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Educational disparities in 20-year trajectories of psychological well-being in a national sample

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Long-term trajectories of psychological well-being were investigated using data from a national longitudinal study known as MIDUS (Midlife in the U.S.) The central question was whether educational status and age were associated with gains, losses, or persistent disadvantage on widely studied dimensions of eudaimonic well-being such as personal growth, purpose in life, and self-acceptance. Findings from a sample of adults (N = 6908), aged 25–74 at baseline, showed primarily loss across the 20-year period (1995–2015). Those with a high school education or less showed persistently lower levels of six distinct aspects of well-being compared to those with more education across time. In addition, purpose in life declined for all age groups. Losses over time for autonomy, environmental mastery, and personal growth were steeper for the oldest age group (i.e., 61 years and older) compared to younger (i.e., 40 years and younger) and midlife (i.e., 41–60 years) adults, while losses for self-acceptance were steepest for young adults compared to the two older age groups. The role of structural inequalities in understanding variation in these well-being trajectories and their implications for future health are considered.

Keywords Psychological well-being, Long-term trajectories, Human development, Inequality, Aging

A college education is increasingly necessary for living a long and healthy life in the United States. American adults without a 4-year college degree have fewer economic and employment opportunities, less political power, a greater burden of disease, and shorter lives compared to their college educated counterparts[1–4]. While educational disparities in income, employment opportunities, health, and longevity have been present for decades, the extent of disparities between those with a 4-year degree and those without has widened in recent years[5–9]. For example, adults aged 45–64 with a college degree experienced no change in disability from 2000 to 2015, whereas those with less than a high school education experienced nearly 80% higher odds of disability in 2015 compared to in 2000[10].

As a defining feature of the present era, these growing inequalities touch many facets of contemporary lives. The current study engages these issues by examining the extent to which high levels of eudaimonic well-being are available to most members of society or are increasingly sequestered among those with educational advantages. So doing brings empirical scrutiny to a distant observation by Dowd[11] (p. 149) "that the opportunities for human development *are not randomly distributed but disproportionately accrue to those in privileged classes of modern society* [emphasis added]." Specifically, this study investigates long-term trajectories of six dimensions of psychological (eudaimonic) well-being[12,13] in the MIDUS (Midlife in the United States) national longitudinal study and the extent to which they are associated with two key demographic variables: educational attainment and age. Derived from theories of lifespan development, personality psychology, and philosophy[14–16] eudaimonic well-being is multidimensional and reflects how individuals strive to function positively while navigating life challenges, whether individuals act in ways that align with their unique potentials, and how individuals grow and develop over time[12,17,18]. Eudaimonic well-being is correlated with, yet distinct from, hedonic well-being, which reflects feeling good and finding pleasure and contentment (e.g., happiness, life satisfaction)[18,19]. Guided by the Ryff model of psychological well-being[12,20], eudaimonia is defined by purpose in life (goals in life and a sense of direction), personal growth (continued growth and development), positive relations with others (warm and satisfying relationships), environmental mastery (competence in managing life situations), autonomy (living in line with personal convictions), and self-acceptance (self-awareness and positive self-regard). Decades

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of research support the multidimensionality of this model of psychological well-being, including diverse antecedents, consequences, and contexts that support these unique dimensions of eudaimonia[20].

Eudaimonic well-being is a much-studied outcome in population health, which makes questions about whether education and age predict well-being trajectories important. Growing evidence documents that eudaimonic well-being matters for health and longevity. For example, meta-analyses show that purpose in life is associated with reduced risk for all-cause mortality[21]. In the national Health and Retirement Study, a one standard deviation increase in well-being was associated with an additional 2–4 years of life expectancy at age 50[22]. Those with higher eudaimonic well-being also have healthier cardiovascular, metabolic, and immune functioning, which may contribute to a later onset and slower progression of chronic illnesses[21,23–25]. Those with higher well-being engage in more physical activity, smoke less, report better sleep, utilize more preventative healthcare, and exhibit better adherence to medication regimens[24,26–29]. Eudaimonia is further linked with favorable functional genomic profiles[30–33] and healthier brain functioning, including faster recovery from negative stimuli, sustained activation in reward circuitry (ventral striatum) following positive stimuli, and greater insular cortex volume, which is involved with higher-order brain functioning[34–37].

Importantly, educational attainment supports the development and maintenance of higher levels of eudaimonic well-being throughout midlife and old age. It is known that education drives opportunities for higher earnings and wealth accumulation, while also predicts lower levels of morbidity and longer lives in the U.S.[1,38,39] Additional evidence shows that those with higher education are more likely to take intentional action to achieve better health[40]. Education likewise is tied to social networks, stress exposures, coping resources, and sense of control[41]. Thus, there are many ways in which higher educational attainment may predict higher psychological well-being. Cumulative advantage/disadvantage theories suggest that higher levels of education afford greater opportunities to cultivate high well-being across time, likely evident in baseline differences as well as widening educational disparities in eudaimonic well-being with age[42]. Supporting cumulative disadvantage perspectives, cross-sectional findings show that educational attainment positively predicts most aspects of eudaimonic well-being, with particularly strong associations evident for personal growth and purpose in life and somewhat weaker associations for positive relations with others and autonomy[23,43–46]. What is unknown is the extent to which opportunities to develop and maintain high eudaimonic well-being across the decades of adult life are structured by educational attainment.

There are likewise age differences in eudaimonic well-being. Patterns for eudaimonia differ across dimensions and, importantly, differ from age differences in hedonic well-being (e.g., happiness, positive affect). Extensive prior research supports that hedonic well-being increases into older adulthood and declines very late in life[23,47,48]. Regarding eudaimonia, initial cross-sectional studies with community samples suggested age increments in autonomy, environmental mastery, and positive relations with others, but decrements in personal growth and purpose in life, with no age differences for self-acceptance[12,17]. Socioemotional selectivity theory (SST)[49] may help explain why some aspects of eudaimonic well-being increase with age. SST describes how, due to more limited time horizons, older adults prioritize goals related to emotion regulation (compared to information seeking or making new friends), which may contribute to greater autonomy and environmental mastery among older adults. Further, the social input model[50] may help explain why positive relations with others increases with age. This model details actions and values (e.g., forgiveness, time perspectives) of older adults and their social partners that support high quality relationships. The declines in personal growth and purpose in life with age may reflect structural lags, referring to our social institutions not keeping up with the extended length of life that many older adults now experience[51]. As social roles diminish with age, fewer opportunities may be available for older individuals to contribute to society, thus limiting opportunities for personal growth and purposeful engagement.

Subsequent longitudinal findings from the Wisconsin Longitudinal Study and two waves of the MIDUS national longitudinal study—both over approximately 10 years—documented downward intra-individual change for personal growth and purpose in life, along with upward change for environmental mastery and positive relations with others, and mixed patterns for autonomy and self-acceptance[52]. Using three waves of data over 8 years from the Health and Retirement study (HRS), Hill and Weston[53] found gradual decline in purpose in life at older ages, although less decline was observed among those with higher educational status. The current study builds on these conceptual models and prior longitudinal inquiries by tracking intra-individual change over three waves, spanning 20 years, in the MIDUS national sample.

Specifically, the current study utilizes three waves of data from the MIDUS national longitudinal study to investigate educational and age disparities in intra-individual change in eudaimonic well-being across 20 years, thereby providing an unprecedented window of time for tracking changes in well-being. Guided by Dowd[11], we hypothesized that those with lower educational standing would show greater decline, or persistent disadvantage in their well-being trajectories across time compared to more highly educated adults. Guided by conceptual models and prior empirical findings on age variation[12,17,53], including across two waves in MIDUS[52], we further expected that some aspects of eudaimonia (i.e., purpose in life, personal growth) would show greater loss with age, while others (i.e., environmental mastery, positive relations with others) would show gains.

Results

Descriptive analyses

Table 1 presents descriptive information for each wave. Given the longitudinal design, the sample shows aging across time, both in average age and percentage of participants in each age group. Slightly more than half of the sample were female across waves. Regarding education, percentages in each educational group reflect attrition across time, thus showing a slight decline the percentage with a high school education or lower across waves, along with a slight increase in those with a college education or higher. Such patterns align with prior reports about attrition in MIDUS[54,55]. Most of the sample identified as White (Wave 1 = 91.20%, Wave 2 = 85.20%, Wave

	Wave 1 (N = 6267)	Wave 2 (N = 4437)	Wave 3 (N = 3240)
Education (%)			
High school or less	37.69%	36.79%	33.10%
Some college	30.46%	29.32%	29.91%
Bachelor's degree or higher	31.95%	33.88%	36.99%
Age in years, *M* (*SD*) [Range]	46.89 (12.93) [20–75]	55.86 (12.36) [30–85]	63.88 (11.17) [39–94]
Early adulthood (40 years or younger; %)	18.11%	16.50%	11.02%
Middle adulthood (41–60 years; %)	35.77%	34.08%	35.34%
Late adulthood (61 years or older; %)	46.11%	49.43%	53.64%
Gender (Female %)	52.47%	56.25%	56.33%
Race (%)			
White	91.20%	85.20%	85.02%
Black and/or African American	5.25%	12.90%	13.24%
Other	3.54%	1.95%	1.74%
Wave 1 work status (%)			
Currently not employed	8.82%	9.94%	9.97%
Retired	11.06%	11.20%	7.75%
Currently employed	77.23%	74.51%	78.67%
Wave 1 household income (1–10)	2.45 (2.17)	2.42 (2.11)	2.60 (2.22)
Wave 1 total chronic conditions	2.41 (2.51)	2.44 (2.45)	2.34 (2.38

Table 1. Descriptive Statistics of Demographic Variables by Wave.

3 = 85.02%). The addition of the Milwaukee sample at Wave 2 increased representation of Black and African American respondents. Bivariate correlations among key study variables at wave 1 are included in Supplementary Table 1.

Associations between education and age with individual trajectories of well-being

Table 2 presents the results from the multilevel modeling analyses by each dimension of eudaimonic well-being. Overall, individual trajectories of eudaimonia declined over time, ($\beta_{10} < -0.01$, $p < 0.05$), except for positive relations with others which increased across the 20-year period ($\beta_{10} = 0.02$, $p < 0.001$). Additional findings by education and age are summarized below. We note that the interaction between education and baseline age in predicting both the intercept and slope for each well-being measure was also examined, but none of the interactions were statistically significant (all *p*s > 0.05).

Education

Figure 1 presents 20-year within-person changes in eudaimonic well-being by educational attainment (i.e., model implied effects). For purpose in life, individuals with a high school education or less showed a flatter decline in purpose in life than those with some college education ($\beta_{11} = -0.010$, SE_$\beta_{11} = 0.004$, $p = 0.022$) or a bachelor's degree or higher education ($\beta_{12} = -0.013$, SE_$\beta_{12} = 0.004$, $p < 0.001$; Fig. 1a). The standardized coefficient for Wave, (β_{10}) indicates that purpose in life declined for those with high school education or less by 0.075 standard deviations at each wave. The standardized coefficients for the Wave by Education interactions (β_{11} and β_{12}) indicate that respondents with some college education declined by 0.029 standard deviation units of purpose in life more than respondents with a high school education or less and those with a bachelor's degree or higher declined by 0.042 standard deviation units of purpose in life more than those with a high school education or less. In contrast to purpose in life trajectories, compared to respondents with a high school education or less, those with higher education (i.e., some college, bachelor's degree or higher) showed a flatter decline over time in personal growth ($\beta_{11} = 0.010$, SE_$\beta_{11} = 0.004$, $p = 0.014$; $\beta_{12} = 0.027$, SE_$\beta_{12} = 0.004$, $p < 0.001$; Fig. 1b), and autonomy (β_{11} [high school or less vs. some college] = 0.009, SE_$\beta_{11} = 0.004$, $p = 0.029$; β_{12} [high school or less vs. bachelor's degree or higher] = 0.016, SE_$\beta_{12} = 0.004$, $p < 0.001$; Fig. 1c). Intra-individual changes in environmental mastery differed only between a high school education or less and a bachelor's degree or higher education ($\beta_{12} = 0.014$, SE_$\beta_{12} = 0.004$, $p < 0.001$), where again, those with less education showed a steeper decline than those with a college degree (Fig. 1d). Educational differences were not found for trajectories of positive relations with others (Fig. 1e), which showed increments across time, or for self-acceptance (Fig. 1f), which showed decrements across time for all education groups.

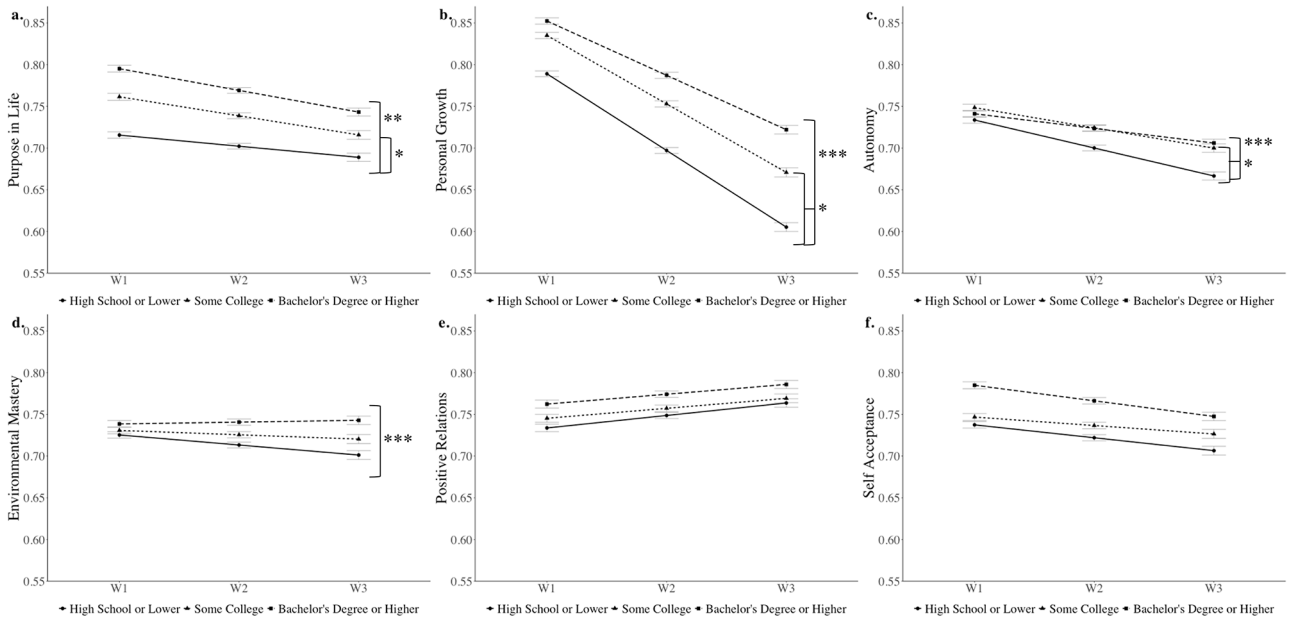
Age

Figure 2 presents within-person change in eudaimonic well-being by age group (early, middle, and late adulthood; i.e., model implied effects). Across all age groups, purpose in life showed decline over 20 years, with no significant differences in the degree of decline between early and late adulthood ($\beta_{13} = -0.003$, SE_$\beta_{13} = 0.005$, $p = 0.533$, but less steep decline for middle adulthood compared to late adulthood ($\beta_{14} = 0.011$, SE_$\beta_{14} = 0.005$, $p = 0.037$; Fig. 2a). Age differences in intra-individual change were found for all other eudaimonic well-being subscales.

	Autonomy				Environmental Mastery				Personal Growth			
Variables	**B**	**SE**	***β***	***p***	**B**	**SE**	***β***	***p***	**B**	**SE**	***β***	***p***
Wave (within-person change; β_{10})	− 0.051	0.005	− 0.227	< 0.001	− 0.034	0.005	− 0.143	< 0.001	− 0.116	0.009	− 0.487	< .0.001
Education (Ref = HS or lower)												
Some college (β_{01})	0.015	0.006	0.038	0.008	0.005	0.006	0.013	0.331	0.046	0.005	0.111	< 0.001
BA or higher (β_{02})	0.007	0.006	0.020	0.189	0.013	0.006	0.033	0.021	0.063	0.005	0.158	< 0.001
Age (Ref = late adulthood)												
Early adulthood (β_{03})	− 0.059	0.008	− 0..156	< 0.001	− 0.069	0.008	− 0.174	< 0.001	0.017	0.007	0.043	0.020
Middle adulthood (β_{04})	− 0.029	0.007	− 0.079	< 0.001	− 0.053	0.007	− 0.139	< 0.001	− 0.001	0.007	− 0.001	0.992
Gender (ref = male; β_{05})	− 0.021	0.004	− 0.059	< 0.001	0.001	0.004	0.003	0.759	0.030	0.004	0.079	< 0.001
Race (ref = white adults)												
Black and/or African American adults (β_{06})	0.028	0.007	0.045	< 0.001	0.011	0.007	0.016	0.103	0.022	0.006	0.034	0.001
Other race adults (β_{07})	0.008	0.012	0.007	0.472	− 0.016	0.012	− 0.014	0.160	− 0.004	0.011	− 0.001	0.716
Income (1–10)	0.001	0.001	0.013	0.276	0.009	0.001	0.099	< 0.001	0.004	0.001	0.050	< 0.001
Work status (ref = not employed)												
Retired (β_{09})	0.007	0.010	0.011	0.470	0.053	0.010	0.086	< 0.001	0.019	0.009	0.030	0.043
Currently employed (β_{010})	0.001	0.007	0.001	0.944	0.027	0.007	0.058	< 0.001	0.034	0.007	0.072	< 0.001
Total chronic conditions (β_{011})	− 0.007	0.001	− .0.100	< 0.001	− 0.019	0.001	− 0.238	< 0.001	− 0.010	0.001	− 0.126	< 0.001
Wave X education (Ref = HS or lower)												
Some college (β_{11})	0.009	0.004	0.029	0.015	0.007	0.004	0.020	0.109	0.010	0.004	0.029	0.014
BA or higher (β_{12})	0.016	0.004	0.055	< 0.001	0.014	0.004	0.046	< 0.001	0.027	0.004	0.086	< 0.001
Wave X age (ref = late adulthood)												
Early adulthood (β_{13})	0.018	0.005	0.061	< 0.001	0.012	0.005	0.037	0.032	0.020	0.005	0.064	< 0.001
Middle adulthood (β_{14})	0.023	0.005	0.089	< 0.001	0.036	0.005	0.134	< 0.001	0.035	0.005	0.130	< 0.001
	Purpose in life				**Positive relations with others**				**Self acceptance**			
Variables	**B**	**SE**	***β***	***p***	**B**	**SE**	***β***	***p***	**B**	**SE**	***β***	***p***
Wave (within− person change; β_{10})	− 0.017	0.005	− 0.075	< 0.001	0.016	0.005	0.061	0.002	− 0.019	0.005	− 0.078	< 0.001
Education (Ref = HS or lower)												
Some college (β_{01})	0.046	0.006	0.113	< 0.001	0.012	0.007	0.026	0.076	0.009	0.006	0.022	0.100
BA or higher (β_{02})	0.080	0.006	0.204	< 0.001	0.029	0.007	0.067	< 0.001	0.047	0.006	0.116	< 0.001
Age (ref = late adulthood)												
Early adulthood (β_{03})	0.038	0.008	0.097	< 0.001	− 0.047	0.009	− 0.110	< 0.001	− 0.041	0.008	− 0.102	< 0.001
Middle adulthood (β_{04})	0.026	0.008	0.070	0.001	− 0.029	0.009	− 0.071	0.001	− 0.027	0.008	− 0.069	< 0.001
Gender (ref = male; β_{05})	0.014	0.004	0.039	< 0.001	0.064	0.005	0.158	< 0.001	0.009	0.004	0.024	0.030
Race (ref = white adults)												
Black and/or African American adults (β_{06})	0.021	0.006	0.032	0.001	− 0.009	0.007	− 0.013	0.208	0.030	0.007	0.045	< 0.001
Other race adults (β_{07})	− 0.028	0.011	− 0.024	0.014	− 0.023	0.013	− 0.018	0.082	− 0.017	0.012	− 0.014	0.155
Income (1–10)	0.009	0.001	0.110	< 0.001	0.009	0.001	0.091	< 0.001	0.012	0.001	− 0.132	< 0.001
Work Status (ref = not employed)												
Retired (β_{09})	0.008	0.009	0.013	0.388	0.005	0.011	0.007	0.651	0.051	0.010	0.081	< 0.001
Currently employed (β_{010})	0.017	0.007	0.037	0.010	0.001	0.007	0.003	0.865	0.025	0.007	0.052	< 0.001
Total chronic conditions (β_{011})	− 0.012	0.001	− 0.163	< 0.001	− 0.015	0.001	− 0.180	< 0.001	− 0.019	0.001	− 0.242	< 0.001
Wave X education (ref = HS or lower)												
Some College (β_{11})	− 0.010	0.004	− 0.029	0.022	− 0.003	0.004	− 0.008	0.477	0.005	0.004	0.016	0.175
BA or higher (β_{12})	− 0.013	0.004	− 0.042	0.001	− 0.003	0.004	− 0.010	0.436	− 0.003	0.004	− 0.010	0.103
Wave X Age (ref = late adulthood)												
Early adulthood (β_{13})	− 0.003	0.005	− 0.011	0.533	− 0.011	0.005	− 0.033	0.039	− 0.008	0.005	− 0.026	0.103
Middle adulthood (β_{14})	0.011	0.005	0.040	0.037	0.007	0.005	0.023	0.191	0.013	0.005	0.048	0.006

Table 2. Multilevel modeling analyses of the longitudinal changes in eudaimonic well-being.
B = unstandardized coefficient. SE = standard error. β = standardized coefficient. *Ref* reference, *HS* high school, *BA* Bachelor's Degree.

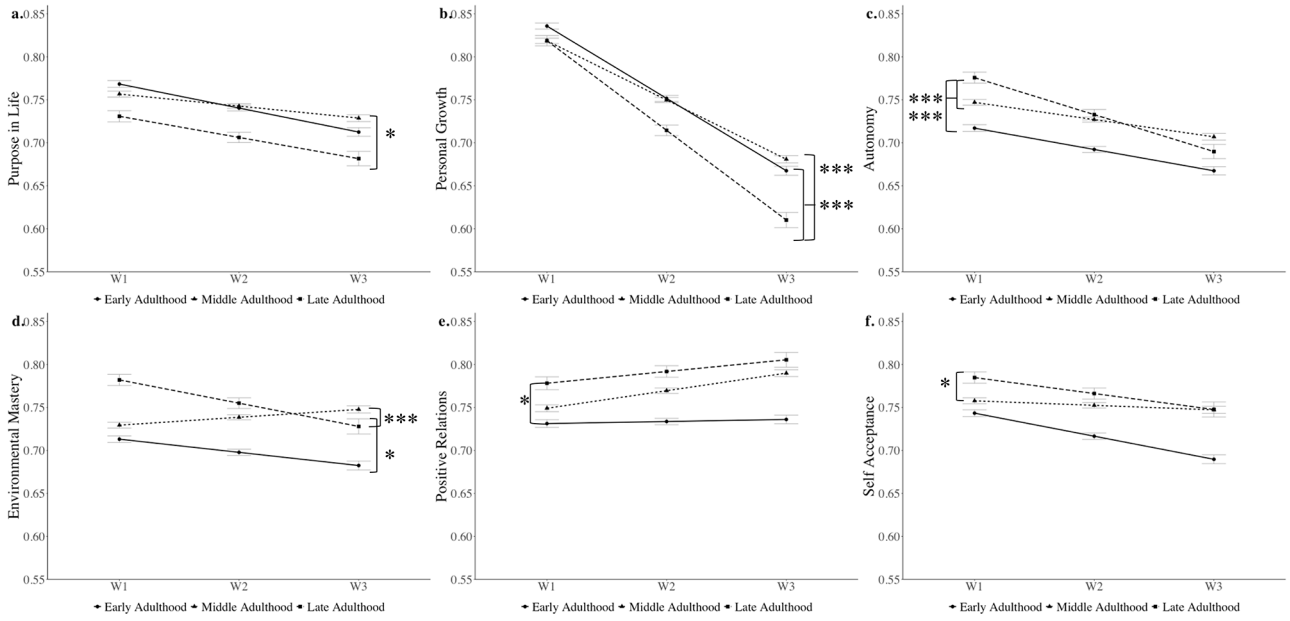
For personal growth, autonomy and environmental mastery, findings showed less cross-time decline in younger compared to the oldest age groups. Specifically, compared to late adulthood, both early and middle adulthood showed a flatter decrease in personal growth (β_{13} = 0.020, SE_β_{13} = 0.005, p < 0.001; β_{14} = 0.035, SE_β_{14} = 0.005, p < 0.001; Fig. 2b) and autonomy (β_{13} [late vs. early adulthood] = 0.018, SE_β_{13} = 0.005, p < 0.001; β_{14} [late vs. middle adulthood] = 0.023, SE_ β_{14} = 0.005, p < 0.001; Fig. 2c), and environmental mastery (β_{13} [late vs. early



Note. Solid line and circle dots = high school education or less, dotted line and triangle dots= some college, dashed line and square dots = bachelor's degree or higher. Error bars = ±1 standard error.

* p < .05, ** p < .005, *** p < .001

Fig. 1. Within-person change in eudaimonic well-being by educational attainment.



Note. Solid line and circle dots = Early adulthood, dotted line and triangle dots= middle adulthood, dashed line and square dots = late adulthood. Error bars = ±1 standard error.

* p < .05, ** p < .005, *** p < .001

Fig. 2. Within-person change in eudaimonic well-being by age group.

adulthood] = 0.012, SE_β_{13} = 0.005, p = 0.032; β_{14} [late vs. middle adulthood] = 0.036, SE_β_{14} = 0.005, p < 0.001; Fig. 2d). In contrast, positive relations with others showed gains with time for the two older age groups, but little change for the younger age group. Within-person incline for the oldest age group was significantly different from the youngest age group (β_{13} = −0.011, SE_β_{13} = 0.005, p = 0.039), but there were no significant differences between middle and late adulthood (β_{14} = 0.007, SE_β_{14} = 0.005, p = 0.19; Fig. 2e).Within-person decline was evident for self-acceptance but was flatter for middle adulthood (β_{14} = 0.013, SE_ β_{14} = 0.005, p = 0.006; Fig. 2f) as compared to late adulthood.

Discussion

This study examined three waves of longitudinal data spanning 20 years on multiple dimensions of eudaimonic well-being in a national sample of U.S. adults. Supporting Dowd's distal claim[11], our findings show that opportunities for continued psychological growth and development are not equally distributed across all segments of society. Although cross-time decline was evident for multiple aspects of eudaimonia, those with a college degree showed less decline—in autonomy, environmental mastery, and personal growth—over 20 years compared to those with a high school education or less, with these gaps by educational status widening over time. For purpose in life, college-educated adults showed steeper decline over time, but such loss did not close the marked disparities compared to those with less educated adults across time. Educational differences in slope were not evident for positive relations with others or self-acceptance, although Fig. 1 shows that those with a high school education or less remained persistently lower at each wave compared to those with more education. Overall, effect sizes for education disparities were small to moderate (i.e., 0.05–0.20 standard deviation differences comparing high school to college educated adults), but these can have large impacts at the population level. For instance, a one standard deviation increase in purpose of life was associated with over 4 years of additional life expectancy at age 50 in the Health and Retirement Study[22]. Further, even when well-being is stable over time, those with persistently high well-being over time exhibited better health than those with persistently moderate or persistently low well-being[56,57]. These patterns of persistent disadvantage of reported experiences of well-being across time was observed for less educated adults, including lower levels of all dimensions of well-being at each wave and steeper longitudinal declines for most well-being dimensions.

Results converge with prior findings underscoring the reality of psychological disadvantage among less educated adults. Recent evidence of an expanding class divide in happiness in the United States showed that the happiness of White adults with high socioeconomic status (i.e., income, education, occupational prestige) was fairly stable between the 1970s through the 2010s, whereas the happiness of White adults with low socioeconomic status declined steadily over this time frame[58]. Findings from MIDUS have similarly shown that mental health (including both negative and positive indicators) has declined over time, particularly among those of lower socioeconomic standing[59,60]. These negative trends have been framed in the context of widening inequality, the opioid epidemic, growing alcoholism, and increased rates of suicide[61–63]. Additional studies have highlighted the increasing societal disparities where individuals with lower educational status were most vulnerable and younger generations demonstrated more severe stress and distress, with fewer age increments in well-being[64,65]. The present focus on long-term, within-person change extends prior cohort-based work by demonstrating that diminished well-being is becoming more prominent, especially among those with less education. These patterns coincide with historical changes in the value of educational attainment across the globe[66]. There are profound differences between those who attain education credentials and those without, including the kinds of occupations individuals can pursue, the levels of income they can command, and their opportunities to live full, healthy, and long lives[67]. Educational attainment may matter for well-being via multiple pathways, including effects on knowledge and literacy about the contexts that support well-being, effects on health behaviors (e.g., sleep, physical activity) that are bi-directionally associated with well-being[68,69], and effects on social networks, perceived control, stress exposure, and coping resources that may help cultivate psychological well-being[41]. It is important for future research to examine these pathways in order to mitigate education disparities in well-being.

Regarding age trends, the predominant tale of intra-individual change in well-being over 20 years was one of decline, which tended to be steeper for the oldest age group (autonomy, environmental mastery, personal growth), although for self-acceptance, it was the youngest and oldest age groups that showed steeper loss over time. All age groups showed comparable loss in purpose in life across the three waves. Only for positive relations with others were gains evident among the two oldest age groups. Figure 2 shows that younger adults were persistently lower than older adults on autonomy, environmental mastery, self-acceptance, and positive relations, but higher than older adults in personal growth and purpose in life.

Interpreting these findings on age variation in well-being trajectories requires consideration of multiple factors. Given the selective attrition that routinely sits behind longitudinal results (i.e., less healthy, less well participants tend to drop out over time[54,55]), the predominance of decline trajectories is notable, although age variation must be considered. That the oldest respondents were journeying across their 70s, 80s, and 90s, when health challenges are increasingly common, may make their diminished reports of environmental mastery and purpose in life across these decades of life understandable[70]. However, that younger adults showed persistently low levels of self-acceptance, along with unexpected loss for multiple other aspects of well-being (autonomy, personal growth, purpose in life) is concerning. Low self-acceptance among younger adults is consistent with other data showing younger adults, relative to older adults, consider goals related to intrinsic values (including self-acceptance) as less important, and goals related to extrinsic values (e.g., money, fame, image) as more important[71]. Further, changing economic circumstances (i.e., increasing income inequality; delayed home ownership) created additional financial pressures for younger, relative to older, adults[72], potentially leading to greater disappointment in achievements and lower self-acceptance overall among younger adults. Data from the National Survey on Drug Use and Health showed that rates of serious psychological distress increased from 2008 to 2017 among young adults as did the rate of young adults with suicidal thoughts and other suicide-related

outcomes, whereas older adults did not show such changes over time[73]. Such patterns align with trends over the last decade showing that psychological ill-being is on the rise, with one in five Americans suffering from a mental disorder in any given year[74]. Eudaimonic well-being has also shown decline at the population level[75]. Together, the overarching picture is that of wide-ranging decline across recent decades in multiple components of positive eudaimonic functioning. The societal picture is thus one of increasing psychological vulnerability.

Drawing on previous research linking eudaimonic well-being to diverse health outcomes, we conclude with consideration of the future health implications of these 20-year trajectories. Considerable evidence shows that certain aspects of eudaimonic well-being, such as purpose in life, predict extended longevity[21,22] as well as reduced risk for multiple diseases[76–78]. Other aspects of well-being are likewise positively associated with health, including better physiological regulation[79,80], and healthier neural functioning (e.g., reward circuitry, volumetric measures)[34,35,37]. A critical next line of inquiry is to investigate what the 20-year well-being trajectories mean for current and unfolding profiles of health. For instance, researchers could ask whether persistently lower levels of purpose in life among the less educated account for greater disparities in chronic conditions or biological risk factors than persistently higher levels of purpose in life. Because many midlife and older adults are living with (multiple) chronic conditions[81], it is also important for future research to examine possible reciprocal relationships between age-related changes in health and eudaimonic well-being, especially among those with low educational status. Prior research shows that health affects well-being trajectories among older adults, such that older adults in worse health show steeper declines in well-being[82,83].

What the present findings bring into high relief is the idea of *cumulative disadvantage across decades of time* for diverse aspects of well-being. The central question going forward is whether persistently low well-being experienced by the less educated will heighten risk for multiple adverse health outcomes (morbidity, mortality, physiological regulation, brain processes). These critical questions need scientific scrutiny across diverse long-term population studies, including whether such findings are comparable across gender and racial/ethnic subgroups. Increasing societal inequality portends possible dire consequences for long-term physical health (e.g., cardiovascular disease)[61,63,84]. That younger generations (e.g., Generation X and Y) have shown worsening physiological and mental health profiles compared to older generations (e.g., Baby Boomers)[85] underscores that health vulnerability is not restricted to later adulthood. New evidence also implicates historical context effects, in which major events (e.g., the Great Recession, the COVID-19 pandemic) may compromise the well-being of many, including younger and midlife adults[86] going forward.

Several limitations of the present research warrant consideration. First, the baseline sample under-represented participants of color. While subsequent waves increased the representation of Black and African American respondents, future research in more diverse samples of people of color is needed to examine potential racial and ethnic variation in long-term trajectories of eudaimonic well-being. Another issue is that individuals who dropped out after the first wave of MIDUS tended to have combinations of vulnerability factors including poor health and low income[54], thus raising the possibility of survivorship bias. The loss of such individuals suggests that the present finding may conservatively estimate the degree of compromised well-being among those who are disadvantaged, although our use of maximum likelihood estimation mitigates that concern to some extent. Third, while our study encompassed three waves of data across 20 years, we were only able to model linear trajectories of eudaimonic well-being, and the reliability and validity of well-being was lower at wave one than subsequent waves given that only 3-item measures were used to assess well-being at wave one and 7-item measures were used in waves two and three. Future work with four or more waves of data will be beneficial to examine possible nonlinear trajectories of eudaimonic well-being and to model trajectories of well-being dimensions with more comparable reliability and validity across time. Finally, given the notable variability in intraindividual trajectories of eudaimonic well-being, future research could examine patterns of resilience, defined by the maintenance or increments in well-being across time. Such inquiries may illuminate social contexts or individual traits that protect and promote the mental health of some despite the predominant trends of increasing psychological vulnerability in the general population.

In conclusion, our findings highlight differing intraindividual trajectories of eudaimonic well-being across 20 years in individuals of different educational status and age. A key message is that some individuals—defined by low educational standing and sometimes by age—show persistent vulnerability in experiences of purpose, growth, and other aspects of positive functioning across long decades of time. The implication of these tales of disadvantage for unfolding health outcomes is a major future research agenda. As studies continue to document the health benefits of eudaimonic well-being, it is imperative to address how larger segments of society can reap these benefits in the long run.

Methods

Transparency and openness

MIDUS data and measures are publicly available through the Inter-university Consortium for Political and Social Research (ICPSR) data repository (https://www.icpsr.umich.edu). The study was approved by Institutional Review Boards at each participating center, and informed written consent was obtained from all participants. All research was performed in accordance with the Declaration of Helsinki. We used R version 4.4.0[87], packages dplyr version 1.10[88], lme4[89], lmerTest[90], and ggplot version 3.4.0[91] to conduct our analyses. The study design, hypotheses, and analytic plan were not pre-registered. Analytic code needed to reproduce the analyses presented in this paper are available at https://osf.io/hktud/?view_only=38cd67f6d2af4bc78ba9512a2f106ae8.

Sample

We used data from the Midlife in the United States (MIDUS), a longitudinal survey of non-institutionalized adults in the United States, Waves 1 through 3. The first wave (MIDUS 1) was collected in 1995–1996 from a national random-digit-dialing sample of adults of ages 25–74 (N = 7108) at baseline. Of the MIDUS 1 respondents,

4963 respondents were re-interviewed approximately 9 years later (MIDUS 2), followed by a third wave of data collection with 3294 respondents in 2013–2014 (MIDUS 3). An additional sample of Black and African American adults from Milwaukee, Wisconsin were added to the study during Wave 2 (N = 592) and followed during Wave 3 (N = 518). Retention rates for both follow up waves, adjusting for ineligibility such as mortality, were 80% and 72% respectively. Detailed information about the sample disposition and reasons for attrition can be found in publicly available documentation (https://www.icpsr.umich.edu/web/ICPSR/series/203). Our final sample (N = 6908) included respondents who completed the self-administered questionnaires with at least *one* PWB measure from at least *one* wave, of which 63.78% (N = 4406) of the respondents had data from two or more waves, making use of all available data from respondents who participated in any of the three waves.

Measures

Eudaimonic well-being

We used six scales of eudaimonic well-being from Ryff's model of Psychological Well-Being[12]: autonomy (e.g., "My decisions are not usually influenced by what everyone else is doing"; α = 0.71), environmental mastery (e.g., "In general, I feel I am in charge of the situation in which I live"; α = 0.78), personal growth (e.g., "For me, life has been a continuous process of learning, changing, and growth"; α = 0.75), positive relations with others (e.g., "I know that I can trust my friends, and they know they can trust me"; α = 0.78), purpose in life (e.g., "Some people wander aimlessly through life, but I am not one of them"; α = 0.71), and self-acceptance (e.g., "When I look at the story of my life, I am pleased with how things have turned out"; α = 0.84). Composite scores were constructed by averaging across items for each dimension. Since eudaimonic well-being was measured using three items per subscale at Wave 1, but with seven items per scale at Waves 2 and 3, the scores of each subscale were min–max normalized within each wave, resulting in a range of 0 to 1 for each subscale at each wave. Each scale with less than three missing items was computed for each respondent.

Education

Educational attainment was measured on a 12-point scale (1 = "no school/some grade school" to 12 = "PhD, MD, JD, or other professional degree"). Given compelling evidence that college completion dramatically affects life opportunities in employment, economic, health, longevity domains[67], responses were recoded into three categories (0 = high school degree or lower [Reference]; 1 = some college; 2 = bachelor's degree or higher).

Age

Age at baseline was calculated based on respondents' birth by subtracting the birth year from the year Wave 1 was conducted (1995). To align with age groupings from prior studies examining age variation in psychological well-being[12,17,52], age was then grouped into early adulthood (40 or younger), middle adulthood (41–60), and late adulthood (61 or older [Reference]).

Sociodemographic covariates

Gender was coded as (0 = male [Reference]; 1 = female). Race was based on self-reported main racial origins (parents, grandparents, and other ancestors; n = 806 Black and/or African American (AA) respondents, $n = 39$ Native American or Alaskan Indigenous respondents, $n = 48$ Asian or Pacific Islander respondents, $n = 174$ multiracial or other race respondents, $n = 5629$ White respondents). Due to limited representation of racial groups other than White and Black and/or AA racial/ethnic origins, race was recoded into a three-level variable (0 = White [Reference]; 1 = Black and/or AA; 2 = Other racial category). Additional covariates at Wave 1 were included that have shown to be associated with age and education and well-being outcomes. Household total income was reported on a $0 to $300,000 range and was re-scaled to be on a 0–10 scale for analyses to aid in interpretation. Work status was recoded into three categories (0 = not employed [Reference], 1 = retired, 2 = currently employed). Total chronic conditions were self-reported from a list of 29 possible conditions and were mean-centered for analyses.

Statistical analysis

To test the proposed hypotheses, separate multilevel modeling analyses were conducted for each eudaimonic well-being dimension (autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, self-acceptance) to examine changes in well-being across 20 years of longitudinal data. Eudaimonic well-being was nested within each respondent, resulting in a two-level analysis.

Change in eudaimonic well-being across time was estimated using the following equation:

Level 1:

$$EWB_{ij} = \pi_{0j} + \pi_{1j}\,(Wave) + e_{ij} \tag{1}$$

Level 2:

$$\begin{aligned}\pi_{0j} = {} & \beta_{00} + \beta_{01}\left(Education\left[vs.somecollege\right]\right) \\ & + \beta_{02}\left(Education\left[vs.bachelor'sdegreeorhigher\right]\right) \\ & + \beta_{03}\left(Age\left[vs.earlyadulthood\right]\right) \\ & + \beta_{04}\left(Age\left[vs.middleadulthood\right]\right) + \beta_{05}\left(Gender\right) \\ & + \beta_{06}\left(Race\left[vs.\frac{Black}{AA}\right]\right) + \beta_{07}\left(Race\left[vs.Other\right]\right) \\ & + \beta_{08}\left(Income\right) + \beta_{09}\left(WorkStatus\left[vs.Retired\right]\right) \\ & + \beta_{010}\left(WorkStatus\left[vs.CurrentlyEmployed\right]\right) + \beta_{011}\left(ChronicConditions\right) \\ & + r_{0j}\end{aligned} \tag{2}$$

$$\begin{aligned}\pi_{1j} = {} & \beta_{10} + \beta_{11}\left(Education\left[vs.somecollege\right]\right) \\ & + \beta_{12}\left(Education\left[vs.bachelor'sdegreeorhigher\right]\right) \\ & + \beta_{13}\left(Age\left[vs.earlyadulthood\right]\right) \\ & + \beta_{14}\left(Age\left[vs.middleadulthood\right]\right) \\ & + r_{1j}\end{aligned} \tag{3}$$

Eudaimonic well-being (EWB_{ij}) was regressed on Wave (coded 0 [Wave 1], 1, or 2) to provide intra-individual change in eudaimonic well-being (Level 1). Education, age at baseline, gender, race, income, work status, and total chronic conditions were included as between-person (Level 2) variables. Model results thus show education and age differences in within-person trajectories of eudaimonic well-being, while adjusting for gender, race, income, work status, and total chronic conditions, income, working status, and chronic condition differences at wave 1. Supplemental Table 2 displays results with both education and age modeled as continuous variables, and results are largely unchanged from those reported in Table 2.

Model random effects, intraclass correlation (ICC) and pseudo R^2 are provided for Table 1. Autonomy: The standard deviation (SD) for autonomy intercept is 0.135. The SD for random slope for study wave is 0.036. The correlation between study wave and intercept is −0.333. The ICC is 0.555, the conditional R^2 (fixed and random effects) is 0.573, and the marginal R^2 (fixed effects only) is 0.041. Environmental Mastery: The SD for environmental mastery intercept is 0.133. The SD for random slope for study wave is 0.057. The correlation between study wave and intercept is -0.346. The ICC is 0.544, the conditional R^2 (fixed and random effects) is 0.588, and the marginal R^2 (fixed effects only) is 0.097. Personal Growth: The SD for personal growth intercept is 0.118. The SD for random slope for study wave is 0.044. The correlation between study wave and intercept is −0.102. The ICC is 0.560, the conditional R^2 (fixed and random effects) is 0.638, and the marginal R^2 (fixed effects only) is 0.177. Purpose in Life: The SD for purpose in life intercept is 0.136. The SD for random slope for study wave is 0.053. The correlation between study wave and intercept is −0.479. The ICC is 0.525, the conditional R^2 (fixed and random effects) is 0.572, and the marginal R^2 (fixed effects only) is 0.100. Positive Relations with Others: The SD for positive relations with others intercept is 0.171. The SD for random slope for study wave is 0.061. The correlation between study wave and intercept is −0.629. The ICC is 0.616, the conditional R^2 (fixed and random effects) is 0.644, and the marginal R^2 (fixed effects only) is 0.073. Self Acceptance: The SD for self acceptance intercept is 0.140. The SD for random slope for study wave is 0.043. The correlation between study wave and intercept is -0.186. The ICC is 0.600, the conditional R^2 (fixed and random effects) is 0.645, and the marginal R^2 (fixed effects only) is 0.112.

Data availability

MIDUS data and measures are publicly available through the Inter-university Consortium for Political and Social Research (ICPSR) data repository (https://www.icpsr.umich.edu/web/ICPSR/series/203). Analytic code needed to reproduce the analyses presented in this paper are available at https://osf.io/hktud/?view_only=38cd67f6d2af4bc78ba9512a2f106ae8.

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Author contributions

JHC and CR conceptualized the study. JHC contributed to data analysis and writing and editing the original draft. JMB contributed to writing and editing the original draft. JAK contributed to data analysis, figure preparation, and editing the writing. CR contributing to funding acquisition, data collection and management, editing the writing, and project supervision. All authors reviewed and approved the final manuscript.

Declarations

Competing interests
The authors declare no competing interests.

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