APPLIED PSYCHOLOGY: Health and Well-Being

IAAP THE INTERNATIONAL ASSOCIATION OF APPLIED PSYCHOLOGY

APPLIED PSYCHOLOGY: HEALTH AND WELL-BEING, 2019, *11* (2), 262–285
doi:10.1111/aphw.12152

The Association of Psychological Well-Being with Disablement Processes in a National Sample

Aura Ankita Mishra,* Elliot M. Friedman, Sharon L. Christ and Madison Denning

Purdue University, USA

Objective: Objectives were to explore subgroups of individuals with differential disability trajectories and evaluate the protective effects of psychological well-being (i.e. hedonic and eudaimonic) in the presence of multiple disease conditions (or multimorbidity) and sociodemographic disadvantages. **Methods:** Data come from the prospective longitudinal cohort study the Midlife Development in the United States (n = 3,904). Three waves of data spanning a 20-year period were used to identify subgroups with different disability trajectories. Subgroup membership was then modelled as a function of psychological well-being assessed at wave 1 of the study using multinomial logistic regression. **Results:** Three unique groups were identified: a normative group with initially low and slowly increasing levels of disability; a group with high levels of disability that was stable over time; and a group with moderate initial levels of disability that increased over time. Hedonic well-being at wave 1 was associated with membership in the risk groups relative to the normative group. **Conclusion:** Individuals may follow one of three disability pathways mostly as a function of multimorbidity. However, hedonic well-being was associated with having an advantageous disability trajectory regardless of multimorbidity status. Cultivating psychological well-being may improve disability outcomes in aging individuals.

Keywords: disability, longitudinal, person-centered, psychological well-being

INTRODUCTION

Functional disability is a prominent concern among the elderly that becomes more pronounced with age. Approximately 15–20 per cent of adults in the United States suffer from one or more functional disabilities or limitations (Schoeni, Martin, Andreski, & Freedman, 2005). Functional disability or limitation includes the inability to perform both basic *activities of daily living* (ADL; e.g.

* Address for correspondence: Aura Ankita Mishra, Department of Human Development and Family Studies, Purdue University, Hanley Hall, #157, 1202 West State St., West Lafayette, IN 47907-2055, USA. Email: mishra30@purdue.edu

bathing, dressing, carrying groceries) and difficulties in performing *instrumental activities of daily living* (IADL; e.g. managing various life tasks, such as balancing a checkbook) that are necessary for day-to-day functioning and mobility (Millán-Calenti et al., 2010). Approximately 13 per cent of all adults in the United States reported mobility-related disability in 2013 (Courtney-Long et al., 2015) and among adults aged 65 years and older, 34.6 per cent had difficulties with ADLs and another 53.5 per cent had difficulties performing IADLs (Millán-Calenti et al., 2010).

Factors Associated with Functional Limitation

A number of factors are associated with risk for functional limitation (or disability), and the most notable of these risk factors is the presence of chronic illnesses and particularly multiple chronic conditions (*multimorbidity*; Calderón-Larrañaga et al., 2018; Verbrugge, Lepkowski, & Imanaka, 1989). Taylor and Lynch (2011) examined profiles of disability trajectories—subgroups of elderly individuals who had a similar disablement process over time—and evaluated how specific chronic physical health problems (e.g. arthritis, diabetes, etc.) affected membership in those subgroups. Findings revealed that while certain chronic diseases like diabetes, stroke, fractures, and arthritis were associated with disablement over time, other chronic illnesses such as sensory problems were not. Other studies, however, have found that loss of visual acuity is associated with loss of functionality over time (Christ et al., 2014). In a more recent study, Martin, Zimmer, and Lee (2017) found that risk of ADL disability was most strongly associated with pain and disease, specifically obesity, diabetes, stroke, arthritis, but not with sociodemographic factors, such as sex and education. Several studies have found an association between *multimorbidity* and increases in disability over time (Martin et al., 2017; Stenholm et al., 2015; Taylor & Lynch, 2011). For example, a study on comorbid physical health conditions showed that individuals with two or more health problems had a greater likelihood of disability progression (Stenholm et al., 2015). Therefore, *multimorbidity* is expected to be a robust determinant of longitudinal change in functional capacity in the present research.

Despite these well-established associations, few studies have focused on the potential role of *positive psychological functioning* in slowing or forestalling functional decline after accounting for the presence of *multimorbidity*. Even though *psychological well-being* has been associated with lower disability among older adults (Boyle, Buchman, & Bennett, 2010), the extent to which *psychological well-being* may be protective for disability progression in the presence of *multimorbidity* is less clear. As most older adults have more than one chronic health condition (Marengoni, Von Strauss, Rizzuto, Winblad, & Fratiglioni, 2009), examining such protective influences is important in order to identify factors that can counteract disability progression over time among older adults (Huppert, 2009; Ryff & Singer, 1998). Moreover, midlife is increasingly recognised as a critical developmental period for understanding disability risk in later life (Lachman, Teshale, & Agrigoroaei, 2015) and therefore warrants further examination of the protective influence of *psychological well-being* during this life stage.

Psychological Well-Being Types and their Association with Health Outcomes

A growing literature shows that *psychological well-being* is associated with diverse health outcomes (Chida & Steptoe, 2008; Ryff, 2014), including reducing the risk of disability in healthy older adults (Boyle et al., 2010). Consistent with a long-standing literature on positive psychological functioning, we bring into consideration two related but distinct domains of well-being—*hedonic* and *eudaimonic* (Ryan & Deci, 2001)—to this analysis. Both of these domains have broadly been protective for multiple health outcomes such as inflammation, medical comorbidity, mortality, and pain in aging populations (Diener & Chan, 2011; Diener, Pressman, Hunter, & Delgadillo-Chase, 2017; Friedman & Ryff, 2012; Friedman & Kern, 2014; Steptoe, Deaton, & Stone, 2015). *Hedonic well-being* generally consists of positive emotions and is typically measured in terms of positive and negative affect as well as general life satisfaction (Diener, 1984; Disabato, Goodman, Kashdan, Short, & Jarden, 2016; Mroczek & Kolarz, 1998; Ryan & Deci, 2001). In contrast, *eudaimonic well-being* is generally defined as fully realising one's potential or self-actualising (e.g. purpose in life, self-acceptance, positive social relationship; Disabato et al., 2016; Ryan & Deci, 2001; Ryff & Singer, 2008) and has been widely operationalised by the Ryff Psychological Well-Being (PWB) scale (Ryff, 1989; Ryff & Keyes, 1995).

Higher levels of positive affect and life satisfaction are associated broadly with better health outcomes such as longevity, and lower levels are associated with poorer outcomes such as limitation in daily activities, chronic illnesses, and inflammation (Cross & Pressman, 2017; Hassett et al., 2009; Sepah & Bower, 2009; Stellar et al., 2015; Strine, Chapman, Balluz, Moriarty, & Mokdad, 2008). Similarly, higher negative affect is associated with more health problems (Dekker, Tola, Aufdemkampe, & Winckers, 1993; Ellis, Orom, Giovino, & Kiviniemi, 2015; Leonard, 2007). *Eudaimonic well-being* in general and purpose in life, in particular, are associated with better health and lower mortality in adulthood and are factors that likely promote resilience even with declining health (Friedman, Christ, & Mroczek, 2015; Hill & Turiano, 2014; Nygren et al., 2005). Moreover, purpose in life has been associated specifically with reduced disability (Boyle et al., 2010) and better physical performance (Kim, Kawachi, Chen, & Kubzansky, 2017) in longitudinal analyses. These findings suggest that *hedonic* and *eudaimonic well-being* might be associated with slower disability progression.

Utilising data from a 20-year longitudinal national study and using a person-centered analytical approach, the current study examines (1) whether there are multiple groups of aging adults with similar trajectories of change in disability over time (i.e. annual increases over 20 years) and (2) whether baseline levels (i.e. wave 1) of *psychological well-being* are associated with membership of certain disability trajectory subgroups. Examination of these factors will help identify subgroups at greatest risk for increases in functional limitations (or disability) as well as those at reduced risk due to protective factors such as *psychological well-being*, thereby broadly informing future efforts aimed at preserving the quality of life in aging adults. From our evaluation, if we find that both *eudaimonic* and *hedonic well-being* are protective for disability progression, then cognitive behavior therapies targeting *eudaimonic well-being* (Friedman et al., 2017) and *hedonic well-being* (Friedman et al., 2017; Jayasekara et al., 2015) that have shown effectiveness in improving *psychological well-being* could be implemented to forestall functional declines over time.

Distinction between the Two Domains of Well-Being

Whereas these two domains of well-being typically show an empirical overlap or a high correlation (i.e. individuals who rate themselves high on *hedonic well-being* also rate themselves high on *eudaimonic well-being*; Joshanloo, 2016), there are reasons to examine their independent contributions to disability trajectories (Joshanloo, 2016). Accumulating data suggest that they have differential associations with some markers of health, such as stress-related patterns of gene expression (Fredrickson et al., 2013; Ryff, 2014). This study tests the hypothesis that both domains of well-being will protect against high levels and progression of functional disability, even in the presence of *multimorbidity*. Based on extant research, *hedonic well-being* may be more protective for disability over time compared to *eudaimonic well-being* (Fredrickson et al., 2013; Ryff, 2014). This, however, is a tenuous hypothesis with very little evidence to draw from for disability progression.

Present Study

To address the gaps in current knowledge, the present research has the following two aims: first, we estimate the individual-level trajectory of disability (by assessing annual average change over the 20-year study period) and then identify subgroups (classes) where individuals with similar disability trajectories are grouped together. The benefit of such a subgroup or class approach is that it describes the most common disability progression trajectories experienced by subgroups of individuals; this approach has been used in previous studies (see Verbrugge, Latham, & Clarke, 2017, for full description). Second, we extend previous research by examining the protective association of *psychological well-*

being, even in the presence of *multimorbidity* and sociodemographic disadvantages, on subgroup disablement trajectories. Following the disablement process model (Verbrugge & Jette, 1994), we examine the role of well-being as a protective factor for disability risk even in the presence of multiple disease conditions and sociodemographic factors. To address these aims, we use data from the longitudinal Survey of Midlife Development in the United States (MIDUS), a sample that includes mid-aged adults.

METHODS

Data

Data come from three waves of the MIDUS study, a longitudinal panel study of adults between the ages of 24 and 75 living in the US. The baseline assessment was conducted in 1995–96 and each subsequent wave was conducted approximately 10 years apart (wave 2: 2004–06 and wave 3: 2013–14). At baseline, a national probability sample of individuals was selected via random digit dialing (n = 3,487), and a sample of their siblings (n = 950) was also included. MIDUS also includes a nationally representative sample of twins (n = 998) and a metropolitan over-sample from five areas (n = 757). Mortality-adjusted retention was 75 per cent between MIDUS 1 and MIDUS 2 and 77 per cent between MIDUS 2 and MIDUS 3. The primary purpose of the MIDUS was to understand correlates of physical and mental health among middle and older adults in the United States (Brim, Ryff, & Kessler, 2004). MIDUS participants completed telephone interviews and self-administered questionnaires at all three waves of data collection. A subsample of participants (n = 3,904) with at least the first two waves of disability data were included in the present study.

Measures

Disability (Waves 1–3). In this study, measures of functional limitations are from a modified version of the SF-36 (Brazier et al., 1992). Although the International Classification of Functioning or ICF provides a framework for understanding disability, the SF-36 (Brazier et al., 1992) is a comprehensive tool used to assess physical disability (Syddall, Martin, Harwood, Cooper, & Sayer, 2009). The SF-36 (Brazier et al., 1992) assesses nine activities: for example, “bathing or dressing”, “walking a block”, etc. Individuals were asked to list how much their physical health prohibited them from performing the aforementioned activities on a scale of 1–4 (1: “A lot” and 4: “Not at all”). In order to ensure that the composite variable reflected functional limitations, ADL scores were dichotomised so that “Some” or “A lot” were coded as 1 while “A little” and “Not at all” responses were coded as 0. The responses on all nine items were then summed to create the composite score that ranged from 0 to 9 ($\alpha > 0.85$ in this sample). Adequate reliability and validity are also demonstrated by previous research for the SF-36 measure (Brazier et al., 1992; reliability > 0.85, construct validity = 0.52).

Psychological Well-Being (Wave 1). *Hedonic well-being* was assessed using three domains: positive affect, negative affect, and life satisfaction (Carr, Friedman, & Jaffe, 2007; Mroczek & Kolarz, 1998). Participants were asked how often in the past 30 days they felt, for example, "cheerful" or "full of life" to assess positive affect and "nervous" or "worthless" to asses negative affect. Items were scored from 1 ("all the time") to 5 ("none of the time"). Mean scores for positive and negative affect were computed. Life satisfaction was measured using an aggregate score of individual assessments of satisfaction with overall life, work, health, and relationship scored from 0 ("worst possible") to 10 ("best possible"). The *hedonic well-being* scale score is a valid and reliable measure and has been used in multiple studies (Carr et al., 2007; Mroczek & Kolarz, 1998). The internal consistencies for the three scales in this sample were: positive affect $\alpha = 0.91$, negative affect $\alpha = 0.87$, and life satisfaction $\alpha = 0.67$.

A latent measurement model or confirmatory factor analysis (CFA) was used to measure *hedonic well-being* at baseline (wave 1) using the three scales: positive affect, negative affect (reverse coded so all three subdomains would load in the same direction) and life satisfaction. Latent variables improve the precision of estimates by extracting random measurement (Bollen & Stine, 1993). From a theoretical perspective, *hedonic well-being* is typically assessed by either affect (positive and negative), or life satisfaction or a combination of these factors (Diener, 1984; Diener & Chan, 2011; Mroczek & Kolarz, 1998; Ryan & Deci, 2001). A latent variable for *hedonic well-being* helps capture the interrelatedness of these three domains and tests the effect of this construct on group/class membership. Moreover, due to the extraction of measurement error (Bollen & Curran, 2006), this latent variable has a reliability of 1.0.

Eudaimonic well-being was assessed using the PWB scales developed by Ryff (1989, 1995). We took the average score of six subdomains: autonomy, environmental mastery, positive relations with others, purpose in life, self-acceptance, and personal growth from a shortened version of the Ryff PWB scales (Ryff, 1989, 1995). Each of these subdomains consisted of three items. Examples of items include: "I tend to be influenced by people with strong opinions", "In general, I feel I am in charge of the situation in which I live", "I sometimes feel as if I've done all there is to do in life". Items were scored from 1 ("Strongly agree") to 7 ("Strongly disagree") and some items were reverse coded so that higher scores were representative of higher levels of well-being. Based on previous research, the measure has adequate reliability and validity (Abbott et al., 2006; Ottenbacher, Kuo, & Ostir, 2007; reliability > 0.66, construct validity > 0.80). The internal consistencies of the subdomains in this sample, however, were low and ranged from α = 0.39 to 0.59 in this sample (positive relations with others: α = 0.58, self-acceptance: α = 0.59, autonomy: α = 0.48, personal growth: α = 0.55, environmental mastery: α = 0.52, and purpose in life: α = 0.36). Therefore, items from the six subdomains were averaged to create an overall composite *eudaimonic well-being* score (α = 0.82 in this sample).

Multimorbidity (Wave 1). A chronic health problems composite was computed using 13 chronic health problems/conditions that are most commonly occurring and have been associated with disability and mortality in older adults (Charlson, Pompei, Ales, & MacKenzie, 1987). The 13 conditions include: asthma, bronchitis, or emphysema; arthritis or other joint conditions; HIV or AIDS; high blood pressure; diabetes; tuberculosis; neurological disorders; stroke; ulcer; cancer; obesity; high cholesterol; and heart disease. Respondents were asked if they had experienced the first nine conditions in the last 12 months (coded: “yes” = 1 and “no” = 0). Respondents were also asked “whether [they] ever had cancer in their lifetime” and “whether a doctor had suspected or diagnosed [them] with heart trouble” (coded: “yes” = 1 and “no” = 0). Obesity was assessed by body mass index (BMI) which was computed using self-measured height and weight data. BMI data were then dichotomised with greater than or equal to 30 coded as 1 (“obese”). High cholesterol was assessed by whether the respondent was currently using medication for high cholesterol (coded 1). A composite score was created by summing all the responses on the 13 health conditions and ranged from 0 to 13. A *multimorbidity* variable was created from this cumulative chronic health problem composite variable where individuals with two or more chronic health problems were coded as 1 and those with fewer than two chronic health problems were coded as 0.

Covariates (Wave 1). Variables for age, sex (1 = “male”, 0 = “female”), race (1 = “white”, 0 = “other”), and educational attainment (1 = “some college or higher”, 0 = “high school or lower”) all of which have been linked to both *multimorbidity* and disability (Marengoni et al., 2009; Schoeni et al., 2005) were included to control for potential confounding.

Data Analysis

First, we fit individual-level trajectories of disability anchored on the respondent’s age (centered at the average age of the sample, i.e. age 46) while taking into account the individual differences in time elapsed between data waves. Even though the maximum number of observations for each participant was three waves, the unit of measurement for time was annual increase in age (i.e. model constraints were used to scale unit of time to age in years) in order to understand the development of disability trajectories per year from ages 46 to 95. For individuals with data for only waves 1 and 2 (n = 919), their annual age-related changes in disability were evaluated for a 10-year period. For all other individuals (n = 2,940), annual age-related changes in disability were evaluated for 20 years. Even though the most number of time points observed are three time points for each individual, we used direct maximum likelihood, a.k.a., full information maximum likelihood (*FIML*; Arbuckle, 1996) to include individuals with fewer than three repeated observations.

Next, latent profile membership was estimated for these disability trajectories (i.e. centered at age 46 and then annual change for the 20-year study period was assessed). Four statistical fit indicators: *AIC*, *BIC*, *adjusted-BIC*, and *entropy*, and two substantive indicators—the amount of new information gained by the addition of a new class and the size of the new class—were used to determine the optimal class solution. Models with a class membership of less than 5 per cent of the participants were not included in final analysis. Once an optimal solution was determined (based on posterior probability), substantive class labels were applied and descriptive statistics for each class were analyzed. Following this, the posterior probabilities from the latent class analysis were used (entropy or average membership probability p = .97) to categorise individuals into their most probable trajectory subgroups.

Next, a multinomial logistic regression model was run to assess the association of *eudaimonic well-being*, *hedonic well-being*, *multimorbidity*, and the above-mentioned covariates (all independent variables were assessed at wave 1) with the trajectory subgroups as outcomes. The largest, normative class was used as the reference group. Monte Carlo integration methods were used for model estimation and all model analyses were conducted using Mplus 7.4 statistical software (Muthén & Muthén, 2005). We also corrected for within-family nesting (i.e. twins and siblings) using the cluster option in Mplus (Muthén & Muthén, 2005).

RESULTS

Sample descriptive statistics are presented in Table 1.

Latent trajectory mixture analysis yielded a three-class solution. The fit indices for the different class solutions are summarised in Table 2. The three-class solution had a lower *AIC*, *BIC*, *adj-BIC*, and a comparable *entropy* relative to the two-class solution; therefore, the addition of a third class added relevant information. Whereas the four-class solution had better statistical fit indices compared to the three-class solution, the smallest class membership was 4 per cent, making for a potentially unstable class. Additionally, the four-class solution did not replicate when the number of random starts was increased for the model, thereby suggesting that the solution was a local maxima and not a global solution. Therefore, the three-class solution was considered optimal.

The following descriptive class labels were assigned—Class 1: medium disability at baseline with increases over time (medium increasing disability class;

TABLE 1
Descriptive Statistics for Independent Variables for Each Class and the Entire Sample

Independent variables	*Entire sample*			*Medium disability class: Medium disability at baseline with moderate increases over time (10%; n = 390)*			*High stable class: High stable disability over time (6%; n = 247)*			*Normative class: Normative class or low disability at baseline increasing slightly over time (84%; n = 3,267)*		
	N	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
Hedonic Well-being Wave 1	3900	3.41	0.71	389	3.12	0.81	247	3.19	0.80	3264	3.46	0.68
Eudaimonic Well-being Wave 1	3896	16.73	2.32	390	15.87	2.49	246	15.75	2.45	3260	16.91	2.24
Age Wave 1	3904	47.34	12.43	390	49.96	12.14	247	51.47	12.37	3267	46.72	12.37
Proportions												
Multimorbidity Wave 1	3904	0.26	0.44	390	0.53	0.50	247	0.64	0.48	3267	0.20	0.40
Gender Wave 1: Males	3904	0.56	0.50	390	0.69	0.46	247	0.72	0.45	3267	0.53	0.50
Race Wave 1: White	3855	0.94	0.24	383	0.92	0.28	239	0.88	0.33	3233	0.94	0.23
Education Wave 1: Some College or Higher	3904	0.65	0.48	390	0.51	0.50	247	0.49	0.50	3267	0.68	0.47

TABLE 2
Fit Indices for Latent Profile Analysis of Disability Trajectories

	AIC	*BIC*	*Adj-BIC*	*Entropy*	*Largest class (%)*	*Smallest class (%)*
Two-class solution	42135.31	42204.28	42169.32	0.97	90	10
Three-class solution	41146.77	41234.55	41190.06	0.96	84	6
Four-class solution	40429.05	40535.64	40481.62	0.96	80	4

Note: *Adj-BIC* = adjusted *BIC*.

10%; n = 390), Class 2: high stable disability over time (high stable disability class; 6%; n = 247), and Class 3: normative class or low disability at baseline increasing slightly (over time; normative class; 84%; n = 3,267). Figure 1 displays the disability trajectory for each class plotted from ages 46 to 90. The average baseline disability at age 46 for the medium increasing disability class was 3.40 (SE = 0.17, p < .001) and average annual change in disability for the medium increasing disability class was 0.05 per year (SE = 0.01, p < .001). Average baseline disability at age 46 for the high stable disability class was 6.89 (SE = 0.19, p < .001) and average annual change in disability for the high stable disability class was 0.01 per year (SE = 0.01, p = .582). Similarly, baseline (age 46) disability for the normative class was 0.42 (SE = 0.02, p < .001) and average annual change in disability for the normative class was 0.03 (SE = 0.00, p < .001). The average annual change during the study (trajectory)

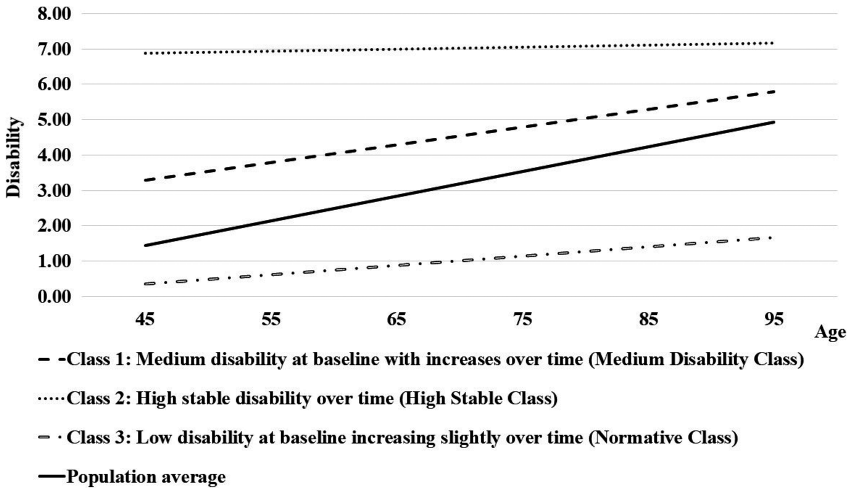

FIGURE 1. Disability trajectory classes and population.

for the medium increasing disability class was different from the average annual change for the high stable disability class (z = 0.04, p = .011). The average annual change during the study for the medium increasing disability class was also different from the average annual change for the normative class (z = 0.02, p < .001). The slopes (i.e. change assessed each year during the study period) of the high stable disability class and the normative class (z = 0.02, p = .063) were not different from one another and were similar in pattern. However, all three classes significantly differed on their baseline (i.e. at age 46) levels of disability (high stable disability class vs. medium increasing disability class: z = −2.97, p < .001; high stable disability class vs. normative class: z = −6.50, p < .001; medium increasing disability class vs. normative class: z = −3.50, p < .001).

Table 1 also includes descriptive statistics for these three classes. Table 3 provides the subgroup mean difference test results for the independent variables. Results indicated that the high stable disability group (Class 1) and the medium increasing disability group (Class 2) differed in their mean levels from the normative group (Class 3) on all key independent variables assessed at wave 1. The high stable disability group (Class 1) and the medium increasing disability group (Class 2) differed from one another only in their mean levels of *multimorbidity* at wave 1.

The latent *hedonic well-being* measurement variable at wave 1 with gender (wave 1) covariate was used to obtain model fit where gender was included in order to have an over-identified model (*CFI*: 0.99, *TLI*: 0.96, *RMSEA*: 0.08, χ^2 = 4.58, df = 2, p = .08). The model fit met prescribed standards for a well-fitting model (Bollen & Stine, 1993). The significant χ^2 value is likely due to the large sample size used in this study whereby small differences in implied and observed covariance matrices are detectable (Bollen & Stine, 1993).

The results from the multinomial regression are summarised in Table 4. In the multinomial logistic regression model, the subgroups that emerge from the above latent profile analysis were the dependent variable and *eudaimonic well-being*, *hedonic well-being*, *multimorbidity*, and covariates were independent variables (all assessed at wave 1). A unit increase in *hedonic well-being* at wave 1 was associated with a 62 per cent (*OR* = 0.38) lower likelihood of being in the medium increasing disability class compared to the normative class. Also, a unit increase in *hedonic well-being* at wave 1 was associated with 67 per cent (*OR* = 0.33) lower likelihood of being in the high stable disability class compared to the normative class. Moreover, whites (covariate assessed at wave 1) were less likely to be in the high stable disability class (by 51%; *OR* = 0.49). Those who had completed at least some college (covariate assessed at wave 1) were 42 per cent less likely to be in the medium increasing disability class and 44 per cent less likely to be in the high stable disability class vis-à-vis the normative class. Having *multimorbidity* at wave 1 and being female (wave 1 covariate) were associated with higher likelihood of being in the medium increasing

TABLE 3
Comparison of Independent Variable Means by Groups

Variables	*Medium increasing disability class vs. High stable disability class*				*Medium increasing disability class vs. Normative class*				*High stable disability class vs. Normative class*			
	Mean difference	*t*	*df*	*p*	*Mean difference*	*t*	*df*	*p*	*Mean difference*	*t*	*df*	*p*
Hedonic Well-being Wave 1	−0.07	−1.59	632	.284	0.4	10.77	3501	<.001	0.3	9.77	3645	<.001
Eudaimonic Well-being Wave 1	0.12	0.58	634	.551	−1.16	−7.77	3504	<.001	−1.04	−8.57	3648	<.001
Multimorbidity Wave 1	−0.12	−2.89	635	.006	0.44	16.42	3512	<.001	0.33	14.74	3655	<.001
Age Wave 1	−1.5	−1.51	635	.129	4.75	5.81	3512	< .001	3.24	4.9	3655	<.001
Gender Wave 1: Female	−0.24	−0.65	635	.416	0.19	5.8	3512	<.001	0.17	6.24	3655	<.001
Race Wave 1: White	0.04	1.54	620	.102	−0.06	−4.04	3470	<.001	−0.03	−2.11	3614	<.001
Education Wave 1: Some College or Higher	0.02	0.56	635	.623	−0.19	−6.18	3512	<.001	−0.17	−6.68	3655	<.001

Note: The actual mean values used to calculate the mean differences are presented in Table 1.

TABLE 4
Results from Multinomial Logistic Regression Comparing Disability Groups

	Medium increasing disability class vs. Normative class					*High stable class vs. Normative class*				
Predictors	*b*	*p*	*SE (b)*	*OR*	*95% CI (LL, UL)*	*b*	*p*	*SE (b)*	*OR*	*5% CI (LL, UL)*
Hedonic Well-being Wave 1	−0.96	< .001	0.17	0.38	(0.27, 0.54)	−1.1	<.001	0.22	0.33	(0.22, 0.50)
Multimorbidity Wave 1	1.36	< .001	0.12	3.88	(3.09, 4.87)	1.83	<.001	0.15	6.2	(4.65, 8.27)
Eudaimonic Well-being Wave 1	0.01	.794	0.04	1.01	(0.93, 1.09)	0.03	.549	0.05	1.03	(0.94, 1.13)
Gender Wave 1: Female	0.62	< .001	0.12	1.86	(1.47, 2.36)	0.71	<.001	0.16	2.03	(1.49, 2.76)
Race Wave 1: White	−0.31	.149	0.22	0.73	(0.48, 1.12)	-0.7	.003	0.25	0.49	(0.30, 0.78)
Educational Attainment Wave 1: Some College or Higher	−0.54	< .001	0.12	0.58	(0.47, 0.74)	−0.6	<.001	0.15	0.56	(0.42, 0.74)
Model Fit										
AIC	59430.38									
BIC	59731.33									
Adj-BIC	59578.81									

Note: *Adj-BIC* = adjusted *BIC*; *OR* = odds ratio; CI = confidence interval; *UL* = upper limit; *LL* = lower limit.

disability class and the high stable disability class. Specifically, *multimorbidity* at wave 1 was associated with 3.88 times higher likelihood of being in the medium increasing disability class and 6.20 times higher likelihood of being in the high stable disability class. Females (wave 1 covariate) were also 1.86 times as likely to be in the medium increasing disability class and 2.03 times as likely of being in the high stable disability class. Taken together, these results support the results of the *t*-tests in Table 2 wherein the high stable class and the medium increasing class differ from the normative group on all key independent variables.

Post-hoc Analysis Results. Three post-hoc models were evaluated. First, since the largest group consisted of 84 per cent of the sample (n = 3,267), we conducted a post-hoc trajectory model to evaluate inter-individual variance in annual disability progression in this group. As mentioned previously, the average annual increase in disability for this group was 0.03 (SE = 0.00, $p < .001$). Specifically, even in this group, higher levels of *hedonic well-being* at wave 1 were associated with slower annual disability progression over the 20-year study period ($b = -0.01$, SE = 0.00, $p < .001$).

Second, to test if there were differences in the key predictors between the two vulnerable groups, we conducted another post-hoc multinomial regression wherein we compared the medium disability class to the high stable class. We found that with the exception of *multimorbidity* the independent variables did not differentiate between these two risk groups. Having multiple morbidities at wave 1 was associated with 37 per cent lower likelihood (OR = 0.63, $b = -0.47$, $SE\ (b)$ = 0.17, $p < .001$) of being in the medium disability group compared to the high stable disability group. This finding corroborates results presented in Table 2 wherein the medium increasing disability class and the high stable disability class only differed from one another in their levels of *multimorbidity* at wave 1.

Finally, since *eudaimonic well-being* at wave 1 was not a significant predictor of disability subgroups, we conducted post-hoc analysis to test whether subdomains of *eudaimonic well-being* (wave 1) were associated with subgroup membership. Our results indicated that higher autonomy at wave 1 was the only subdomain that was linked to a higher likelihood of being in the medium disability class or the high stable class (1.05 times more likely for both; OR = 1.05, $b = -0.05$, $SE\ (b)$ = 0.02, $p < .001$). To illustrate, greater autonomy at wave 1 was associated with less favorable trajectories of change in disability or more average annual increases in disability.

DISCUSSION

This study pursued two aims: the first was to estimate the individual-level trajectory of disability and then identify subgroups (classes) where individuals with similar disability trajectories (i.e. annual change in disability over the 20-year study period) were grouped together. The second was to evaluate the protective association of *psychological well-being* at wave 1 in the presence of *multimorbidity*, and sociodemographic disadvantages (both assessed at wave 1) on these disability trajectory subgroups.

Results for the first aim suggest that, on average, MIDUS respondents reported one functional limitation at age 46 and increased by about one limitation over the course of the next 20 years. Latent trajectory mixture analyses revealed that within this general trend there were three subgroups with distinct profiles of change in disability. The normative class represented the majority of MIDUS participants. These individuals had low levels (i.e. disability at age 46) of and slow annual increases in disability during the study period. On average, individuals in the normative class reported less than one functional limitation at wave 1 and less than two functional limitations 20 years later, indicating only a modest increase in disability over time. In contrast, compared to the normative class, individuals in the medium disability class reported almost three functional limitations at age 46 with gradual annual increases in disability over the course of the study or five functional limitations 20 years later. Finally, individuals in the high stable class had substantially higher levels of disability—an average of seven limitations at age 46 and this number remained stable over the study period: six limitations 20 years later.

Of the three classes, the normative class showed the most advantageous profiles of disability over time, both in terms of absolute levels of disability at age 46 (significantly lower than the other two classes), and in the relatively lower rates of annual increase in disability over time (vs. the medium disability class, which showed significantly higher increases in impairment by the end of the study). These results are consistent with a recent study showing that most middle-aged and older adults in the Health and Retirement Study avoid or delay disability, with a small number showing high, persistent levels of disability (Verbrugge et al., 2017). This heterogeneity in disability trajectories is consistent with the disablement process model (Verbrugge & Jette, 1994), which allows for potential acceleration or mitigation of the onset and progression of disability by diverse external and internal factors, and with the ICF (World Health Organization, 2001). We found that individual-level factors assessed at wave 1 such as demographics, *multimorbidity* and well-being were associated with disability change over the 20-year study period. Of specific interest to the present paper was the protective influence of well-being at wave 1 on differential disability progression.

Results for aim two demonstrate that wave 1 *hedonic* but not *eudaimonic well-being* was associated with differences in disability trajectories (change assessed annually) net of wave 1 demographic characteristics and *multimorbidity*. Specifically, individuals in the normative class with the most advantageous profile of disability progression also had higher *hedonic well-being* at wave 1 compared to the two vulnerable classes. In addition, within this advantageous normative class, individuals with higher *hedonic well-being* at wave 1 had lower progression of disability over time. Therefore, our results suggest that wave 1 *hedonic well-being* may be protective not only for disability progression as is the case with the medium increasing disability class but also for disability onset and continuously high levels of disability over time like the high stable disability class.

These results are consistent with previous studies broadly linking positive affect to better health outcomes, including mortality (Steptoe et al., 2015), and they suggest that higher baseline levels (i.e. wave 1) of positive emotions and general life satisfaction may buffer against the levels of and increases in disability associated with various forms of risk, including advancing age, chronic illness, and socioeconomic adversity. There are several potential routes by which higher levels of *hedonic well-being* might lead to reduced disability risk. Higher levels of well-being have been associated with more physical activity, for example (Netz, Wu, Becker, & Tenenbaum, 2005; Rector, Christ, & Friedman, 2018), and greater physical activity is linked to reduced disability risk (Gine-Garriga, Roque-Figuls, Coll-Planas, Sitja-Rabert, & Salva, 2014). These behavioral outcomes such as physical activity could be potential mechanisms promoting higher or lower disability risk. In addition, biological processes, such as inflammation, are associated with increased risk of disability (Brinkley et al., 2009; Friedman et al., 2015; Lima-Costa et al., 2017), and higher levels of *hedonic well-being* have been linked to lower levels of inflammation in aging adults (Steptoe, O'Donnell, Badrick, Kumari, & Marmot, 2007). These behavioral and biological mechanisms, therefore, warrant further examination. These mechanisms could also be potential targets for prevention and clinical work aimed at reducing high chronic levels or greater progression of disability over time by increasing levels of *hedonic well-being*.

The lack of association between *eudaimonic well-being* and membership in the different classes was unexpected, and there may be both methodological and/or theoretical explanations. We were unable to model *eudaimonic well-being* using a latent variable. We had tried to test all domains of *eudaimonic well-being* as a single latent construct; only five of the six domains of *eudaimonic well-being* significantly loaded onto a single latent variable. Due to a lack of theoretical reason for excluding environmental mastery from the *eudaimonic well-being* latent construct—indeed prior analyses have supported the use of all domains (Abbott et al., 2006; Clarke, Marshall, Ryff, & Wheaton, 2001)—we used an aggregate measure of all six domains of *eudaimonic well-being* instead. Even though the reliability of the aggregate measure of *eudaimonic well-being* was fairly high, each domain of the PWB scales is theoretically distinct (Ryff, 1989, 1995), and their empirical associations with diverse health outcomes do not always overlap (Ryff, 2014). Previous studies have demonstrated, for example, that purpose in life specifically is robustly linked to a range of positive health outcomes in older adults (Ryff, 2014). Moreover, purpose in life has been associated specifically with reduced disability (Boyle et al., 2010) and better physical performance (Kim et al., 2017) in longitudinal analyses. Possible discrete associations between longitudinal disability class membership and subdomains of PWB in this study may thus have been masked by using the overall PWB score. Nevertheless, our post-hoc models for subdomain effects were too small to demonstrate meaningful differences, likely due to the low internal consistency of each of the subdomains of the PWB scale.

Importantly, the null findings for *eudaimonic well-being* also underscore the theoretical and empirical distinctions between *eudaimonic* and *hedonic* aspects of well-being. Even though both of these aspects of well-being are likely correlated, and individuals who report high levels on one may report high levels on the other, scholars have argued that these two domains of well-being are in fact distinct (Joshanloo, 2016). For example, striving for engagement to create a meaningful life might not be strongly related to feelings of happiness and satisfaction (Ryan & Deci, 2001).

In addition, in the present study, we evaluated only levels of *eudaimonic well-being* at wave 1, and all three groups had similar mean levels of *eudaimonic well-being* at the beginning of the study. Change in *eudaimonic well-being* over time might affect disability trajectories and differential trajectories between groups. Whereas some research demonstrates that *eudaimonic well-being* domains show steep declines with age (Ryff, 1989; Ryff & Keyes, 1995; Springer, Pudrovska, & Hauser, 2011), other studies show that *eudaimonic well-being* stems from finding meaning and fulfillment in life, a process that can include adaptation to age-related challenges like disability (Ryff, 2014). The latter perspective is bolstered by prior research showing that *eudaimonic well-being* is preserved even in the context of *multimorbidity* (Friedman & Ryff, 2012). It is therefore likely that declining *eudaimonic well-being* over time could result in greater likelihood of increasing disability and vice versa. Such dynamic associations merit closer examination in future efforts. Specifically, intervention studies could improve the causal validity of the dynamic associations between well-being and disability by determining whether promoting well-being prevents disability progression over time. Nonetheless, this study demonstrates the protective effects of *hedonic well-being* against disability risk levels and progression over time, an observation that has implications for prevention of disability among individuals at risk due to greater numbers of chronic medical conditions.

Limitations

A number of limitations inform the interpretation of these findings. First, data for all measures were all based on self-reports and therefore may suffer from single reporter bias. However, self-reports on health outcomes tend to be comparable to clinical reports (Kriegsman, Penninx, Van Eijk, Boeke, & Deeg, 1996). Extant research also demonstrates that *psychological well-being* measures are strong indicators of self-reported health outcomes (Diener & Chan, 2011; Friedman & Ryff, 2012; Friedman & Kern, 2014; Steptoe et al., 2015). It is also likely that the relationship between disability and well-being is reciprocal, with disability leading to impairments of well-being (Lucas, 2007). This likelihood does not undercut the significance of the present results since such reciprocal associations can only exist for baseline levels of disability and *hedonic well-being*. The relation between baseline *hedonic well-being* and change over time in disability is free from such reciprocal association because, in these analyses, wave 1 well-being was associated with subsequent changes in disability (i.e. annual changes over the 20 years of the study). This research was, however, only able to test the association between *hedonic well-being* and disability progression over time. Future intervention research will be needed to test the causal association between *hedonic well-being* and disability change over time. Another limitation of this study is that we evaluated *multimorbidity* by combining several chronic conditions that are most frequently associated with disability (Charlson et al., 1987). Though beyond the scope of the present study, it is likely that specific conditions or combinations of conditions might influence disability progression over time, and such an evaluation needs to be examined further. A final limitation of the study is that the analytical sample was limited to adults who were able to participate—the most functionally or cognitively impaired were less likely to have been represented—thereby constricting the range of data on key variables as well as reducing the generalisability of the findings.

Conclusions and Implications

In spite of these limitations, the present study has several merits. Consistent with the disablement process model (Verbrugge & Jette, 1994) and ICF (World Health Organization, 2001), we identified robust heterogeneity in longitudinal progression of functional limitations in a national sample that included midlife as well as older adults, the norm being relatively low disability and slow decreases in functional capacity over time. We also found that *hedonic well-being* was associated with reduced disability risk even in the presence of *multimorbidity* and sociodemographic risk factors. The large representative sample used in this study further adds to its merit. Importantly, *hedonic well-being* can be promoted in mid-life to potentially forestall functional declines in the aging population. Specifically, intervention studies could be designed to target *hedonic well-being* among older adults. Such intervention studies could demonstrate the causal role of *hedonic well-being* in promoting more advantageous disability trajectories over time. Some such interventions have been previously developed (Friedman et al., 2017; Ho, Yeung, & Kwok, 2014) and may prove to be beneficial clinical and preventative tools for preventing disability progression (Friedman et al., 2017; Jayasekara et al., 2015). Since both the medium increasing disability class and the high stable disability class show lower mean levels of *hedonic well-being* compared to the normative class, interventions increasing *hedonic well-being* can benefit both these vulnerable classes and ultimately lead to better health in the aging population.

Even with improved medical services and quality of life, disability still remains an important problem facing the rapidly growing aging population and there is significant inter-individual variation in the development of disability (Martin et al., 2017; Millán-Calenti et al., 2010; Schoeni, Freedman, & Martin, 2008; Taylor & Lynch, 2011). Understanding factors that explain these differences is important in identifying prevention strategies and policies that ameliorate the conditions for those subgroups that are most vulnerable to chronic disability and rapid disability increases in adulthood.

ACKNOWLEDGEMENTS

This research was supported by grant R01-AG041750 to EMF from the National Institute on Aging. The MIDUS I study Midlife in the US was supported by the John D. and Catherine T. MacArthur Foundation Research Network on Successful Midlife Development. The MIDUS II research was supported by a grant from the National Institute on Aging (P01-AG020166) to conduct a longitudinal follow-up of the MIDUS I investigation. The MIDUS 3 study was also supported by a grant from the NIA (P01-AG020166).

REFERENCES

Abbott, R.A., Ploubidis, G.B., Huppert, F.A., Kuh, D., Wadsworth, M.E., & Croudace, T.J. (2006). Psychometric evaluation and predictive validity of Ryff's psychological well-being items in a UK birth cohort sample of women. *Health and Quality of Life Outcomes*, *4*, 1–16. https://doi.org/10.1186/1477-7525-4-76

Arbuckle, J.L. (1996). Full information estimation in the presence of incomplete data. In G.A. Marcoulides & R.E. Schumacker (Eds.), *Advanced structural equation modeling: Issues and techniques* (pp. 243–277). New York and London: Psychology Press, 2013.

Bollen, K.A., & Curran, P.J. (2006). *Latent curve models: A structural equation perspective.* (Vol. 467). Hoboken, NJ: John Wiley & Sons. doi:10.1353/sof.0.0084

Bollen, K.A., & Stine, R.A. (1993). Bootstrapping goodness-of-fit measures in structural equation models. *Sociological Methods & Research*, *21*, 205–229. https://doi.org/10.1177/0049124192021002004

Boyle, P.A., Buchman, A.S., & Bennett, D.A. (2010). Purpose in life is associated with a reduced risk of incident disability among community-dwelling older persons. *American Journal of Geriatric Psychiatry*, *18*, 1093–1102. https://doi.org/10.1097/jgp.0b013e3181d6c259

Brazier, J.E., Harper, R., Jones, N.M., O'Cathain, A., Thomas, K.J., Usherwood, T., & Westlake, L. (1992). Validating the SF-36 health survey questionnaire: New outcome measure for primary care. *British Medical Journal*, *305*, 160–164.

Retrieved from: https://www.bmj.com/content/bmj/305/6846/160.full.pdf?casa_token=FG1AuDdDk5MAAAAA:Oq6exavpEkTzvGSkaG8JsJTAStLaneJ_Ttzxk1u1_QiattFAb01ebT9EYd89yT8SyXd8maBZFKSA

Brim, O.G., Ryff, C.D., & Kessler, R.C. (2004). *How healthy are we? A national study of well-being at midlife*. Chicago, IL: University of Chicago Press.

Brinkley, T.E., Leng, X., Miller, M.E., Kitzman, D.W., Pahor, M., Berry, M.J., . . ., Nicklas, B.J. (2009). Chronic inflammation is associated with low physical function in older adults across multiple comorbidities. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, *64*, 455–461. https://doi.org/10.1093/gerona/gln038

Calderón-Larrañaga, A., Santoni, G., Wang, H.X., Welmer, A.-K., Rizzuto, D., Vetrano, D.L., & Fratiglioni, L. (2018). Rapidly developing multimorbidity and disability in older adults: Does social background matter? *Journal of Internal Medicine*, *283*, 489–499. https://doi.org/10.1111/joim.12739

Carr, D., Friedman, M.A., & Jaffe, K. (2007). Understanding the relationship between obesity and positive and negative affect: The role of psychosocial mechanisms. *Body Image*, *4*, 165–177. https://doi.org/10.1016/j.bodyim.2007.02.004

Charlson, M.E., Pompei, P., Ales, K.L., & MacKenzie, C.R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases*, *40*, 373–383. Retreived from: http://www.calculadoradevida.es/masinfo/Charlson.-1987.-Comorbidity.pdf

Chida, Y., & Steptoe, A. (2008). Positive psychological well-being and mortality: A quantitative review of prospective observational studies. *Psychosomatic Medicine*, *70*, 741–756. https://doi.org/10.1097/PSY.0b013e31818105ba

Christ, S.L., Zheng, D.D., Swenor, B.K., Lam, B.L., West, S.K., Tannenbaum, S.L., & Lee, D.J. (2014). Longitudinal relationships among visual acuity, daily functional status, and mortality: The Salisbury eye evaluation study. *JAMA Ophthalmology*, *2055*, 1–7. https://doi.org/10.1001/jamaophthalmol.2014.2847

Clarke, P.J., Marshall, V.W., Ryff, C.D., & Wheaton, B. (2001). Measuring psychological well-being in the Canadian study of health and aging. *International Psychogeriatrics*, *13*, 79–90. Retrieved from: https://www.researchgate.net/profile/Victor_Marshall/publication/11470389_Measuring_Psychological_Well-Being_in_the_Canadian_Study_of_Health_and_Aging/links/0fcfd50d49458e894d000000/Measuring-Psychological-Well-Being-in-the-Canadian-Study-of-Health-and-Aging.pdf

Courtney-Long, E.A., Carroll, D.D., Zhang, Q.C., Stevens, A.C., Griffin-Blake, S., Armour, B.S., & Campbell, V.A. (2015). Prevalence of disability and disability type among adults—United States, 2013. *Morbidity and Mortality Weekly Report*, *64*, 777–783. Retrieved from: http://europepmc.org/articles/PMC4584831

Cross, M.P., & Pressman, S.D. (2017). Understanding the connections between positive affect and health. In C.L. Cooper & J. Campbell Quick (Eds.), *The handbook of stress and health: A guide to research and practice* (pp. 75–95). Hoboken, NJ: John Wiley & Sons.

Dekker, J., Tola, P., Aufdemkampe, G., & Winckers, M. (1993). Negative affect, pain and disability in osteoarthritis patients: The mediating role of muscle weakness. *Behaviour Research and Therapy*, *31*, 203–206. https://doi.org/10.1016/0005-7967(93)90073-4

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, *95*, 542–575. Retrieved from: http://labs.psychology.illinois.edu/~ediener/Documents/Diener_1984.pdf

Diener, E., & Chan, M.Y. (2011). Happy people live longer: Subjective well-being contributes to health and longevity. *Applied Psychology: Health and Well-Being*, *3*, 1–43. https://doi.org/10.1111/j.1758-0854.2010.01045.x

Diener, E., Pressman, S.D., Hunter, J., & Delgadillo-Chase, D. (2017). If, why, and when subjective well-being influences health, and future needed research. *Applied Psychology: Health and Well-Being*, *9*, 133–167. https://doi.org/10.1111/aphw.12090

Disabato, D.J., Goodman, F.R., Kashdan, T.B., Short, J.L., & Jarden, A. (2016). Different types of well-being? A cross-cultural examination of hedonic and eudaimonic well-being. *Psychological Assessment*, *28*, 471–482. https://doi.org/10.1037/pas0000209

Ellis, E.M., Orom, H., Giovino, G.A., & Kiviniemi, M.T. (2015). Relations between negative affect and health behaviors by race/ethnicity: Differential effects for symptoms of depression and anxiety. *Health Psychology*, *34*, 966–969. https://doi.org/10.1037/hea0000197

Fredrickson, B.L., Grewen, K.M., Coffey, K.A., Algoe, S.B., Firestine, A.M., Arevalo, J.M., . . . Cole, S.W. (2013). A functional genomic perspective on human well-being. *Proceedings of the National Academy of Sciences, USA*, *110*, 13684–13689. https://doi.org/10.1073/pnas.1305419110

Friedman, E.M., Christ, S.L., & Mroczek, D.K. (2015). Inflammation partially mediates the association of multimorbidity and functional limitations in a national sample of middle-aged and older adults: The MIDUS study. *Journal of Aging and Health*, *27*, 843–863. https://doi.org/10.1177/0898264315569453

Friedman, H.S., & Kern, M.L. (2014). Personality, well-being, and health. *Annual Review of Psychology*, *65*, 719–742. https://doi.org/10.1146/annurev-psych-010213-115123

Friedman, E.M., Ruini, C., Foy, R., Jaros, L., Sampson, H., & Ryff, C.D. (2017). Lighten UP! A community-based group intervention to promote psychological well-being in older adults. *Aging & Mental Health*, *21*, 199–205. https://doi.org/10.1080/13607863.2015.1093605

Friedman, E.M., & Ryff, C.D. (2012). Living well with medical comorbidities: A biopsychosocial perspective. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *67*, 535–544. https://doi.org/10.1093/geronb/gbr152

Giné-Garriga, M., Roqué-Fíguls, M., Coll-Planas, L., Sitja-Rabert, M., & Salvà, A. (2014). Physical exercise interventions for improving performance-based measures of physical function in community-dwelling, frail older adults: A systematic review and meta-analysis. *Archives of Physical Medicine and Rehabilitation*, *95*, 753–769. https://doi.org/10.1016/j.apmr.2013.11.007

Hassett, A.L., Maclean, R., Peterson, C., Stuart, M.R., Buyske, S., Park, N., & Seligman, M.E.P. (2009). The observational evaluation of subjective well-being in patients with rheumatoid arthritis. *Applied Psychology: Health and Well Being*, *1*, 46–61. https://doi.org/10.1111/j.1758-0854.2008.01002.x

Hill, P.L., & Turiano, N.A. (2014). Purpose in life as a predictor of mortality across adulthood. *Psychological Science*, *25*, 1482–1486. https://doi.org/10.1177/0956797614531799

Ho, H.C., Yeung, D.Y., & Kwok, S.Y. (2014). Development and evaluation of the positive psychology intervention for older adults. *Journal of Positive Psychology*, *9*, 187–197. https://doi.org/10.1080/17439760.2014.888577

Huppert, F.A. (2009). Psychological well-being: Evidence regarding its causes and consequences. *Applied Psychology: Health and Well-Being*, *1*, 137–164. https://doi.org/10.1111/j.1758-0854.2009.01008.x

Jayasekara, R., Procter, N., Harrison, J., Skelton, K., Hampel, S., Draper, R., & Deuter, K. (2015). Cognitive behavioural therapy for older adults with depression: A review. *Journal of Mental Health*, *24*, 168–171. https://doi.org/10.3109/09638237.2014.971143

Joshanloo, M. (2016). Revisiting the empirical distinction between hedonic and eudaimonic aspects of well-being using exploratory structural equation modeling. *Journal of Happiness Studies*, *17*, 2023–2036. https://doi.org/10.1007/s10902-015-9683-z

Kim, E.S., Kawachi, I., Chen, Y., & Kubzansky, L.D. (2017). Association between purpose in life and objective measures of physical function in older adults. *JAMA Psychiatry*, *74*, 1039–1045. https://doi.org/10.1001/jamapsychiatry.2017.2145

Kriegsman, D.M.W., Penninx, B.W.J.H., Van Eijk, J.T.M., Boeke, A.J.P., & Deeg, D.J.H. (1996). Self-reports and general practitioner information on the presence of chronic diseases in community dwelling elderly. A study on the accuracy of patients' self-reports and on determinants of inaccuracy. *Journal of Clinical Epidemiology*, *49*, 1407–1417. https://doi.org/10.1016/S0895-4356(96)00274-0

Lachman, M.E., Teshale, S., & Agrigoroaei, S. (2015). Midlife as a pivotal period in the life course. *International Journal of Behavioral Development*, *39*, 20–31. https://doi.org/10.1177/0165025414533223

Leonard, B.E. (2007). Inflammation, depression and dementia: Are they connected? *Neurochemical Research*, *32*, 1749–1756. https://doi.org/10.1007/s11064-007-9385-y

Lima-Costa, M.F., Mambrini, J.V., Torres, K.C., Peixoto, S.V., Andrade, F.B., De Oliveira, C., . . ., Martins-Filho, O.A. (2017). Multiple inflammatory markers and 15-year incident ADL disability in admixed older adults: The Bambui-Epigen Study. *Archives of Gerontology and Geriatrics*, *72*, 103–107. https://doi.org/10.1016/j.archger.2017.05.013

Lucas, R.E. (2007). Long-term disability is associated with lasting changes in subjective well-being: Evidence from two nationally representative longitudinal studies. *Journal of Personality and Social Psychology*, *92*, 717–730. https://doi.org/10.1037/0022-3514.92.4.717

Marengoni, A., Von Strauss, E., Rizzuto, D., Winblad, B., & Fratiglioni, L. (2009). The impact of chronic multimorbidity and disability on functional decline and survival in elderly persons: A community-based, longitudinal study. *Journal of Internal Medicine*, *265*, 288–295. https://doi.org/10.1111/j.1365-2796.2008.02017.x

Martin, L.G., Zimmer, Z., & Lee, J. (2017). Foundations of activity of daily living trajectories of older Americans. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *72*, 129–139. https://doi.org/10.1093/geronb/gbv074

Millán-Calenti, J.C., Tubío, J., Pita-Fernández, S., González-Abraldes, I., Lorenzo, T., Fernández-Arruty, T., & Maseda, A. (2010). Prevalence of functional disability in activities of daily living (ADL), instrumental activities of daily living (IADL) and associated factors, as predictors of morbidity and mortality. *Archives of Gerontology and Geriatrics*, *50*, 306–310. https://doi.org/10.1016/j.archger.2009.04.017

Mroczek, D.K., & Kolarz, C.M. (1998). The effect of age on positive and negative affect: A developmental perspective on happiness. *Journal of Personality & Social Psychology*, *75*, 1333–1349. Retrieved from: https://core.ac.uk/download/pdf/22865910.pdf

Muthén, L K., & Muthén, B.O. (2005). Mplus statistical analyses with latent variables. User's guide, version 7.

Netz, Y., Wu, M.J., Becker, B.J., & Tenenbaum, G. (2005). Physical activity and psychological well-being in advanced age: A meta-analysis of intervention studies. *Psychology & Aging*, *2*, 272–284. https://doi.org/10.1037/0882-7974.20.2.272

Nygren, B., Aléx, L., Jonsén, E., Gustafson, Y., Norberg, A., & Lundman, B. (2005). Resilience, sense of coherence, purpose in life and self-transcendence in relation to perceived physical and mental health among the oldest old. *Aging & Mental Health*, *9*, 354–362. https://doi.org/10.1080/1360500114415

Ottenbacher, M.E., Kuo, Y.-F., & Ostir, G.V. (2007). Test-retest reliability of a psychological well-being scale in hospitalized older adults. *Aging Clinical and Experimental Research*, *19*, 424–429. https://doi.org/10.1007/BF03324725

Rector, J.L., Christ, S.L., & Friedman, E.M. (2018). Well-being and long-term physical activity participation in midlife adults: A latent class analysis. *Annals of Behavioral Medicine*, kay016. doi: 10.1093/abm/kay016

Ryan, R.M., & Deci, E.L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, *52*, 141–166. Retrieved from: https://search.proquest.com/docview/205845157?pq-origsite=gscholar

Ryff, C.D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality & Social Psychology*, *57*, 1069–1081. Retrieved from: http://psycnet.apa.org/buy/1990-12288-001

Ryff, C.D. (1995). Psychological well-being in adult life. *Current Directions in Psychological Science*, *4*, 99–104. Retrieved from: https://journals.sagepub.com/doi/pdf/10.1111/1467-8721.ep10772395?casa_token=EEk0AH7zl1QAAAAA%3ADRDgxLRuwBp3AeP5XLrjcZup1sEE8mHP6QdjNrSXz9pWvXb05iP7zL3yk2oo8fd-5TnL8dwf8YU

Ryff, C.D. (2014). Psychological well-being revisited: Advances in the science and practice of eudaimonia. *Psychotherapy and Psychosomatics*, *83*, 10–28. https://doi.org/10.1159/000353263

Ryff, C.D., & Keyes, C.L.M. (1995). The structure of psychological well-being revisited. *Journal of Personality & Social Psychology*, *69,* 719–727. Retrieved from: http://www.aging.wisc.edu/midus/findings/pdfs/830.pdf

Ryff, C.D., & Singer, B. (1998). The contours of positive human health. *Psychological Inquiry*, *9*, 1–28. https://doi.org/10.1207/s15327965pli0901_1

Ryff, C.D., & Singer, B.H. (2008). Know thyself and become what you are: A eudaimonic approach to psychological well-being. *Journal of Happiness Studies*, *9*, 13–39. https://doi.org/10.1007/s10902-006-9019-0

Schoeni, R.F., Freedman, V.A., & Martin, L.G. (2008). Why is late-life disability declining? *Milbank Quarterly*, *86*, 47–89. https://doi.org/10.1111/j.1468-0009.2007.00513.x.

Schoeni, R.F., Martin, L.G., Andreski, P.M., & Freedman, V.A. (2005). Persistent and growing socioeconomic disparities in disability among the elderly: 1982–2002. *American Journal of Public Health*, *95*, 2065–2070. https://doi.org/10.2105/AJPH.2004.048744

Sepah, S.C., & Bower, J.E. (2009). Positive affect and inflammation during radiation treatment for breast and prostate cancer. *Brain, Behavior, and Immunity*, *23*, 1068–1072. https://doi.org/10.1016/j.bbi.2009.06.149

Springer, K.W., Pudrovska, T., & Hauser, R.M. (2011). Does psychological well-being change with age? Longitudinal tests of age variations and further exploration of the multidimensionality of Ryff's model of psychological well-being. *Social Science Research*, *40*, 392–398. https://doi.org/10.1016/j.ssresearch.2010.05.008

Stellar, J.E., John-Henderson, N., Anderson, C.L., Gordon, A.M., McNeil, G.D., & Keltner, D. (2015). Positive affect and markers of inflammation: Discrete positive emotions predict lower levels of inflammatory cytokines. *Emotion*, *15*, 129–133. https://doi.org/10.1037/emo0000033

Stenholm, S., Westerlund, H., Head, J., Hyde, M., Kawachi, I., Pentti, J., & Vahtera, J. (2015). Comorbidity and functional trajectories from midlife to old age: The health and retirement study. *Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *70*, 332–338. https://doi.org/10.1093/gerona/glu113

Steptoe, A., Deaton, A., & Stone, A.A. (2015). Subjective wellbeing, health, and ageing. *The Lancet*, *385*, 640–648. https://doi.org/10.1016/S0140-6736(13)61489-0

Steptoe, A., O'Donnell, K., Badrick, E., Kumari, M., & Marmot, M. (2007). Neuroendocrine and inflammatory factors associated with positive affect in healthy men and women: The Whitehall II study. *American Journal of Epidemiology*, *167*, 96–102. https://doi.org/10.1093/aje/kwm252

Strine, T.W., Chapman, D.P., Balluz, L.S., Moriarty, D.G., & Mokdad, A.H. (2008). The associations between life satisfaction and health-related quality of life, chronic illness, and health behaviors among US community-dwelling adults. *Journal of Community Health*, *33*, 40–50. https://doi.org/10.1007/s10900-007-9066-4

Syddall, H.E., Martin, H.J., Harwood, R.H., Cooper, C., & Sayer, A.A. (2009). The SF-36: A simple, effective measure of mobility-disability for epidemiological studies. *Journal of Nutrition, Health and Aging*, *13*, 57–62. Retrieved from: https://link.springer.com/content/pdf/10.1007%2Fs12603-009-0010-4.pdf

Taylor, M.G., & Lynch, S.M. (2011). Cohort differences and chronic disease profiles of differential disability trajectories. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *66*, 729–738. https://doi.org/10.1093/geronb/gbr104.

Verbrugge, L.M., & Jette, A.M. (1994). The disablement process. *Social Science & Medicine*, *38*, 1–14. Retrieved from: https://deepblue.lib.umich.edu/bitstream/handle/2027.42/31841/0000788.pdf?sequence=1&isAllowed=y

Verbrugge, L.M., Latham, K., & Clarke, P.J. (2017). Aging with disability for midlife and older adults. *Research on Aging*, *39*, 741–777. https://doi.org/10.1177/0164027516681051

Verbrugge, L.M., Lepkowski, J.M., & Imanaka, Y. (1989). Comorbidity and its impact on disability. *Milbank Quarterly*, *67*, 450–484. Retrieved from: https://www.jstor.org/stable/pdf/3350223.pdf?casa_token=Gx7l8tLgOrgAAAAA:aR9aIYL6Zza-pfTwu_N1JDgO-LI5SggGH27t4UpqQLcE7WCrDDnTCwzkul1dabz-d8g0T_uwpEhBGu0DT6XtTly5qWuKIuvMuPxP2tLnPXRXM_X_qae3

World Health Organization (2001). *International Classification of Functioning, Disability and Health: ICF*. Geneva, Switzerland: WHO. Retrieved from: http://apps.who.int/iris/bitstream/handle/10665/42407/9241545429.pdf