activity that a person engages in during leisure time. Leisure researchers have demonstrated that engaging in leisure activities facilitates positive efforts to recover from work stress (Nimrod, Kleiber, & Berdychevsky, 2012; Sonnentag, 2001). Leisure activities are health-promoting behaviors that alleviate the stress-health relationship (Coleman & Iso-Ahola, 1993; Orsega-Smith, Mowen, Payne, & Godbey, 2004; Qian, Yarnal, & Almeida, 2013) and can be targeted for change (Pate et al., 1995). The present study examined how work-family spillover affects physical health in adulthood and explored whether leisure-time physical activities in everyday life may ameliorate any negative effects and amplify any positive effects of work-family spillover on health.

Negative and Positive Work-Family Spillover and Health

There are two major perspectives that guide research regarding how the work-family interface may affect health. The *role conflict* perspective holds that taking multiple roles across life domains may generate strain and stress (Goode, 1960; Greenhaus & Beutell, 1985). One individual can hold different roles in varying contexts. For example, one can be a mother of two sons in a family while being a financial manager at work. Research indicates that within the work-family interface, strain and stress is manifested in two distinct dimensions: negative work-to-family spillover, and negative family-to-work spillover. Negative types of work-family spillover have been conceptualized as a type of chronic stressor, which may activate a physiological stress response (Grzywacz, 2000a).

Empirical studies support this perspective, showing evidence that negative work-family spillover is related to poorer physical and mental health (Frone, 2003; Kim et al., 2013; Okechukwu et al., 2012). For example, experiences of conflict between work and family

have been associated with emotional exhaustion and depression (Jawahar, Kisamore, Stone, & Rahn, 2012; Van Steenbergen, Ellemers, & Mooijaart, 2007), and higher negative work-family spillover has been linked with worse self-reported overall physical health, a greater number of physical health symptoms (Amstad et al., 2011), musculoskeletal pain (Kim et al., 2014), a greater likelihood of obesity (Grzywacz, 2000), and more sleep problems (Crain et al., in press). Although most research assessing the link between spillover and health used cross-sectional data, one longitudinal study found that an increase in negative work-family spillover over four years was associated with greater depressive symptoms, poorer physical health, and a greater likelihood of hypertension diagnosis (Frone, Russell, & Cooper, 1997).

The *expansionist* (Barnett & Hyde, 2001) or *enrichment* perspective (Greenhaus & Powell, 2006) is a line of reasoning positing that multiple commitments across life domains may provide benefits that sometimes outweigh the disadvantages, which may be manifested in positive work-to-family and positive family-to-work spillover (Grywacz & Marks, 2000a). For example, having several important roles in varying contexts may promote personal growth and help explore one's identity and opportunities and may help buffer a stressor arising from an individual role.

When compared to the effect of negative spillover, relatively few studies have examined the effect of positive work-family spillover on health-related outcomes (Crain & Hammer, 2013). Past reviews (e.g., Frone, 2003; Gronlund & Oun, 2010) have also acknowledged the importance of investigating both negative and positive spillover in order to capture the broader array of potential influences on well-being. Most of the limited research suggests that positive work-family spillover is associated with better psychological well-being and physical health, such as better sleep quality (Williams et al., 2006), lower psychological distress (Haar & Bardoel, 2008), fewer chronic health conditions, and lower levels of depression (Hammer, Cullen, Neal, Sinclair, & Shafiro, 2005). However, Carlson et al. (2011) found that positive work-family spillover was positively associated with physical health but not related to mental health, and Gryzwacz (2000) did not find a significant association between positive work-family spillover and obesity. Research has also shown that even after controlling for the effects of work-family conflict, work-family enrichment is a significant predictor of socio-emotional well-being (Gareis, Barnett, Ertel, & Berkman, 2009), and higher job performance and satisfaction (Van Steenbergen, Ellemers & Mooijaart, 2007). These findings provide support to the idea that positive and negative spillovers are distinct concepts and that they should both be included in research when work-family spillover is taken into account.

This review of past literature reveals a number of critical gaps in research. First, there were far fewer longitudinal studies than cross-sectional studies that assessed the association between work-family spillover and health (cf. Frone et al., 1997; Hammer et al., 2005). These latter studies used data from two time points with a 4-year and 1-year interval, respectively. In the present study, an opportunity existed to examine two waves of data that were approximately nine years apart to test the associations between work-family spillover and health. Second, there was some evidence showing that positive spillover was distinct from negative spillover, but relatively few studies tested this empirically. Therefore, positive

and negative work-family spillovers were included in the same model to test their unique influences on health.

The Role of Leisure Time Physical Activity: Effort-Recovery Model

Most interventions designed to alleviate the negative impacts or leverage the positive effects of work-family spillover on health target various work characteristics and policies (e.g., flexible work schedule). However, individuals may act as active agents (Bordin, 1994) and also invest time and effort in certain activities to manage their health. The effort-recovery model provides a useful framework for examining how the effects of negative work-family spillover may be attenuated through individuals' behaviors (Geurts, Kompier, Roxburgh, & Houtman, 2003; Van Hooff, Geurts, Kompier, & Taris, 2006; Van Hooff, Geurts et al., 2005). The effort-recovery model was developed in the field where a number of studies have investigated individual-level efforts to reduce the negative and enhance the positive impacts of work characteristics (Geurts et al., 2003; Mejiman & Mulder, 1998; Voydanoff, 2004). More specifically, the effort-recovery model assumes that individuals spend effort on their work and non-work life, which may lead to a series of physiological and behavioral processes that affect their health negatively. However, these processes are reversible: the negative effect of work-related effort spent can be reduced in favor of activities that facilitate recovery. That is, stress is released during the recovery process, and thus, health and well-being are restored (Sonnentag, 2001). Through this process of reducing the negative consequences of workload, one can expect long-term positive effects on health by restoring resources and improving mood (Van Hooff et al., 2005).

Although many other leisure activities, such as taking vacations (Eden, 2001), playing computer games (Reinecke, 2009), or doing volunteer work (Mojza, Lorenz, Sonnentag, & Binnewies, 2010), are known to restore positive resources, leisure-time physical activities (LTPA) seem to be particularly effective in relieving stress and improving health (Geurts et al., 2003; Sonnentag, 2001; Stanton-Rich & Iso-Ahola, 1998; Qian, Yarnal, & Almeida, 2013). LTPA differ from obligations (e.g., job-related, household, or child-care activities) in that they are voluntary and that the goal is not to accomplish specific tasks or projects but rather to relieve tension and gain pleasure (Kleiber, Walker, & Mannell, 2011). These activities usually involve physical movements for a certain period of time, such as exercise, recreation, sport, and walking. Findings from mortality studies indicate that there is a dose-response relation between the amount of physical activity and benefit from it (Shiroma & Lee, 2010; Blair & Connelly, 1996). Furthermore, one large-scale longitudinal study tracking women's health over fifty years indicated that higher levels of midlife physical activity are associated with better health and longer life-expectancy (Sun et al., 2010). Physical relaxation and emotional support could also be facilitated through LTPA, which play critical roles in relieving stress and improving health (McFadden & Swan, 2012). In sum, past studies suggest that intentional effort spent on LTPA allows individuals to restore resources and recover from any work-family demands that have the potential to impact health in a negative way.

A few studies have tested the effort-recovery model in the context of work-family experiences. Van Hooff and colleagues (2005) used a two-wave longitudinal data design to

examine the relationships between negative work-family spillover and employee health based on the effort-recovery model. Results indicated that higher levels of negative work-family spillover at the first wave predicted more health impairments and health complaints one year later. Based on these previous findings, Van Hooff et al. (2006) then examined the associations between negative work-family spillover and health in employees' daily activity patterns and found support for the effort-recovery model, showing that those who engaged in low-effort leisure activities were more likely to report a lower level of work-family conflict.

To our knowledge, studies by Van Hooff and his colleagues' (2005, 2006) were the only work explicitly examining the role of leisure-time activities in the context of the relationship between work-family spillover and health. These studies were, however, based on relatively shorter-term longitudinal designs (i.e., 1 year and 5 days). Little knowledge is available about whether the moderating role of physical activity would still hold when the time frame is much longer. Thus, the present study builds upon prior research testing the effort-recovery framework by applying longitudinal data that were collected almost for a decade. Furthermore, Van Hooff and colleagues (2006) used a broader definition of active leisure-time activities, which included physical, creative, and social activities. The present study focused only on LTPA among various leisure-time activities to examine the unique role of physical movements during leisure time in the context of the relationship between work-family spillover and physical health.

The Use of Longitudinal Data

A majority of past research assessing the associations between spillover and health or leisure and health have used cross-sectional data (Allen, Herst, Bruck, & Sutton, 2000), despite the fact that a number of researchers (e.g., Casper et al., 2007) have argued for the need to examine work-family interactions using longitudinal data. Longitudinal research is needed for two main reasons. First, conceptually, work and family experiences are dynamic and cannot adequately be assessed using only one point in time (Crouter & Pirretti, 2006). For example, changes may occur in marital status, child-care needs and arrangements, the health of family members, job responsibilities, and job positions. Unfortunately, previous studies using cross-sectional data were not able to capture the changes (or stability) of spillover and their influence on physical health over time (e.g., Allen & Armstrong, 2006).

Second, there are statistical advantages to using longitudinal data when examining work and family issues. Longitudinal designs allow researchers to begin to make stronger inferences (J. Goodwin, 2010), as they test the covariance in indicators of change, rather than simply examine relationships based on contemporaneous covariance. Thus, longitudinal data let us test whether change in one variable is associated with change in another variable.

Objectives of the Study

Using a two-wave national sample of adults, the present study investigated the longitudinal associations between work-family spillover, LTPA, and health outcomes in an effort-recovery model across a 9-year time span. Two research questions were addressed: (1) Are changes in work-family spillover associated with change in physical health over a 9-year

span? and (2) Does LTPA moderate the associations between changes in work-family spillover and changes in physical health?

Based on the work and family role conflict perspective (Goode, 1960; Greenhaus & Beutell, 1985) and work-family enrichment perspective (Greenhaus & Powell, 2006), it was hypothesized that an increase in negative work-family spillover would be associated with worse physical health, whereas an increase in positive work-family spillover would be associated with better health. Based on the effort-recovery model (Mejiman & Mulder, 1998), it was expected that more engagement in LTPA would reduce the negative impact of increased negative spillover but would amplify the positive impact of increased positive spillover.

The present study contributes to existing literature in three ways. First, it took advantage of a 9-year longitudinal study of a fairly large sample of U.S. adults by examining the association between work-family spillover and health across time. The nature of the study design enabled us to account for the variability over time and examine how change in work-family spillover was associated with change in physical health, which accounted for a gap in past research. Second, by examining the role of positive spillover and negative spillover at the same time, the uniqueness of the two spillovers could be conceptually and empirically validated. Third, the study was also expected to provide further knowledge on the role of LTPA as an effort to ameliorate the negative and intensify the positive health implications.

Methods

Participants

The sample was derived from employed participants taking part in two waves of the National Survey of Midlife Development in the United States (MIDUS), a national survey of non-institutionalized, English-speaking adults of the contiguous United States (see Brim, Ryff, & Kessler, 2004 and Radler & Ryff, 2010 for a detailed description of the original study).

Briefly, at the initial wave (referred to as T1 hereafter), participants were recruited through working telephone banks and administered a 30-minute telephone interview. Following completion of the interview, respondents were invited to complete a two-part mail-in self-administered paper-and-pencil questionnaire. Both the telephone and the mail-in surveys assessed behavioral, psychological and social factors (e.g., personality, coping, stressful life events, features of work and family functioning, caregiving), as well as facets of health and well-being (e.g., physical functioning, chronic conditions, depressive symptoms, satisfaction with life). These baseline data collection efforts spanned from 1995 to 1996. The interval between the first and second waves of data collection ranged from 7.8 to 10.4 years (occurring between 2004 and 2006), with an average interval of approximately 9 years. Similar to the baseline procedure, upon re-contact of MIDUS respondents (referred to as T2 hereafter), interviewers first administered a telephone interview and mailed a more extensive self-administered questionnaire. After adjusting for mortality, the response and completion rate for the telephone survey was 75%. For a more detailed report of procedures and response rates, see http://midmac.med.harvard.edu/research.html.

The initial sample included 4,963 participants who participated at both occasions of measurement. For the purpose of the present study, only participants who reported working for pay at both T1 and T2 were included. One participant with a body mass index (BMI) of 82 was removed because the person was considered as an outlier (the BMI measure is described later in this section). If a participant had missing data for any of the predictors (T1 and T2 spillover), LTPA, or health outcomes (global self-rated physical health, chronic conditions, BMI), the person was removed from the sample. The final sample included 1,354 adults, who were, at T2, between the ages of 33 and 81 (M = 51.21, SD = 9.74). The sample was predominantly white (90.5 %) and married (73.9%), and approximately half of the sample (51.8%) was female. About 44.9% of the sample had at least a 4-year college degree or above and the average number of work hours per week was 40.9 (SD = 15.1).

Measures

Work-family spillover—Work-family spillover was measured at T1 and T2 using a scale created for the MIDUS study (Grzywacz & Marks, 2000a). This scale assesses four dimensions of work-family spillover: positive work-to-family (e.g., “The skills you use on your job are useful for things you have to do at home”), negative work-to-family (e.g., “Your job reduces the effort you can give to activities at home”), positive family-to-work (e.g., “Your home life helps you relax and feel ready for the next day’s work”), and negative family-to-work (e.g., “Responsibilities at home reduce the effort you can devote to your job”). Respondents rated the frequency of a given experience during the past year. The available response options were 1(*All the time*), 2 (*Most of the time*), 3 (*Sometimes*), 4 (*Rarely*), and 5 (*Never*). Each scale consisted of four items. For persons who answered at least two items within a scale, the missing values were replaced with the person’s mean score of the responded items. Then, the four items were summed into a scale score. Items were reverse-coded so that a higher score indicated a greater level of spillover. Cronbach’s alphas for positive work-to-family spillover were .73 (T1) and .69 (T2), for negative work-to-family .84 (T1) and .83 (T2), for positive family-to-work spillover .71 (T1) and .72 (T2), and for negative family-to-work spillover.81 (T1) and .80 (T2). All measures at both times ranged from 4 to 20. Means and standard deviations of each measure are presented in Table 1.

Leisure-time physical activity (LTPA)—The LTPA scale was a measure created for MIDUS. Participants were asked at T2 how often they engage in vigorous, moderate, and light LTPA separately for winter and summer (e.g., “How often do you engage in *light* physical activity that requires little physical effort (examples: light housekeeping like dusting or laundry; bowling, archery, easy walking, golfing with a power cart or fishing) during your leisure or free time… during the summer?”, “How often do you engage in *moderate* physical activity, that is not physically exhausting, but it causes your heart rate to increase slightly and you typically work up a sweat (examples: leisurely sports like light tennis, slow or light swimming, low impact aerobics, or golfing without a power cart; brisk walking, mowing the lawn with a walking lawnmower) during your leisure or free time… during the winter?”). The response scale was: 1 (*Several times a week or more*), 2 (O*nce a week*), 3 (*Several times a month*), 4 (*Once a month*), 5 (*Less than once a month*), and 6 (*Never*). Scores were reverse-coded so that higher scores represented more physical activity.

Average scores of reported activity during the summer and winter were created for vigorous, moderate, and light LTPA separately and they were significantly correlated (Table 1). Although a formal evaluation of the validity of this measure has not been conducted, evidence has accumulated that provides supports for its validity. For example, constructs that would be expected to be correlated with physical activity based on theory and past research – such as higher levels of education, household income, and smaller waist circumference – have been found to be associated with higher levels of physical activity reported using this scale (Choi et al., 2010; Lachman & Agrigoroaei, 2010).

Physical health—Three health-related dependent variables were measured at T1 and T2: global self-rated health, number of chronic conditions, and Body Mass Index (BMI). *Global self-rated health* was measured using a single item asking how the respondent rated one's physical health using a scale of 1 (*Poor*) to 5 (*Excellent*). This item is commonly used in research to assess perceived physical health (e.g., Bookwala, 2005). To assess the number of *chronic conditions*, a summary score of self-reported chronic conditions was used – a validated approach to assessing the prevalence of chronic health conditions (Martin, Leff, Calonge, Garrett, & Nelson, 2000) that has been utilized extensively in published work on the MIDUS sample (e.g., Piazza et al., 2013). Participants were asked to endorse whether they had experienced or had been treated for any of the 29 chronic health conditions (e.g., migraine headaches, high blood pressure) in the past 12 months. *BMI* was measured by dividing the respondents' weight (in kilograms) by their squared height (in meters).

Control variables—Variables that have been previously found as correlates of work-family spillover and health outcomes were included in the model to examine the unique variance explained by the predictors (e.g., R. Goodwin & Engstrom, 2002; Grzywacz & Marks, 2000a; Turiano et al, 2012). Control variables, measured at T1, were age (years), number of children, educational level (scores range from 1 = *no school/some grade school (1–6)*, to 12 = *professional degree*), total household income, and work hours. All of these were assumed to be interval scaled. One may argue that these variables are not strictly interval variables but, in practice, it is not uncommon to treat variables with ordinal scales as continuous as long as the variable is understood to be a continuous variable and meets the other assumptions of regression analysis (Tabachnik & Fidell, 2007). All of the previously-mentioned control variables were normally distributed (skewnesses were within −1 ~ 1 range) and, therefore, were included in the models as continuous variables. The dummy-coded variables gender (*male* = 1, *female* = 0), parental status (*parent* = 1, *non-parent* = 0) and marital status (*married* = 1, *non-married* = 0) were also included as controls. In addition, neuroticism was controlled for because it is known to be positively associated with physical health problems (Lahey, 2009) and extraversion as it was negatively associated with physical illness (R. D. Goodwin & Friedman, 2006). Neuroticism and extraversion were assessed by asking participants to rate how much each of nine self-descriptive adjectives apply to them using a 7-point numerical rating scale (1 = *strongly agree*, 7 = *strongly disagree;* α = .74 and .78 for neuroticism and extraversion, respectively). Adjectives used for the neuroticism scale were "moody", "worrying", "nervous", and "calm" (reverse-coded) and those for extraversion were "outgoing", "friendly", "lively", "active", and "talkative".

Analyses

Four hierarchical regression models were run for each health outcome (i.e., global self-rated health, chronic conditions, and BMI). Hierarchical regression is useful when the researcher is interested in determining how much variance each independent variable (or a set of independent variables) further explains in addition to what has already been explained by variables that were already in the equation, while stepwise regression is used when the researcher is interested in determining which of the independent variables explain the most variance of the dependent variable (Tabachnik & Fidell, 2007). The focus of the present study was to examine the role of work-family spillovers and the moderating role of LTPA. Therefore, hierarchical regression analysis was more appropriate than stepwise regression because the research question specifically addressed how much variance of physical health was explained by the interaction between work-family spillover and LTPA, above and beyond what has already been known to predict physical health. To assess how changes in spillover predicted changes in health, Model 1 included both T1 and T2 spillover (positive/negative work-to-family and positive/negative family-to-work) in addition to T1 health entered as predictors. Controlling for T1 predictors is a common method used by researchers in order to conduct a stronger test of the associations between variables (e.g., Hammer et al., 2005). These analyses allowed us to assess the association between changes in spillover and changes in health across the two time points. To assess LTPA as a moderator of the associations between spillover and health, Models 2–4 investigated each level of physical activity as a moderator separately (Model 2 = light LTPA; Model 3 = moderate LTPA; Model 4 = vigorous LTPA). In Models 2–4, all predictors in Model 1 were included as predictors, in addition to the health behaviors and the interaction between the health behaviors with spillover at T2. Covariates were entered as predictors in all analyses.

Results

Descriptive Statistics and Bivariate Correlations

Descriptive statistics for predictor variables and correlations between spillover and health behaviors are presented in Table 1. Bivariate correlations show that positive spillovers were concurrently correlated with each other and that negative spillovers were correlated with each other as well. Interestingly, negative family-to-work spillover was positively correlated with positive work-to-family spillover. Regarding longitudinal associations, none of the cross-lagged auto correlations among spillover measures were significant (see bold face figures in Table 1). The low stability suggests a great extent of variability in intra-individual change in these measures (note that the internal consistency of the measures was adequate). A comparison of the mean levels showed that, on average, respondents reported less negative work-to-family spillover and more positive family-to-work spillover at T2 ($t(1353) = 3.10$, $p < .01$ and $t(1353) = 2.38$, $p < .05$, respectively). The associations between the study variables are shown in Table 1.

Global Self-Rated Health

Table 2 presents hierarchical regressions predicting change in global self-rated health. Overall, the models explained a significant portion of variance in global self-rated health (adjusted R^2 ranged from 0.10 to 0.13, $p < .001$). An increase in negative work-to-family

spillover was associated with decreasing global self-rated health across all four models. Individuals who engaged in higher levels of vigorous or moderate LTPA reported better improvements in global self-rated health across 9 years (Models 3 and 4).

Moderate levels of LTPA also significantly buffered the association between spillover and global self-rated health (Model 3). This moderation effect is depicted in Figure 1 (top panel). For individuals who frequently engaged in a moderate level of LTPA, increases in positive work-family spillover predicted significantly better self-reported global self-rated health. For respondents who reported engaging in moderate levels of LTPA less frequently, increases in positive work-family spillover predicted decreases in global self-rated health. But, these results did not hold for light or vigorous LTPA.

Chronic Conditions

Table 3 shows the regressions predicting change in chronic health conditions. Overall, the models explained a significant portion of variance in chronic conditions (adjusted $R^2 = 0.10$, $p < .001$). An increase in negative work-to-family spillover was associated with an increase in chronic conditions (Model 1) and this association held throughout subsequent models. Engagement in moderate levels of LTPA moderated the association between both types of positive spillover and chronic conditions (Model 3). An increase in positive work-to-family spillover was associated with reduced chronic conditions only for those who engaged in frequent moderate LTPA (see Figure 1, bottom panel). Similar to the findings with global self-rated health, positive family-to-work spillover was associated with reduced chronic conditions for persons who frequently engaged in moderate LTPA, only. The negative effect of decreasing positive family-to-work spillover could be buffered by more frequent moderate LTPA (see Figure 2, top).

Light and vigorous LTPA did not show any moderating effects or any direct effects on chronic conditions (Models 2 and 4).

BMI

Overall, the models explained a significant proportion of variance in BMI (adjusted R^2 ranged from 0.04 to 0.06, $p < .001$). The results in Table 4 indicate that changes in spillover did not predict changes in BMI from T1 to T2. Instead, light, moderate, and vigorous LTPA all predicted reduced BMI at T2. Nevertheless, an interaction effect of negative family-to-work spillover with moderate LTPA was revealed. Moderate LTPA was found to be a moderator of the association between changes in negative family-to-work spillover and changes in BMI (Table 4, Model 3). As can be seen in Figure 2 (bottom panel), moderate physical activity served as a protective factor. For those who engaged in more frequent moderate LTPA, BMI did not increase even if negative family-to-work spillover increased. For those who engaged less frequently in moderate LTPA, BMI increased. Light and vigorous LTPA were not significant moderators of the spillover-to-BMI relationships.

Discussion

Using the effort-recovery model, the present study examined the associations between change in work-family spillover, LTPA, and change in physical health. This study adds

knowledge to previous literature in several ways. First, the study included positive spillover in addition to negative spillover to examine its association with physical health as suggested by several scholars (e.g., Gronlund & Oun, 2010). This enabled us to consider both the role conflict perspective (Goode, 1960; Greenhaus & Beutell, 1985) and the expansionist perspective (Barnett & Hyde, 2001; Greenhaus & Powell, 2006) in one model. Second, the associations between spillover, LTPA, and health were examined using a national sample and a longitudinal survey design. Third, the study tested the role of LTPA as an individual-level effort to promote health in the relationship between spillover and health. The findings from the present study partly supported the hypotheses.

Change in Work-Family Spillover

Even though participants reported, on average, similar levels of each type of work-family spillover across 9 years, there were no significant correlations between spillovers across the two time points. These results suggest that the rank order of spillover changed over time (e.g., a respondent high in spillover relative to the rest of the sample at the first phase of data collection may be low in spillover at the second phase of data collection). Given that the two waves of data collection were nearly 10 years apart, this implies how adults' experience pertaining to work and family life can change dramatically.

Associations between Spillover and Health

Overall, the results indicate that the variables included in the models – spillover, demographic variables such as age and socioeconomic status, and personality variables – were significant predictors of self-reported physical health, chronic conditions, and BMI. The models accounted for between 10–13% of the variance in self-reported physical health and chronic conditions, but only explained between 4–6% of the variance in BMI. When answering the question whether these effect sizes are meaningful, it is important to remember that small effect sizes can be important, particularly when translated to the scale of public health (Prentice & Miller, 1992). In addition, a number of other proximal and distal factors are known to be associated with health, including genetics, diet, family members' health, and neighborhood contexts. Given the limited number of predictors included in the models, the figures of 4–13% of the variance explained can be considered modest but meaningful.

When looking at the individual effects of spillover, the results showed that increases in negative work-to-family spillover were associated with worse self-reported health and an increased number of chronic conditions over a 9-year time span, after accounting for the effects of personal and work characteristics. These results are consistent with past research that found a concurrent association between negative work-to-family spillover and poorer physical health (e.g., Grzywacz, 2000) and also support the view that taking roles in the work and family domain at the same time may exacerbate one's health and well-being (Greenhaus & Beutell, 1985). In other words, work-related experiences that restrict one from engaging in family activities is what primarily exacerbates health and well-being. This finding is especially noteworthy as it pertains to workplace interventions. Organizations should pay attention to employees' integration of work and family (Friedman & Greenhaus, 2000) as it can be directly linked to employee health. Whether it be formal (e.g., workplace

policies; Crouter & Booth, 2009) or informal (e.g., family-supportive organizational culture; Mennino, Rubin, & Brayfield, 2005) support from the organization, it seems important that organizations invest to create a workplace that enables employees to pursue lives both in the work and family domains.

Consistent with previously-published studies investigating the association between positive work-to-family spillover and physical health (Grzywacz, 2000; Grzywacz & Bass, 2003), findings from the present study indicate that increases in positive work-to-family spillover were not associated with increases in BMI and global self-rated health. However, increases in positive work-to-family spillover were associated with an increased number of chronic conditions (Models 3 and 4 in Table 3). One explanation for this finding could be that those who experienced an increase in the number of chronic conditions during the course of nearly 10 years may have also experienced an adjustment in their work life. Because the changes in both negative and positive work-to-family spillover were associated with a change in number of chronic conditions, it is possible that there was a general level of change in the work context, which would have changed the experience of work-to-family spillover. For example, people with more chronic conditions may have gradually moved away from active roles in their work life by scaling down to a less-demanding job or going from full-time to part-time jobs. People who were diagnosed with additional chronic conditions may actively seek out different work settings to accommodate their conditions. This assumption could be tested in future research. Still, even if this hypothesis held true, it is notable that the impact of change in negative work-to-family spillover on change in chronic conditions [$\beta = .13$] was stronger (at the trend level, $z = 1.84$, $p = .067$) than that of change in positive work–to-family spillover [$\beta = .06$] indicating that in relation to positive work-to-family spillover, negative work-to-family spillover may have been a stronger predictor of increased number of chronic conditions.

Turning to family-to-work spillover, no evidence was found for a main effect of changes in family-to-work spillover on health. This finding may seem inconsistent with a previous study that found an association between positive family-to-work spillover and fewer chronic conditions (Grzywacz, 2000). However, Grzywacz (2000) examined such association only within those experiencing four or more chronic health problems and thereby using a much more restricted sample. Therefore, findings from the present study should be considered to be an observation among a more generic sample.

Overall, changes in specific physical health outcomes were associated with changes in either positive work-to-family spillover or negative work-to-family spillover. However, the results were dependent on the type of health outcome, suggesting that the process of work-to-family spillover may have varying effects on different types of physical health outcomes. Further, neither change in positive or negative family-to-work spillover was related to changes in physical outcomes. At least with the sample of the present study, whatever mood or experience that spilled over from the family domain to the work domain was not detrimental to individuals' physical health. However, it is possible for family-to-work spillover to have a negative effect on other health outcomes, such as psychological health as found in previous studies (e.g., Hammer et al., 2005; Ruderman et al., 2002). Further research is warranted to tackle down the real impact of family-to-work spillover on health.

Recovering from Work-Family Spillover by Engaging in Moderate Leisure-Time Physical Activity

Results support the finding that a moderate level of LTPA moderates the relationship between spillover and health (Sonnentag, 2001). That is, the positive effect of positive spillover on health was evident only for those who were more frequently involved in moderate LTPA. However, the link between health and negative work-to-family spillover, the type of spillover that seems at a first glance most detrimental for health, was not affected by LTPA. This result is noteworthy in several ways. First, it warrants the demand that has increasingly been expressed in the literature (e.g. Frone, 2003) to look more closely into positive forms of spillover. Findings from the present study suggest that combining a work environment that is facilitating positive interplay between the spheres of work and family with LTPA of employees may have a positive effect on health that surpasses the effect of LTPA on its own. However, the mechanisms that are responsible for this relationship remain unknown. Further research should try to clarify this process.

Second, noting that only moderate levels of LTPA, but not light or vigorous levels facilitate this process, observing an “adequate” level of LTPA may be important. A few past studies are in line with this contention. For example, participation in a moderate level of LTPA was associated with lower risk of mortality (Moore et al., 2012). Moreover, in a longitudinal population study across 38 years in Denmark, participants who kept moderate levels of LTPA reported a lower risk of hip fracture (Hoidrup et al., 2000). The National Heart, Lung, and Blood Institute (NHLBI) also suggested that 30 minutes of moderate level of daily LTPA (e.g., brisk walking, bicycling, and gardening) is one of the most important prevention of high blood pressure (NHLBI; http://www.nhlbi.nih.gov). Interpreting these results in the light of effort-recovery theory, it seems like pursuing LTPA can restore resources to trigger a recovering process, but only moderate activity can achieve this end. Individuals might use LTPA as a refuge to escape from work and family responsibilities and thereby restore their health and well-being. In contrast to moderate levels of LTPA providing a chance to improve health, intensive LTPA may require too much effort and light LTPA may provide too little positive resources for recovery.

Limitations and Future Research

There were a number of limitations in the present study. First, as the study investigated the associations between changes in spillover experience and changes in health, the results examined correlations in change and did not strictly test causal relationships. Second, the self-reported measurement of levels of LTPA may be controversial, as this scale was based on individuals’ subjective perceptions about the level of their physical activity. Thus, the same type of physical activity may be viewed differently by persons. For some participants doing one hour of walking might be “vigorous” physical activity, while others may judge it to be “light.” Future research could make use of ambulatory assessment methods that record physiological function and activity in an objective manner to make the level of physical activity comparable between persons. Third, the study only focused on physical health outcomes. Work-family spillover is also known to be associated with mental or psychological health outcomes, such as depression and anxiety (e.g., Grzywacz & Bass, 2003). The role of LTPA in the relationship between work-family experiences and health

may be even more pronounced when psychological health outcomes are considered. Fourth, although age was included as a control variable, the present study did not specifically investigate how the associations between spillover and health change across the life course. Although this was not the main purpose of the current study, research has indicated that work-family spillover varies dramatically across the life course in part due to changing work and family demands (Martinengo, Jacob, & Hill, 2010). Therefore, future research should investigate the associations between spillover and health across the life course. Fifth, attrition occurred, which is a common feature of many longitudinal studies; participants who remained in the study showed generally better health than those who dropped out of the study, which may have influenced results presented here. It is also important to point out the relative homogeneity of the participants, who attained relatively high education levels and were generally of White racial/ethnic background. Future research should examine the behavioral moderators of the relations between changes in spillover and health among a sample diverse in ethnic and socioeconomic status compositions.

Despite these limitations, the present study has uniquely added further knowledge to existing research investigating longitudinal associations between work-family spillover and physical health among a large national survey of U.S. adults. The results provide further evidence that negative work-family spillover may be particularly problematic for physical health, with results indicating that changes in negative work-family spillover are associated with changes in physical health. In addition, findings from the present study suggest that increases in positive spillover, when combined with moderate level of LTPA, may have the potential to serve as a protective factor for health.

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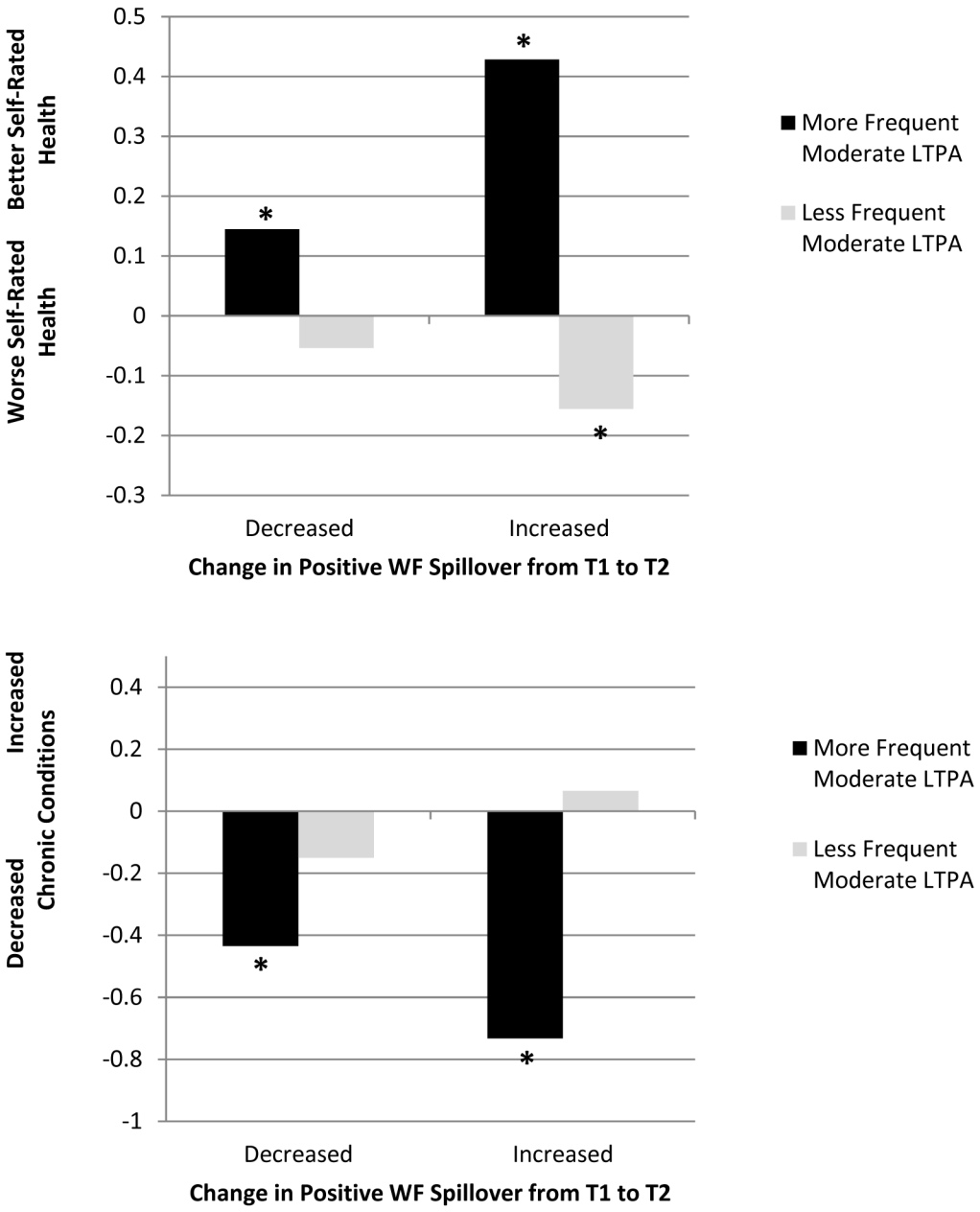

Figure 1.

(Top) Moderate LTPA as a moderator of the relationship between changes in positive work-to-family spillover and global self-rated health between T1 and T2. (Bottom) Moderate LTPA as a moderator of the relationship between changes in positive work-to-family spillover and chronic conditions between T1 and T2.

Note. WF: work-to-family; Participants were categorized as engaging in "more frequent moderate LTPA" if they reported working out more than once per week and were categorized as engaging in "less frequent moderate LTPA" if they reported working out once a month or less. *$p < .05$ (significantly different than 0).

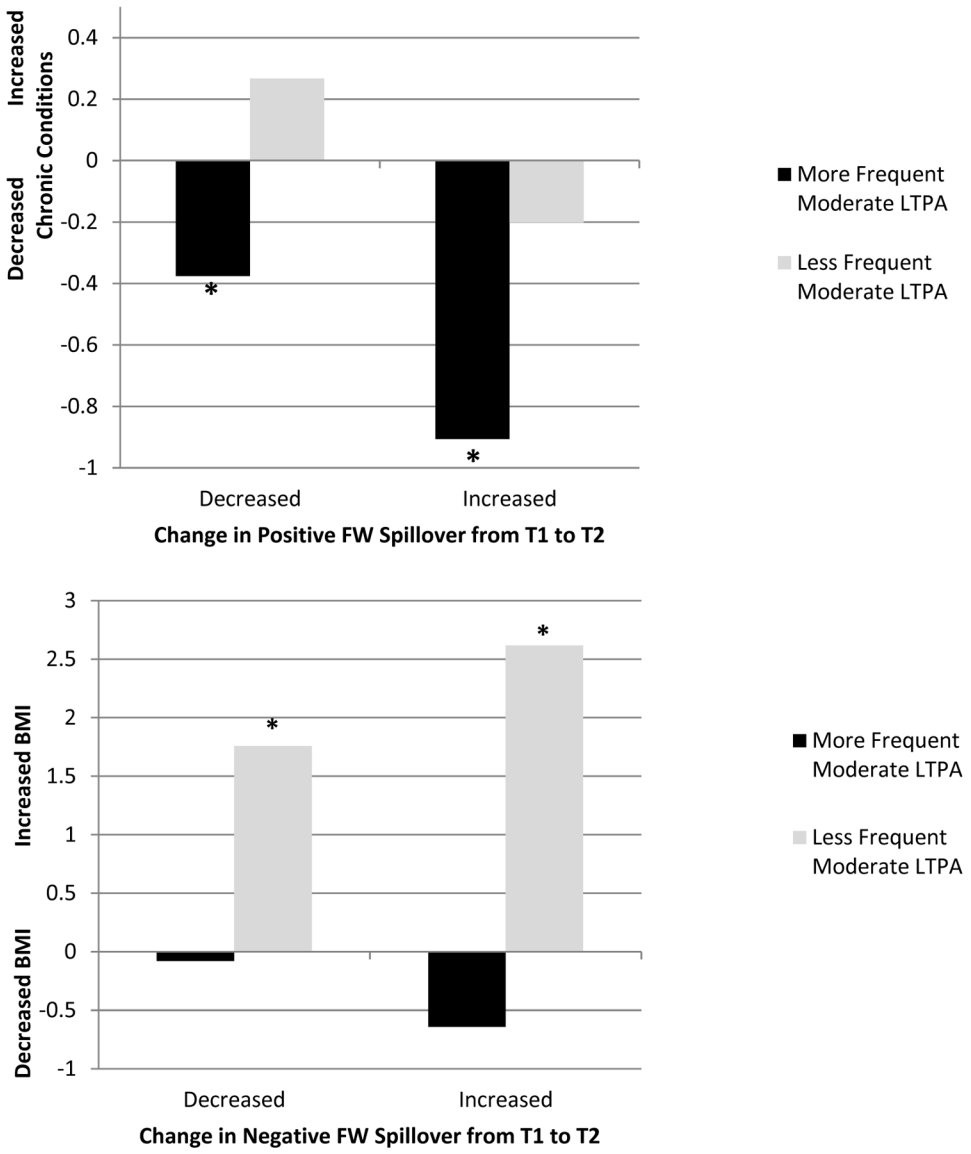

Figure 2.

(Top) Moderate LTPA as a moderator of the relationship between changes in positive family-to-work spillover and chronic conditions between T1 and T2. (Bottom) Moderate LTPA as a moderator of the relationship between changes in negative family-to-work spillover and BMI between T1 and T2.

Note: FW: family-to-work; Participants were categorized as engaging in "more frequent moderate LTPA" if they reported working out more than once per week and were categorized as engaging in "less frequent moderate LTPA" if they reported working out once a month or less. *$p < .05$ (significantly different than 0).

Table 1

Descriptive Statistics and Bivariate Correlations

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Positive W-F (t1)																	
2. Negative W-F (t1)	.06																
3. Positive F-W (t1)	.38***	.06															
4. Negative F-W (t1)	.16***	.47***	.02														
5. Positive W-F (t2)	**−.03**	−.03	−.00	.02													
6. Negative W-F (t2)	.01	**−.02**	.01	.02	−.01												
7. Positive F-W (t2)	.01	−.02	**.00**	.03	.38***	.05											
8. Negative F-W (t2)	−.01	−.02	.02	**−.01**	.07**	.53***	−.00										
9. Light PA	−.00	−.01	.01	.02	.04	.02	.06	.01									
10. Moderate PA	.00	.02	.00	−.02	.08**	.03	.03	.05	.52***								
11. Vigorous PA	−.01	−.04	.02	−.04	.05	.04	.05	.05	.34***	.69***							
12. Self-Rated Health (t1)	.06*	−.08**	.10***	−.08**	.01	.02	.01	−.00	.02	.02	.01						
13. Self-Rated Health (t2)	−.03	−.01	.01	−.01	.05	−.13	.07	−.12	.11	.18***	.18***	**.05**					
14. Chronic Conditions (t1)	−.03	.17	−.09	.14	.00	−.01	−.02	.02	.02	.00	.00	−.35***	−.02				
15. Chronic Conditions (t2)	.02	−.01	.02	−.03	.03	.11***	−.03	.07*	−.06*	−.12***	−.12***	−.01	−.32***	**.01**			
16. BMI (t1)	.00	.07*	−.02	−.02	.04	−.01	.01	.01	.04	.05	.05	−.25***	.03	.17***	−.01		
17. BMI (t2)	−.01	−.02	.07	−.03	.01	.04	.02	.04	−.09***	−.14***	−.13***	−.00	−.29***	−.03	.19***	**−.01**	
Mean	11.59	10.52	13.31	8.32	11.68	10.17	13.58	8.21	5.16	4.21	3.55	3.65	3.79	2.26	1.84	26.67	27.73
Standard Deviation	2.91	2.97	3.04	2.60	2.79	2.74	2.93	2.42	1.33	1.67	1.81	0.90	0.88	2.28	1.98	5.21	5.64

Note. W-F: work-to-family spillover, F-W: family-to-work spillover, PA: physical activity, BMI: Body Mass Index. Bold face figures indicate stability coefficients. N = 1,354.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Table 2

Regression Models Examining Changes in Spillover on Global Self-Rated Health

	Model 1	Model 2	Model 3	Model 4
	B (β)	B (β)	B (β)	B (β)
Intercept	3.78 (.00)***	3.79(.00)***	3.78(.00)***	3.80(.00)***
Control variables				
Age	−0.00 (−.04)	−0.00(−.03)	−0.00(−.03)	−0.00(−.02)
Gender	−0.12 (−.06)*	−0.12(−.07)*	−0.13(−.07)*	−0.14(−.08)*
Marital status	0.09 (.04)	0.08(.04)	0.08(.04)	0.08(.04)
Parental status	−0.03 (−.05)	−0.03(−.05)	−0.02(−0.04)	−0.02(−.04)
Extraversion	0.17 (.11)***	0.17(.11)***	0.16(.10)***	0.15(.10)***
Neuroticism	−0.14 (−.10)***	−0.13(−.09)**	−0.14(−.10)***	−0.14(−.10)***
Education level	0.05 (.15)***	0.05(.14)***	0.05(.13)***	0.05(.13)***
Income	0.00 (.10)**	0.00(.09)**	0.00(.09)**	0.00(.09)**
Work hours	0.00 (.07)*	0.00(.07)*	0.00(.07)*	0.00(.07)*
Self-rated health (t1)	0.04 (.04)	0.03(.03)	0.03(0.03)	0.04(.04)
Positive W-F (t1)	−0.01 (−.03)	−0.01(−.03)	−0.01(−.03)	−0.01(−.03)
Negative W-F (t1)	−0.00(−.01)	−0.00(−.01)	−0.00(−.02)	−0.00(−.01)
Positive F-W (t1)	0.01 (.03)	0.01(.03)	0.01(.03)	0.01(.02)
Negative F-W (t1)	0.00 (.01)	0.00(.01)	0.01(.01)	0.00(.01)
Predictors				
Positive W-F (t2)	−0.00 (−.01)	−0.00(−.01)	−0.00(−.01)	−0.00(−.01)
Negative W-F (t2)	−0.04 (−.11)***	−0.04(−.11)***	−0.04(−.11)***	−0.03(−.11)***
Positive F-W (t2)	0.01 (.04)	0.01(.03)	0.01(.04)	0.01(.03)
Negative F-W (t2)	0.02 (−.05)	−0.02(−.05)	−0.02(−.05)	−0.01(−.05)
Light PA		0.03(.05)		
Moderate PA			0.06(.12)***	
Vigorous PA				0.06(.12)***
Interactions				
Pos. W-F (t2) * Light PA		0.00(.01)		
Neg. W-F (t2) * Light PA		−0.00(−.02)		
Pos. F-W (t2) * Light PA		−0.01(−.05)		
Neg. F-W (t2) * Light PA		0.01(.05)		
Pos. W-F (t2) * Mod. PA			0.01(.07)*	
Neg. W-F (t2) * Mod. PA			0.01(.03)	
Pos. F-W (t2) * Mod. PA			−0.01(−.04)	
Neg. F-W (t2) * Mod. PA			−0.00(−.01)	
Pos. W-F (t2) * Vig. PA				0.01(.03)

	Model 1	Model 2	Model 3	Model 4
	B (*β*)	B (*β*)	B (*β*)	B (*β*)
Neg. W-F (t2) * Vig. PA				0.01(.04)
Pos. F-W (t2) * Vig. PA				−0.01(−.04)
Neg. F-W (t2) * Vig. PA				−0.01(−.05)
Adjusted R-Squared	0.10***	0.10***	0.13***	0.11***

Note. W-F: work-to-family spillover, F-W: family-to-work spillover, PA: physical activity. Model 1= Leisure-time physical activity (LTPA) not included, Model 2 = Light LTPA included, Model 3 = Moderate LTPA included, Model 4 = Vigorous LTPA included.

* $p < .05$;

** $p < .01$;

*** $p < .001$

Table 3

Regression Models Examining Changes in Spillover on Chronic Conditions

	Model 1	Model 2	Model 3	Model 4
	B (β)	B (β)	B (β)	B (β)
Intercept	2.18 (.00)***	2.17 (.00)***	2.18 (.00)***	2.17 (.00)***
Control variables				
Age	0.04 (.21)***	0.04 (.21)***	0.04 (.20)***	0.04 (.20)***
Gender	−0.28 (−.07)*	−0.28 (−.07)*	−0.28 (−.07)	−0.27 (−.07)*
Marital status	−0.29 (−.06)*	−0.28 (−.06)*	−0.28 (−.06)	−0.28 (−.06)*
Parental status	−0.03 (−.02)	−0.03 (−.02)	−0.03 (−.03)	−0.03 (−.03)
Extraversion	−0.22 (−.06)*	−0.22 (−.06)*	−0.20 (−.06)*	−0.20 (−.06)*
Neuroticism	0.46 (.14)***	0.45 (.14)***	0.45 (.14)***	0.45 (.14)***
Education level	−0.06 (−.08)**	−0.06 (−.08)**	−0.05 (−.07)*	−0.06 (−.07)*
Income	0.00 (.00)	0.00 (.00)	0.00 (.00)	0.00 (.00)
Work hours	−0.01 (−.08)**	−0.01 (−.08)**	−0.01 (−.08)	−0.01 (−.08)**
Chronic conditions (t1)	0.01 (.01)	0.01 (.01)	0.01 (.01)	0.01 (.01)
Positive W-F (t1)	0.01 (.02)	0.01 (.02)	0.01 (.02)	0.01 (.02)
Negative W-F (t1)	−0.01(−.01)	−0.01 (−.01)	−0.00 (−.01)	−0.01 (−.01)
Positive F-W (t1)	0.01 (.01)	0.01 (.01)	0.01 (.01)	0.01 (.00)
Negative F-W (t1)	−0.03 (−.04)	−0.03 (−.04)	−0.03 (−.04)	−0.03 (−.04)
Predictors				
Positive W-F (t2)	0.04 (.06)	0.04 (.06)	0.04 (.06)*	0.04 (.06)*
Negative W-F (t2)	0.09 (.13)***	0.09 (.13)***	0.09 (.13)***	0.09 (.13)***
Positive F-W (t2)	−0.01 (−.02)	−0.01 (−.02)	−0.01 (−.01)	−0.01 (−.01)
Negative F-W (t2)	−0.00 (−.00)	−0.00 (−.00)	0.00 (.00)	0.00 (.00)
Light PA		−0.02 (−.01)		
Moderate PA			−0.08 (−.07)*	
Vigorous PA				−0.06 (−.05)
Interactions				
Pos. W-F (t2) * Light PA		0.00 (.01)		
Neg. W-F (t2) * Light PA		0.01 (.02)		
Pos. F-W (t2) * Light PA		0.01 (.02)		
Neg. F-W (t2) * Light PA		−0.02 (−.04)		
Pos. W-F (t2) * Mod. PA			−0.02 (−.06)*	
Neg. W-F (t2) * Mod. PA			−0.00 (.01)	
Pos. F-W (t2) * Mod. PA			0.03 (.07)*	
Neg. F-W (t2) * Mod. PA			0.01 (.01)	
Pos. W-F (t2) * Vig. PA				−0.01 (−.02)

	Model 1	Model 2	Model 3	Model 4
	B (β)	B (β)	B (β)	B (β)
Neg. W-F (t2) * Vig. PA				0.00 (.00)
Pos. F-W (t2) * Vig. PA				0.01 (.03)
Neg. F-W (t2) * Vig. PA				0.01 (.02)
Adjusted R-Squared	0.10***	0.10***	0.10***	0.10***

Note. W-F: work-to-family spillover, F-W: family-to-work spillover, PA: physical activity. Model 1= Leisure-time physical activity (LTPA) not included, Model 2 = Light LTPA included, Model 3 = Moderate LTPA included, Model 4 = Vigorous LTPA included.

* $p < .05$;

** $p < .01$;

*** $p < .001$

Table 4

Regression Models Examining Changes in Spillover on BMI

	Model 1	Model 2	Model 3	Model 4
	B (β)	B (β)	B (β)	B (β)
Intercept	27.68 (0)***	27.64 (0)***	27.63 (0)***	27.57 (0)***
Control variables				
Age	0.01 (.02)	0.01 (.01)	0.00 (.00)	−0.00 (−.00)
Gender	1.25 (.11)***	1.24 (.11)***	1.34 (.12)***	1.40 (.12)***
Marital status	−0.74 (−.06)*	−0.70 (−.05)	−0.69 (−.05)	−0.67 (−.05)
Parental status	0.29 (.08)**	0.29 (.08)**	0.27 (.08)**	0.27 (.08)**
Extraversion	−0.41 (−.04)	−0.41 (−.04)	−0.29 (−.03)	−0.22 (−.02)
Neuroticism	−0.52 (−.06)	−0.59 (−.07)*	−0.58 (−.07)*	−0.57 (−.06)*
Education level	−0.21 (−.09)	−0.18 (−.08)**	−0.16 (−.07)*	−0.16 (−.07)*
Income	−0.00 (−.06)*	−0.00 (−.06)	−0.00 (−.05)	−0.00 (−.05)
Work hours	0.02 (.04)	0.01 (.04)	0.01 (.04)	0.01 (.04)
BMI (t1)	−0.01 (−.00)	−0.00 (−.00)	−0.00 (−.00)	−0.00 (−.00)
Positive W-F (t1)	−0.06 (−.03)	−0.07 (−.04)	−0.07 (−.04)	−0.07 (−.04)
Negative W-F (t1)	−0.02 (−.01)	−0.02 (−.01)	−0.02 (−.01)	−0.03 (−.01)
Positive F-W (t1)	0.15 (.08)**	0.15 (.08)**	0.14 (.08)**	0.15 (.08)**
Negative F-W (t1)	−0.07 (−.03)	−0.05 (−.03)	−0.07 (−.03)	−0.07 (−.03)
Predictors				
Positive W-F (t2)	0.01 (.00)	0.01 (.00)	0.01 (.00)	0.00 (.00)
Negative W-F (t2)	0.07 (.04)	0.08 (.04)	0.08 (.04)	0.08 (.04)
Positive F-W (t2)	0.05 (.03)	0.06 (.03)	0.04 (.02)	0.04 (.02)
Negative F-W (t2)	0.12 (.05)	0.12 (.05)	0.12 (.05)	0.13 (.05)
Light PA		−0.26 (−.06)*		
Moderate PA			−0.44 (−.13)***	
Vigorous PA				−0.40 (−.13)***
Interactions				
Pos. W-F (t2) * Light PA		0.03 (.02)		
Neg. W-F (t2) * Light PA		0.00 (.00)		
Pos. F-W (t2) * Light PA		0.06 (.05)		
Neg. F-W (t2) * Light PA		−0.06 (−.04)		
Pos. W-F (t2) * Mod. PA			−0.06 (−.05)	
Neg. W-F (t2) * Mod. PA			0.01 (.01)	
Pos. F-W (t2) * Mod. PA			0.04 (.04)	
Neg. F-W (t2) * Mod. PA			−0.11 (−0.08)**	
Pos. W-F (t2) * Vig. PA				−0.01 (−.01)

	Model 1	Model 2	Model 3	Model 4
	B (β)	B (β)	B (β)	B (β)
Neg. W-F (t2) * Vig. PA				−0.01 (−.01)
Pos. F-W (t2) * Vig. PA				−0.01 (−.01)
Neg. F-W (t2) * Vig. PA				−0.07 (−0.05)
Adjusted R-Squared	0.05***	0.04***	0.06***	0.05***

Note. W-F: work-to-family spillover, F-W: family-to-work spillover, PA: physical activity. Model 1= Leisure-time physical activity (LTPA) not included, Model 2 = Light LTPA included, Model 3 = Moderate LTPA included, Model 4 = Vigorous LTPA included.

* $p < .05$;

** $p < .01$;

*** $p < .001$