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Psychosocial and behavioural contributors to health: Age-related increases in physical disability are reduced by physical fitness

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Psychosocial and behavioural contributors to health: Age-related increases in physical disability are reduced by physical fitness†

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The aging process is associated with increased risk for disease which can cause physical and economic burden for older adults. In a national longitudinal sample of 3910 participants aged 24–75 years (55% women), we examined psychosocial and behavioural factors associated with physical health in adulthood. With hierarchical regression analyses controlling for Time 1 values of the dependent variable and demographic characteristics, we found that participants reporting better social relations, a higher sense of control, a smaller waist circumference and greater physical activity at Time 1 reported better self-rated physical health (Adj. $R^2 = 0.33$, $F(11, 3661) = 164.66, p < 0.001$) and less physical disability (Adj. $R^2 = 0.44, F(13, 3659) = 226.25, p < 0.001$) 9 years later than their counterparts reported. Furthermore, significant interactions showed that smaller waist circumference and greater physical activity at Time 1 attenuated age-related increases in physical disability. Beneficial effects of physical fitness are considered within the context of lifespan theories of health, and implications for interventions are discussed.

Keywords: health; aging; social relations; control beliefs; physical activity

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Introduction

According to the Centers for Disease Control and Prevention (CDC, 2008), the aging process is associated with increased risk for disease that can cause physical and economic burden for older adults. Thus, the growing older adult population places significant burden on the health care system. From anti-wrinkle creams to anti-oxidants, many companies are currently in the business of selling products to delay the aging process. However, despite the promises of clever marketing tools, eternal youth may not be available in a can, cream or pill. Psychosocial and behavioural factors, however, can contribute greatly to healthy aging (CDC, 2008). The goal of the present study was to examine the possible joint protective effects of high-quality social relationships, a high sense of personal control over the environment, a fit

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† Participants in the study reported in this manuscript were treated in accordance with the ethical standards outlined by the American Psychological Association, through approval by the University Internal Review Board.

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physique and regular physical activity for age-related declines in health, with a particular emphasis on factors that can attenuate worsening physical health with age.

Social relations

The social environment has a great impact on health and well-being (Cohen, 2004). Social relationships typically include both social support (the positive aspects of social relations) and social strain (the negative aspects of social relations). Social support positively affects physical and psychological well-being (e.g. Berkman, Glass, Brisstette, & Seeman, 2000; Heller & Rook, 2001; Walen & Lachman, 2000) and promotes positive health behaviours (Cohen, 2004), while social strain negatively affects health and well-being (e.g. Antonucci, Akiyama, & Lansford, 1998; Davis & Swan, 1999; Rook, 1984, 1990).

In a national study of married or cohabiting adults participating in the first wave of data collection for the study of Midlife Development in the United States (MIDUS), Walen and Lachman found that older adults reported better social relations than younger and middle-aged adults. Specifically, older adults reported more social support from their families than did younger or middle-aged adults. Furthermore, older men reported less social strain from their families and friends than did younger or middle-aged men, and older women reported less social strain from their families than did younger and middle-aged women. However, these results were based on cross-sectional data, thus limiting the ability to examine change or to draw directional conclusions. The fact that older adults typically report better social relations but worse physical health than younger adults suggests that social relations are not the only contributor to physical health across the lifespan.

Control beliefs

The sense of control, defined as 'beliefs or expectations about the extent to which one's actions can bring about desired outcomes' (Lachman et al., 1997, p. 254) is another important aspect of successful aging (e.g. Abeles, 1991; Lachman & Firth, 2004; Rodin, 1986; Schulz, Heckhausen, & Locher, 1991). Maintaining a sense of control in older adulthood is beneficial for both physical health (e.g. lower number of acute and chronic illness, better physical functioning status: Lachman & Firth, 2004; Rodin, 1986; less physical disability: Harkapaa, Jarvikoski, & Estlander, 1996; better self-rated current and recent physical health: Ruthig, Chipperfield, Perry, Newall, & Swift, 2007) and psychological health (e.g. lower depressive symptoms, higher life satisfaction: Lachman & Firth, 2004; Rodin, 1986; fewer negative emotions: Ruthig et al., 2007).

However, older adults experience declines in their sense of personal control over health and physical functioning with age. For example, Lachman and Firth (2004) found that older adults participating in the MIDUS study at Time 1 perceived significantly more constraints on their ability to exert control than younger or middle-aged participants. Furthermore, older adults reported significantly less control over the domain of health than younger or middle-aged adults. Because a low sense of control is associated with low motivation for action (Abramson, Seligman, & Teasdale, 1978), it may be associated with fewer health-promoting behaviours, which may negatively affect health (Rodin, 1986). Therefore, if the sense

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of control can be maintained throughout adulthood, older adults may be able to protect against or minimise declines in physical health (Chipperfield, Campbell, & Perry, 2004).

Physical fitness

There are also numerous physical and mental health benefits associated with maintaining physical fitness. One measure of physical fitness is body composition or the ratio of the body's fat mass to fat-free mass (ACSM, 2000). For example, having a waist circumference larger than 40 inches for men or 35 inches for women, which is indicative of excessive body fat, is associated with increased risk for hypertension, dyslipidemia, diabetes, heart disease, stroke, osteoarthritis and some cancers (CDC, 2008). Obesity rates among adults have risen dramatically over the past 10 years, and the effects of carrying extra body fat, particularly around the waist, tend to be cumulative, suggesting that older adults are at particular risk for diseases associated with excess body fat (CDC, 2008).

Regular physical activity is one of the most effective methods of body fat reduction, and is also associated with positive health effects related to low-body fat (ACSM, 2000). In addition, regular physical activity is associated with more strength and balance, fewer falls, reduced risk for a number of diseases, relief of many disease symptoms, and increased longevity (ACSM, 2000). Furthermore, regular physical activity also enhances independence (Hickey, Wolf, Robins, Wagner, & Harik, 1995) and reduces physical functioning declines (Miller, Rejeski, Reboussin, Ten Have, & Ettinger, 2000) among older adults.

Despite the healthy aging benefits associated with physical activity, the CDC reports that physical activity declines with advancing age. In fact, the CDC (2008) estimated that more than 24% of American adults age 65 and older were completely inactive (did not participate in leisure time, household or transportation physical activity) in 2005. In addition, only 12% of adults aged 65–74 years and 10% of adults over 75 years old met the CDC's strength training recommendations in 2001, which had been designed to reduce the number of falls and promote the maintenance of independent living for older adults (Kruger, Brown, Galuska, & Buchner, 2004). Because physical fitness is associated with healthy aging, those older adults who maintain low body fat and a physically active lifestyle may enjoy better health throughout their older adulthood.

The present study

Concerns about the health and well-being of older adults may be addressed by psychosocial and behavioural factors. Good social relationships, beliefs in personal control, low body fat composition and regular physical activity have positive relationships with self-reported and objective measures of health, suggesting that targeting these factors may improve some of the physical limitations associated with advancing age. However, examining age interactions with psychosocial and behavioural variables is difficult in smaller samples, which are not likely to include participants in the outer ranges of the distribution where the interaction effect can be detected (McClelland & Judd, 1993). Therefore, in the present study we examined data from a longitudinal study of a national sample of Americans that was large

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enough to include participants in the outer ranges of the distribution ($N = 3910$). We examined the direct and age-moderating roles of social relations, control beliefs, waist circumference, and physical activity to changes in self-rated health and physical disability over 9 years.

Hypotheses

We hypothesised that better social relations, a higher sense of control, a smaller waist circumference, and more frequent physical activity at Time 1 would predict better self-rated health and less physical disability at Time 2 when controlling for Time 1 values of these health outcomes. Furthermore, we hypothesised that better social relations, a higher sense of control, smaller waist circumference and greater physical activity would attenuate the health declines typically associated with advancing age.

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Method

Data for the present study are from the study of Midlife Development in the United States (MIDUS), a national longitudinal investigation of behavioural, psychological and social factors associated with aging-related differences in physical and mental health.

Participants

Participants were 3910 non-institutionalised, English-speaking adults aged 24–75 years ($M = 47.42, \mathrm{SD} = 12.44$), who volunteered to participate in a telephone survey, as well as a self-administered mail questionnaire. Fifty-five percent of participants were women, and annual household income (including wages, pensions, social security, investments and government assistance) ranged from \$0 to \$300,000 ($M = \$60,472.86, \mathrm{SD} = \$49,291.61$). Information regarding the demographic characteristics of race, education, income and marital/cohabitation with current partner status was also collected. Race was dichotomised such that Caucasians consisted of one group (94%) and all other races were combined to create the non-Caucasian group (6%). Education (measured with 12 categories) was also dichotomised such that participants with education up to a high-school diploma were considered of the low-education group (35%), and participants with some college education or more were considered of the high-education group (65%). Marital/Cohabitation status was dichotomised with one category of participants who were currently married and/or cohabitating with their partner (75%) and the second category with participants who were single, separated, divorced or widowed and not cohabitating with their partner (25%). See Table 1 for a complete description of participant characteristics.

Measures: independent variables and covariates

All analyses controlled for the covariates gender, race, education, income and marital/cohabitation status. Age, social relations, control beliefs, physical activity and waist circumference were included in analyses as independent variables.

Social relations were measured as social support (e.g. 'How much do your friends really care about you?') and social strain (e.g. 'How often does your family

Table 1. Summary of participant characteristics for the longitudinal sample ($N = 3910$).

Variable	T1 *N*	T1%	T2 *N*	T2%
Gender				
Male	1743	44.6	1743	44.6
Female	2167	55.4	2167	55.4
Marital/Cohabitation status				
Married/cohabiting	2945	75.4	2922	74.8
Not married/cohabiting	963	24.6	983	25.2
Education				
No. school/some school	8	0.2	10	0.3
8th grade/junior high school	44	1.1	49	1.3
Some high school	210	5.4	175	4.5
GED	44	1.1	50	1.3
High school graduation	1049	26.9	1000	25.6
1–2 years of college	674	17.3	657	16.8
3 or more years of college	172	4.4	150	3.8
Associate's degree	292	7.5	309	7.9
Bachelor's degree	776	19.9	764	19.6
Some graduate school	122	3.1	124	3.2
Master's degree	350	9.0	426	10.9
Professional degree	162	4.2	191	4.9
Race				
White	3616	93.7		
Black/African American	142	3.7		
Native American	16	0.4		
Asian or Pacific Islander	23	0.6		
Other	40	1.0		
Multiracial	22	0.6		
Variable	*N*	Range	Mean	SD
Age Time 1	3910	24–75	47.42	12.44
Age Time 2	3910	32–84	56.35	12.39
Income Time 1	3910	$0–$300,000	$60,472.86	$49,291.61
Income Time 2	3910	$0–$300,000	$78,373.99	$54,559.91
Social relations Time 1	3897	1.44 – 4.00	3.18	0.38
Social relations Time 2	3886	1.50 – 4.00	3.24	0.38
Control beliefs Time 1	3894	1.08 – 7.00	5.53	1.00
Control beliefs Time 2	3886	1.08 – 7.00	5.53	1.00
Physical activity Time 1	3903	0.00 – 5.00	3.75	1.16
Physical activity Time 2	3737	0.00 – 5.00	3.03	1.62
Waist circumference Time 1	3720	14 in–66 in	35.35 in	5.76 in
Waist circumference Time 2	3706	18 in–65 in	37.27 in	5.89 in
Self-rated health Time 1	3906	1.00–5.00	3.62	0.93
Self-rated health Time 2	3909	1.00–5.00	3.56	1.00
Physical limitations Time 1	3904	1.00–4.00	1.42	0.61
Physical limitations Time 2	3892	1.00–4.00	1.67	0.79

criticise you?') from the spouse/partner, family and friends (Walen & Lachman, 2000). Responses to items were averaged, with higher scores reflecting better social relations (strain items were reverse-coded and possible scores ranged from 1 to 4, $\alpha = 0.87$).

Control beliefs were measured with the Mastery and Perceived Constraints scales (e.g. 'I can do just about anything I really set my mind to', 'I have little control over

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the things that happen to me'; Lachman & Weaver, 1998). Responses to items were averaged, with higher scores reflecting a higher sense of control (constraints items were reverse-coded). Possible scores range from 1 to 7, ($\alpha = 0.85$).

Physical activity was measured with 4 items assessing the participant's frequency of vigorous and moderate physical activity in the summer and winter months on a 6-point scale (0 = Never, 1 = Less than once a month, 2 = Once a month, 3 = Several times a month, 4 = Once a week, 5 = Several times a week): 'During the summer, how often do you engage in vigorous physical activity (e.g. running or lifting heavy objects) long enough to work up a sweat?', 'What about during the winter – how often do you engage in vigorous physical activity enough to work up a sweat?', 'During the summer, how often do you engage in moderate physical activity (e.g. bowling or using a vacuum cleaner)?', 'What about during the winter – how often do you engage in moderate physical activity?'. The average of these four scores created the participants' physical activity score ($\alpha = 0.80$), with possible scores ranging from 0 to 5.

Waist circumference was measured as the circumference of the waist (inches) around the smallest part of the torso. Participants were sent instructions on how to take their own waist circumference measurement with a cloth measuring tape provided for them. According to the National Institutes of Health (NIH, 2008), waist circumference is an indicator of abdominal fat, which is a more reliable and valid predictor of body fat and risk for disease than waist-to-hip ratio (Taylor, Jones, Williams, & Goulding, 2000) and Body Mass Index (NIH, 2008). A waist circumference of over 40 inches (101.6 cm) in men and over 35 inches (88.9 cm) in women signifies risk.[1]

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Measures: dependent variables

Self-rated health was measured with one item asking participants to rate, on a 5-point scale, 'In general, would you say your PHYSICAL HEALTH is excellent (5), very good (4), good (3), fair (2) or poor (1)?'. Self-ratings of health such as these items have demonstrated predictive validity for future functional ability and health status (Idler & Kasl, 1995).

Physical disability was measured as difficulty with nine activities of daily living adapted from the SF-36 (Ware & Sherbourne, 1992). Participants were asked, 'How much does you health limit you in doing each of the following? Lifting or carrying groceries; Bathing or dressing yourself; Climbing several flights of stairs; Bending, kneeling, or stooping; Walking more than a mile; Walking several blocks; Walking one block; Vigorous activity (e.g. running, lifting heavy objects); Moderate activity (e.g. bowling, vacuuming)'. Responses (4 = A lot, 3 = Some, 2 = A little, 1 = Not at all) were averaged such that higher scores reflected more physical disability, with a possible range of 1–4 ($\alpha = 0.94$).

Procedure

Participants were recruited in 1994 and 1995 by Survey Sampling, Inc. using a random digit dialling procedure, which sampled working telephone banks in the coterminous United States ($N = 7100$, see Brim, Ryff, & Kessler, 2004 for more detail), and selected households with adults between the ages of 24 and 74 years.

Seventy percent of those contacted participated in the MIDUS I telephone interview. Among the telephone respondents, 86.3% also completed the lengthy self-administered questionnaires at Time 1, yielding an overall response rate of 60.8% for all questionnaires at Time 1. Comparison of the MIDUS I sample with the Current Population Survey (CPS, 1995) revealed that the sample under-represented those with a high school education or less and African Americans, and over-represented older males (by intention, to facilitate gender comparisons by age). The representation by gender and marital status was close to the CPS.

All living participants were contacted again in 2004 and 2005, when they were 32–84 years old, and asked to participate in the second wave of data collection. Approximately 70% of people contacted at Time 2 agreed to participate in Time 2 data collection ($N = 4967$). As is typical of longitudinal survey data, women and participants with higher education and income and better self-rated health were less likely to drop out of the study than their counterparts (data available upon request from the first author). Only data from participants who completed the telephone interview and the self-administered questionnaires at both time points were examined in the present study ($N = 3910$).

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Analysis plan

First, exploratory analyses were conducted on all variables to determine normality of the distribution and reliability of measures. Second, zero-order correlations between all variables were calculated (Table 2). Next, the direct and moderated longitudinal relationships with the dependent variables, self-rated physical health and physical disability, were examined in two separate Hierarchical Multiple Regression (HMR) analyses. The Time 1 value of the dependent variable was entered on the first step of each model to examine residualised change, followed by the variables gender, race, education, income and marital/cohabitation status at the second step[2]. Waist circumference, age, social relations[3], control beliefs and physical activity were centred and entered on the next step. Interaction terms were entered into the models on the final step. All possible two-way interactions with age were examined, but only the significant interactions are reported. Results from the final step of the regressions are presented in Table 3.

Results

Self-rated health

Predictor variables explained 33.1% of the variance in Time 2 self-rated physical health in the HMR analysis, $F(11, 3661) = 164.66$, $p < 0.001$. As shown in Table 3, Time 1 self-rated health explained 27.6% of the variance in Time 2 self-rated health ($\beta = 0.42, p < 0.001$). Gender ($\beta = -0.04, p = 0.78$), race ($\beta = -0.02, p = 0.19$), education ($\beta = 0.11, p < 0.001$), income ($\beta = 0.05, p < 0.001$) and marital/cohabitation status ($\beta = 0.00, p = 0.91$) explained an additional 2.4% of the variance in Time 2 self-rated physical health (Cohen's $f = 0.03$). Consistent with predictions, smaller waist circumference ($\Delta R^2 = 0.007, \beta = -0.10, p < 0.001$, Cohen's $f = 0.01$), younger age ($\Delta R^2 = 0.006, \beta = -0.09, p < 0.001$, Cohen's $f = 0.009$), better social relationships ($\Delta R^2 = 0.001, \beta = 0.05, p = 0.003$, Cohen's $f = 0.001$), a higher sense of control ($\Delta R^2 = 0.003, \beta = 0.06, p < 0.001$, Cohen's $f = 0.004$) and more frequent physical

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Table 2. Correlations between all variables ($N = 3910$).

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(1) Age T1	–													
(2) Gender T1	−0.02	–												
(3) Race T1	−0.04	0.05	–											
(4) Education T1	−0.12	−0.09	−0.02	–										
(5) Income T1	0.12	−0.13	−0.07	0.24	–									
(6) Mar/Cohab T1	0.01	−0.11	−0.10	−0.03	0.30	–								
(7) Waist T1	0.18	−0.42	0.00	−0.08	−0.02	0.06	–							
(8) Soc Rel T1	0.15	0.02	−0.06	0.01	0.06	0.09	−0.07	–						
(9) Control T1	−0.06	−0.08	−0.03	0.14	0.17	0.08	−0.08	0.39	–					
(10) Activity T1	−0.22	−0.18	−0.09	0.16	0.13	0.07	−0.13	0.07	0.20	–				
(11) S-R Health T1	−0.10	−0.05	−0.07	0.20	0.21	0.06	−0.23	0.19	0.26	0.31	–			
(12) S-R Health T2	−0.16	−0.01	−0.06	0.24	0.19	0.05	−0.23	0.15	0.24	0.26	0.53	–		
(13) Disability T1	0.25	0.14	0.07	−0.17	−0.16	−0.09	0.23	−0.12	−0.24	−0.42	−0.46	−0.38	–	
(14) Disability T2	0.35	0.13	0.02	−0.22	−0.17	−0.07	0.25	−0.10	−0.24	−0.33	−0.40	−0.55	0.60	–

Notes: All correlations above 0.05 are significant at the $p < 0.001$ level. Gender, race, education, and marital/cohabitation status were dichotomized such that −0.5 = male, 0.5 = female; 1 = Caucasian, 2 = other racial group; −0.5 = high school education or lower, 0.5 = some college or higher; −0.5 = not married/cohabitating, 0.5 = married/cohabitating.

Table 3. Hierarchical multiple regression analyses predicting outcomes (Final Step, $N = 3910$).

Self-rated health				Physical disability			
Variable	B	SE	β	Variable	B	SE	β
T1 S-R Health	0.45	0.02	0.42***	T1 Disability	0.57	0.02	0.44***
T1 Gender	−0.01	0.03	−0.00	T1 Gender	0.25	0.03	0.11***
T1 Race	−0.08	0.06	−0.02	T1 Race	−0.11	0.06	−0.02
T1 Education	0.23	0.03	0.11***	T1 Education	−0.19	0.03	−0.08***
T1 Income	0.00	0.00	0.05***	T1 Income	0.00	0.00	−0.05**
T1 Mar/Cohab	0.00	0.03	0.00	T1 Mar/Cohab	−0.03	0.04	−0.01
T1 Waist	−0.02	0.00	−0.10***	T1 Waist	0.03	0.00	0.15***
T1 Age	−0.01	0.00	−0.09***	T1 Age	0.02	0.00	0.20***
T1 Soc Rel	0.12	0.04	0.05**	T1 Soc Rel	−0.11	0.04	−0.04**
T1 Control	0.06	0.02	0.06***	T1 Control	−0.07	0.02	−0.06***
T1 Activity	0.05	0.01	0.06***	T1 Activity	−0.03	0.01	−0.03*
T1 Age × Activity	–	–	–	T1 Age × Activity	−0.00	0.00	−0.03*
T1 Age × Waist	–	–	–	T1 Age × Waist	0.00	0.00	0.06***
Adj. $R^2 = 0.329$				Adj. $R^2 = 0.444$			
$F(11, 3661) = 164.66$, $p < 0.001$				$F(13, 3659) = 226.25$, $p < 0.001$			

Notes: Gender, race, education and marital/cohabitation status were dichotomized such that −0.5 = male, 0.5 = female; 1 = Caucasian, 2 = other racial group; −0.5 = high school education or lower, 0.5 = some college or higher; −0.5 = not married/cohabitating, 0.5 = married/cohabitating.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

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activity ($\Delta R^2 = 0.003, \beta = 0.06, p < 0.001$, Cohen's $f = 0.004$) were significantly related to better Time 2 self-rated physical health, and together explained 3.1% of additional significant variance (Cohen's $f = 0.05$). There were no significant interactions predicting Time 2 self-rated physical health.

Physical disability

Predictor variables explained 44.6% of the variance in Time 2 physical disability in the HMR analysis, $F(13, 3659) = 226.25$, $p < 0.001$. As shown in Table 3, Time 1 physical disability explained 35.9% of the variance in Time 2 physical disability ($\beta = 0.44, p < 0.001$). Gender ($\beta = 0.11, p = 0.01$), race ($\beta = -0.02, p = 0.06$), education ($\beta = -0.08, p < 0.001$), income ($\beta = -0.05, p = 0.001$) and marital/cohabitation status ($\beta = -0.01, p = 0.37$) explained an additional 1.9% of the variance in Time 2 physical disability (Cohen's $f = 0.03$). Consistent with predictions, larger waist circumference ($\Delta R^2 = 0.015, \beta = 0.15, p < 0.001$, Cohen's $f = 0.03$), older age ($\Delta R^2 = 0.034, \beta = 0.20, p < 0.001$, Cohen's $f = 0.06$), poorer social relationships ($\Delta R^2 = 0.001, \beta = -0.04, p = 0.007$, Cohen's $f = 0.002$) and a lower sense of control ($\Delta R^2 = 0.003, \beta = -0.06, p < 0.001$, Cohen's $f = 0.005$) were significantly related to greater Time 2 physical disability, and together explained 6.4% of additional variance (Cohen's $f = 0.12$).

In addition to direct relationships with Time 2 physical disability, the age by physical activity ($\Delta R^2 = 0.00, \beta = -0.03, p = 0.04$, Cohen's $f = 0.00$) and the age by waist circumference ($\Delta R^2 = 0.003, \beta = 0.05, p < 0.001$, Cohen's $f = 0.005$) interaction

terms explained 0.4% of additional variance and were significantly related to Time 2 physical disability[4] (Cohen's $f = 0.01$). As shown in Figure 1, there are main effects for age and physical activity, such that older age and less frequent physical activity are related to higher physical disability over time. However, these effects are qualified by an interaction. Physical activity moderates the relationship of age and physical disability, such that engaging in regular physical activity is protective against age-related increases in physical disability. Similarly, as shown in Figure 2, higher

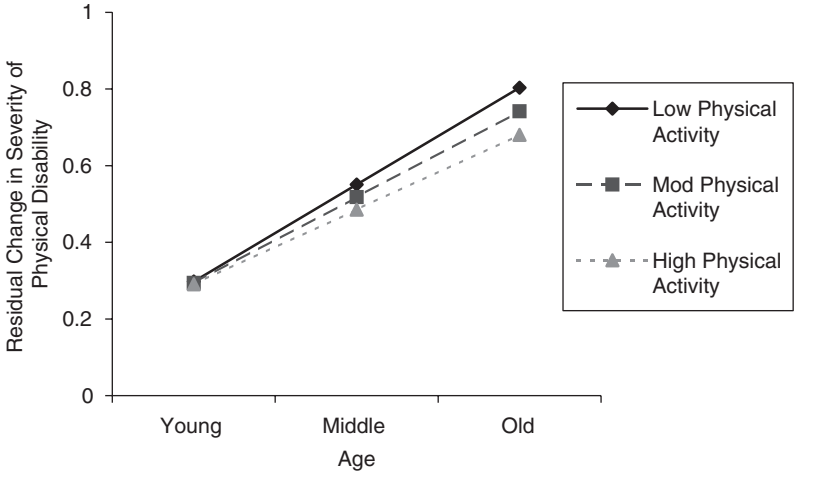

Figure 1. The interaction of age and physical activity on residual change in severity of physical disability, controlling for gender, race, education, income and marital/cohabitation status.

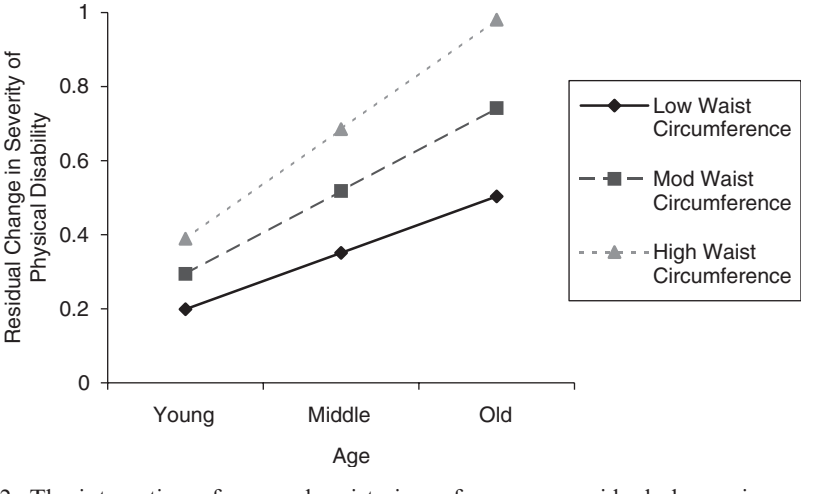

Figure 2. The interaction of age and waist circumference on residual change in severity of physical disability, controlling for gender, race, education, income and marital/cohabitation status.

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waist circumference and older age are related to higher physical disability over time. Waist circumference also moderates the relationship of age and physical disability, such that having a smaller waist (i.e. less body fat) is protective against age-related increases in physical disability. In fact, disability scores for the oldest participants in the present study showed almost a full point of difference in later physical disability (on a 1–4 scale) depending on their waist circumference.

Discussion

On average, health became worse over time, that is, self-rated physical health decreased, and physical disability increased over the 8–10-year interval. This is not surprising given that the sample became, on average, 9 years older over the course of the study. However, consistent with previous research examining health outcomes (CDC, 2008), the present investigation confirmed that there are individual differences in change and there are factors that can moderate these declines. Better social relationships, a higher sense of control, and greater physical fitness were related to better self-rated physical health and less physical disability over time. Furthermore, physical fitness (low-body fat and frequent physical activity) was found to attenuate age-related increases in physical disability over time.

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Social relations

Many previous studies have found that social relations have implications for physical health (e.g. Cohen, 2004). High-quality social relationships, characterised by high support and low strain, can bolster physical health (e.g. Cohen, 2004) while low-quality social relationships, characterised by low support and high strain, can undermine physical health (e.g. Rook, 1984, 1990). Social support is thought to improve health via two avenues: indirectly by enhancing coping abilities (buffering against the negative physiological states caused by stress), and directly by promoting the positive psychological states that cause positive physiological states (Cohen, 2004). Social strain, on the other hand, is thought to undermine physical health by acting as a source of stress, thereby causing negative psychological and physiological states (Cohen, 2004). Thus, it is adaptive for physical health to have high-quality relationships, as we found in the current study, because relationships characterised by high support and low strain may promote positive psychological and physical states while discouraging negative ones.

Control beliefs

The sense of control is another psychosocial factor that is adaptive for maintaining health across the lifespan. Consistent with reports from Lachman and Firth (2004), we found that having a higher sense of control was associated with better self-rated physical health and less physical disability, despite participant age. As Lachman and Firth argue, the sense of control is adaptive at any age because it helps people to achieve goals and manage losses. For example, having a high sense of control over health places the onus on the individual to engage in healthy behaviours, including regular doctor visits, proper diet and regular exercise. Alternatively, having a low sense of control places responsibility outside the individual, thus stripping the

individual of motivation to engage in health behaviours because there is no perceived link between actions taken and improved health.

Having a high sense of control over health behaviours leads to more engagement in those health behaviours (e.g. Bandura, 1997). Thus, engagement in health behaviours is a likely mediator of the relationship between control beliefs and health outcomes (Bandura, 1997). However, this mediation process has been found when behaviour-specific efficacy/control beliefs (i.e. control over exercise behaviour) are examined (Bandura, 1997; McAuley, Jerome, Elavsky, Marquez, & Ramsay, 2003). In the present study, we did not find that physical activity behaviour mediated the influence of the general sense of control on health behaviours, possibly because the general sense of control is too far removed from physical activity behaviour to have an obvious impact. Future studies should examine this mediation process using context-specific control beliefs, examining the impacts of both control over health and control over health behaviours on health behaviours and the influence of health behaviours on health in turn (e.g. Napolitano et al., 2008).

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Physical fitness

In addition to psychosocial factors, behavioural factors play a key role in maintaining physical health throughout adulthood. In the present study, having a smaller waist circumference (and therefore a lower percentage of body fat) and engaging in regular physical activity were related to better health outcomes over time. These results are consistent with reports from the CDC (2008), which state that normal body composition and regular physical activity are associated with less disease and disability. It is important to note that physical activity explained variance in health outcomes over and above that of waist circumference in the present sample. The benefits of physical activity are typically discussed for their positive effects on body composition and, consequently, risk for disease and disability. However, physical activity has unique health benefits, suggesting that it is a worthwhile pursuit even for those who already have a healthy body composition (e.g. Kadogluo et al., 2007; Katzmarzyk & Craig, 2006).

Furthermore, variables explained a higher percentage of variance in physical disability than in self-rated health. This result may be due, in part, to the fact that a certain degree of functional health is required in order to be able to engage in physical activity. Thus, participants needed to have some physical abilities in order to engage in physical activity. This potential confound was at least moderately addressed, however, by controlling for Time 1 physical disability in regression analyses, and the results suggest that people who are more physically active are less likely to decline on measures of physical ability.

In addition to direct effects on health outcomes, physical fitness also buffered against physical limitations in the present study. In other words, while (on average) everyone who participated in the study experienced physical functioning declines, being fit initially helped to reduce these declines over the course of the study, especially for the old who are most vulnerable to the cumulative effects of poor health and poor health behaviours. These results are consistent with reports from the CDC (2008), which state that normal body composition and regular physical activity are associated with reduced risk for disease and disability over time.

Interestingly, the direct relationships of waist circumference and physical activity to the two outcomes in the present study were very similar. Furthermore, self-rated physical health and physical disability were highly correlated with each other at both time points. Although the measures of physical health and physical disability were both self-reported, the present results are consistent with reports that people's self-evaluations of their health are reliable indicators of the actual state of their physical health (Benyamini, Idler, Leventhal, & Leventhal, 2004; Idler & Kasl, 1995; Idler, Leventhal, McLaughlin, & Leventhal, 2004; Levy & Myers, 2005).

However, the interaction results in the present study were different for the two outcomes: no significant interactions were found predicting self-rated health, while two age-by-health behaviour interactions significantly predicted physical disability. Self-rated health is a psychological construct and older adults are particularly skilled at psychological adaptation to stressors (e.g. higher positive affect and lower negative affect than younger adults despite more objective losses and limitations: sometimes called the Paradox of Aging; Mroczek & Kolarz, 1998). Therefore, the fact that the age-by-health behaviour interactions did not significantly predict self-rated health *may* reflect psychological adaptation to increased physical disability. In other words, participants' subjective judgements of their health may have remained high, despite increased physical limitations, due to psychological adaptation.

Consistent with this suggestion, the results for disability show that the influences of physical activity and body fat are most pronounced in later life when declines in physical abilities are most salient. This may also reflect the fact that younger adults already function at high levels, and thus have little room to improve, unlike older adults, who show more variability in their functional abilities. Furthermore, the kinds of physical disabilities that older and younger adults report may be different. For example, younger adults may report physical limitations due to injuries from which they will soon recover. Older adults, on the other hand, may report physical limitations due to chronic illness and accumulation of injuries, from which they are unlikely to recover without taking appropriate measures, like engaging in health behaviours.

The presented results suggest that it is important to communicate the value of behavioural factors for maintaining functional health. In fact, despite public health campaigns in the past decade aimed at promoting exercise (e.g. NIH, 2008), some older adults still fear that engaging in physical activity will cause injury (Lees, Clark, Nigg, & Newman, 2005). Thus, interventions should continue to focus on educating the public about the benefits of health behaviours, not only for the present, but also across the lifespan. Furthermore, interventions should target all age groups: health behaviours yield the best effects when established early, but health behaviours can still have profound effects when adopted later in the life course as well.

Limitations

The use of the MIDUS dataset provides an opportunity to examine many questions of interest with impressive statistical power. However, conducting multiple significance tests increases the chance of finding significant relationships that are actually false, and results with small effect sizes were statistically significant in the

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present investigation (conventions for Cohen's f state that 0.02 is small, 0.15 is medium and 0.35 is large; Cohen, 1988). Thus, results with small effect sizes must be interpreted with caution, as they may not be clinically significant. Furthermore, all variables were measured with a self-report survey method. Therefore, shared method variance may have played a role in the relationships. Also there was some selective dropout in the longitudinal sample, as would be expected, which could have some effects on the generalisability of the findings.

Conclusion

Based on the results from the present study, future intervention work aimed at improving health outcomes across the lifespan should focus on improving social relations, enhancing control beliefs and increasing health behaviours. Maintaining a healthy waist circumference (which is indicative of a healthy body fat percentage) and a regular physical activity regimen are particularly successful methods for relieving age-related declines in health.

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Notes

1. We also examined regression analyses with waist circumference standardised within gender. These analyses yielded the same results (available upon request from the first author), so we reported the results using the raw scores for waist circumference.
2. We also conducted analyses controlling for the big five personality traits of neuroticism, extraversion, openness to experience, conscientiousness and agreeableness. These analyses yielded the same results presented in the current report, and are available upon request from the first author.
3. We examined the unique contributions of social support and social strain (data available upon request from the first author). However, the results demonstrated that social support and social strain had influences of similar strength and opposite direction, as would be expected. Based on these results, we decided to combine social support and social strain (social strain was reverse-coded) in order to conserve parsimony.
4. Because age, physical activity and waist circumference were significantly correlated with education and income, and therefore could bias the age × waist circumference and age × physical activity interaction results, we also examined the three-way interactions of age × education × waist circumference, age × income × waist circumference, age × education × physical activity, and age × income × physical activity, as recommended by Yzerbyt, Muller, and Judd (2003). None of these interactions were significant.

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