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1 Purpose in life is associated with health outcomes among diabetic adults

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Abstract

Objective: Health complications as a result of diabetes place major financial strain on individuals, financially and emotionally. The onset and severity of these complications is largely driven by patients' behaviors, making psychosocial factors that influence behaviors key targets for interventions. One promising factor is sense of purpose, or the degree to which a person believes their life has meaning. **Methods:** Coordinated analysis using 12 datasets cross-sectionally and eight longitudinally (total N = 63,307) estimated the degree to which sense of purpose is associated with smoking, subjective health, and cardiovascular disease among diabetic adults. In addition, effect sizes for diabetic adults was compared to samples of non-diabetic adults, estimating whether the relationship of purpose to health is tempered by the presence of diabetes. Coordinated analysis allows for greater generalizability of results across cultures, time periods, and measurement instruments. **Results:** Sense of purpose was associated with higher self-rated health and lower rates of smoking and cardiovascular disease both cross-sectionally and prospectively and did not differ between diabetic and non-diabetic samples. **Conclusions:** These results highlight the relationship of a key individual difference, sense of purpose, to the behaviors and outcomes of diabetic adults. While more research is needed to determine the boundaries of this relationship, it seems sense of purpose may be considered in the future as a potential target for intervention. Moreover, the similarity of results across diabetic and non-diabetic samples suggests that research specifically for diabetic populations can build upon existing research on purpose using general or healthy samples.

Keywords: purpose, diabetes, coordinated analysis, health behavior, heart disease, self-rated health

Purpose in life is associated with health outcomes among diabetic adults

The prevalence of diabetes among adults has nearly doubled over the past four decades (World Health Organization, 2016), which holds consequences for multiple health concerns including greater risk for cardiovascular disease (Sarwar et al., 2010), contributing to its role as a major mortality risk worldwide (Mathers & Loncar, 2006). Given these additional risks, multiple calls have been made for researchers to investigate the factors that may assist those with diabetes to maintain a healthier life (e.g., Gonzalez, Tanenbaum, & Commissariat, 2016). The current study sought to address this call with respect to understanding the potential benefits associated with sense of purpose in life. Though sense of purpose has been nominated as a consistent factor predicting positive health outcomes (Boyle, Barnes, Buchman, & Bennett, 2009; Hill & Turiano, 2014; Scheier et al., 2006), it remains unclear whether this psycho-social factor still promotes positive health outcomes for individuals currently dealing with a given health ailment. Health maintenance for those with diabetes requires a number of behaviors unique from those that promote health in the broader population, and thus one cannot assume any psycho-social factor that promotes health overall will hold similar effects for those dealing with diabetes. The current study thus sought to compare the associations between sense of purpose and health outcomes, including cardiovascular disease risk and self-rated health, for those individuals who were and were not diagnosed with diabetes, in order to understand whether this factor imbues similar benefits for both groups.

Sense of purpose and health outcomes

Though several personality and well-being factors have demonstrated predictive utility for health outcomes, sense of purpose in particular may be an important target for individuals seeking to improve the health for those dealing with diabetes. Having a purpose in life involves perceiving a central, self-organizing life aim that directs and catalyzes daily

activities and helps individuals set the short-term goals needed to advance toward that aim (McKnight & Kashdan, 2009; Ryff, 1989). Multiple studies have demonstrated that sense of purpose is positively associated with self-reported health and well-being (e.g., Hill, Edmonds, & Hampson, 2017; Scheier et al., 2006), and predicts long-term health outcomes including reduced mortality risk (Boyle et al., 2009; Hill & Turiano, 2014). When considering its value within the context of a health condition, it is worth noting that commitment to a purpose in life has been associated with greater agency and belief in one's ability to navigate obstacles (Bronk, Hill, Lapsley, Talib, & Finch, 2009), as well as greater perseverance over time (Hill, Burrow, & Bronk, 2016). Furthermore, having a sense of purpose has been shown to help individuals perceive daily obstacles as less physically demanding (Burrow, Stanley, Sumner, & Hill, 2014), and purposeful individuals appear less reactive to daily stressors (Hill, Sin, Turiano, Burrow, & Almeida, 2018). Accordingly, purposefulness appears valuable for navigating difficult situations in life, and it has been pointed to as a potential resilience factor during recovery from surgery (Smith & Zautra, 2004).

Moreover, sense of purpose has been linked to several of the health behaviors necessary for maintaining positive health when dealing with diabetes. For instance, sense of purpose has been linked to participants' reports of better dietary behaviors and greater physical activity (Hill et al., 2017). The association with activity has been found using objective markers of mobility as well, with one study showing purposeful individuals had higher step counts using a pedometer (Hooker & Masters, 2016). Furthermore, sense of purpose has been shown to predict reduced risk for cardiovascular issues (R. Cohen, Bavishi, & Rozanski, 2016; E. S. Kim, Sun, Park, Kubzansky, & Peterson, 2013), and with greater use of preventive health care services (E. S. Kim, Strecher, & Ryff, 2014). Accordingly, sense of purpose may be a psycho-social attribute uniquely suited to helping those with diabetes, insofar that it holds positive associations with several health behaviors that are key to treatment for those with diabetes.

However, the associations between sense of purpose and health outcomes have yet to be examined within samples with diabetes, and thus it remains unclear whether this psycho-social factor will hold similar, stronger, or weaker associations with health outcomes for this sample relative to the general population. Though health context has not been considered, previous work has shown limited evidence that sense of purpose differently predicts health outcomes across groups. For instance, research has shown that the association between sense of purpose and later mortality risk was not moderated by either age or working status (Hill & Turiano, 2014). Moreover, a meta-analysis found similar mortality risk ratios for those studies that investigated the role of sense of purpose in samples that either included or did not include participants with cardiovascular disease (R. Cohen et al., 2016). Though these analyses do not provide examinations of whether the role of sense of purpose on health differs by health context, the existing literature would suggest little evidence that the psycho-social factor differentially associates with health outcomes for certain subgroups of the population.

Coordinated analysis

Aiding the study of purpose in life and health is the opportunity to utilize publicly available data sets. Such data sets reduce the burden on individual researchers to collect sufficiently powered samples, and many are longitudinal, allowing for more robust and conservative tests of associations. Indeed, much of the published literature on purpose and health utilizes such data sets (e.g., Hill & Turiano, 2014). However, caution must be exercised when conducting research with pre-existing data. Those data sets often contain a substantial number of participants and variables, resulting in a larger potential number of researcher degrees of freedom (Weston, Ritchie, Rohrer, & Przybylski, 2018).

The potential for publishing spurious results from pre-existing data can be reduced through the use of coordinated analysis (Hofer & Piccinin, 2009, 2010). For this type of

study, analyses are performed on multiple studies, with models and variables harmonized to improve comparability between studies. Coordinated analyses guard against overindulgence in researcher degrees of freedom, as this method limits potential model complexity to only those analyses that are feasible in many studies. Moreover, spurious results have small to no impact; that is, if a null effect is deemed significant (or substantial) in one study because of random variation, it has a very low chance of being replicated in the other studies in the coordinated analysis and will stand out as an outlier. To some extent, the assessment of the same model in multiple data sets may be considered a kind of “replication” (Hofer & Piccinin, 2009, p. 152)

Not only do researchers report results from each data set, but they also calculate the overall effect size by combining results and the heterogeneity between studies, in case meaningful data set differences impact the results. In this way, the generalizability of an effect across measurement tools, cultures, or years (to name only a few potential moderators) may be assessed.

The current study

We sought to estimate the relationship between sense of purpose and three key health indicators – self-rated health, smoking, and cardiovascular disease – among diabetic adults. Given the overall positive relationship between purpose and health, we expect that sense of purpose would be positively associated with self-rated health and negatively associated with smoking and cardiovascular disease.

We also tested whether the relationships between purpose and health differed for diabetic adults compared to healthier adults. We hypothesized a significant interaction, such that at low levels of purpose, diabetic adults would have worse self-rated health, higher odds of smoking and higher rates of cardiovascular disease than non-diabetic adults, but at high

levels of purpose, there would be no difference between the groups. In other words, we expected purpose to mitigate the effects of diabetes. We tested these results in a coordinated analysis, combining results from 12 publicly available data sets.

Study 1 Methods

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study.

Data sets

Data sets were identified through the Inter-university Consortium for Political and Social Research (icpsr.umich.edu). Data sets were included in these analyses if they met the following criteria. First, they had to include a measure of purpose in life or sense of purpose. Second, they had to include a measure of diabetes status. Third, the study had to include at least a measure of self-rated health, current smoking status or heart condition status. (All studies presented here contained a measure of self-rated health, but not all included smoking or heart condition.) Finally, these measures had to have been assessed concurrently. A total of twelve studies were identified for inclusion in the current study.

American's Changing Lives (ACL). The ACL Survey is a nationally representative longitudinal study focusing on the differences between Black and White Americans in middle and late life (House, 2014). Data collection began in 1986 with adults over the age of 25; Black Americans and adults age 60 years or older were over-sampled at this time. Wave 4 was the only wave of data collection (which took place in 2001 and 2002) that included a measure of purpose in life. At this time, 1,648 participants (63% female, 27% non-white) had data on purpose in life, diabetes status and health outcomes. The average age of participants was 61.52 ($SD = 14.32$). Participants had, on average, 12.74 years of

education ($SD = 2.31$).

Australian Longitudinal Study of Aging (ALSA). The ALSA sought to examine the health and well-being of adults aged 70 and over living in Australia (Andrews & Myers, 2005). Data collection began in 1992, and purpose in life was first assessed in 1994. At this time, 1,522 participants (50% female) had data on purpose in life, diabetes status and health outcomes. Race was not included in this study, as race was not assessed and 98% of participants identified their ethnicity as Australian. The average age of participants was 79.27 ($SD = 6.32$). Participants had, on average, 9.28 years of education ($SD = 2.76$).

Changing Lives of Older Couples (CLOC). The Changing Lives of Older Couples study is a multi-wave prospective study of spousal bereavement (Nesse, Wortman, House, Kessler, & Lepkowski, 2003). Initial data collection began in 1987 and targeted older, married couples in the Detroit metropolitan area. Participants were interviewed as a couple and follow-up times were based on when the first spouse died. Only the third wave of data collection (48 months after spouse's death) contained a purpose in life assessment. At this time, 202 participants (91% female, 15% non-white) had data on purpose in life, diabetes status and health outcomes. The average age of participants was 75.44 ($SD = 6.14$). Participants had, on average, 12.04 years of education ($SD = 2.40$).

English Longitudinal Study of Ageing (ELSA). The ELSA sought to understand aging and quality of life in the UK for people over the age of 50 (M. Marmot et al., n.d.). It was patterned after the Health and Retirement Study in the United States. Purpose in life was first assessed in Wave 2 (2004) of data collection. At this time, 373 participants (54% female, 1% non-white) had data on purpose in life, diabetes status and health outcomes. The average age of participants was 66.18 ($SD = 9.28$). Education was scored as 1 (Less than high school), 2 (High school graduate), 3 (Some college), and 4 (College graduate and above; $M = 2.03$, $SD = 1.09$).

Health and Retirement Study (HRS). The HRS is a national panel study of older adults in America (Sonnega et al., 2014). Purpose in life was first administered to a subset of participants in 2006; an additional subset received the scale in 2008. At this time, 20,929 participants (58% female, 24% non-white) had data on purpose in life, diabetes status and health outcomes. The average age of participants was 65.93 ($SD = 11.07$). Participants had, on average, 12.65 years of education ($SD = 3.15$).

Korean General Social Survey (KGSS). The KGSS is the South Korean version of the General Social Survey (S.-W. Kim, 2013). Purpose in life was first assessed in 2009. At this time, 1,587 participants (52% female) had data on purpose in life, diabetes status and health outcomes. Race was not assessed by the KGSS and was not included in these analyses. The average age of participants was 43.47 ($SD = 15.21$). Education was measured on a scale from 1 (No formal schooling) to 7 (Graduate school/Ph.D.; $M = 4.61$, $SD = 1.49$).

Survey of Midlife in Japan (MIDJA). The MIDJA follows a sample of Japanese adults in the Tokyo metropolitan area (Ryff et al., 2018). Measures parallel those of the Midlife in the United States Study. Purpose in life was first assessed in 2008. At this time, 1,001 participants (51% female) had data on purpose in life, diabetes status and health outcomes. Race was not assessed by the midja and was not included in these analyses. The average age of participants was 54.17 ($SD = 14.01$). Education was measured on a scale from 1 (8th grade/junior high graduate) to 8 (Graduate school; $M = 4.48$, $SD = 2.07$).

Midlife in the United States (MIDUS). The MIDUS is a national panel study patterns, predictors and consequences of midlife development in the United States (Brim et al., 2017). The purpose in life scale was included in the first wave of data collection in 1992. At this time, 6,116 participants (53% female, 9% non-white) had data on purpose in life, diabetes status and health outcomes. The average age of participants was 46.87 ($SD = 12.93$). Education was measured on a scale from 1 (no school) to 12 (Ph.D. or professional degree; $M = 6.87$, $SD = 2.48$).

Project STRIDE: Stress, Identity and Mental Health (STRIDE). Project STRIDE examined the effect of stress and minority identity on mental health (Meyer, Dohrenwend, Schwartz, Hunter, & Kertzner, 2016). Participants were residents of the New York City area. Purpose in life was assessed in 2004. At this time, 524 participants (50% female, 50% non-white) had data on purpose in life, diabetes status and health outcomes. The average age of participants was 32.06 ($SD = 9.27$). For education, participants reported whether they had less than or equivalent to a high school diploma (18%), whether they had completed some college but not received a degree (28%) and whether they had a received a bachelor's degree (53%). Responses were converted into numeric values representing approximately the amount of time participants spend in formal schooling (5 years for less than a high school diploma, 12 years for a high school degree, 14 for more than a high school diploma but less than a bachelor's degree and 16 years for a bachelors). Participants had, on average, 13.40 years of education ($SD = 4.10$).

Study of Women's Health Across the Nation (SWAN). SWAN was designed to examine how mid-life experiences affect the health and well-being of women (Sutton-Tyrell et al., 2014). A purpose in life scale was included in the screener for this study. At this time, 15,442 participants (50% non-white) had data on purpose in life, diabetes status and health outcomes. The average age of participants was 47.09 ($SD = 4.34$). Education was measured on a scale from 1 (Less than high school) to 5 (post [college] graduate education; $M = 3.02$, $SD = 1.21$).

United States National Health Measurement Survey (USNHMS). USNHMS aimed to cross-calibrate several measures of health-related quality of life in a sample of older US adults (Fryback, 2009). This was a cross-sectional survey, with data collected in 2005 and 2006. At this time, 3,801 participants (57% female, 33% non-white) had data on purpose in life, diabetes status and health outcomes. The average age of participants was 60.20 ($SD = 14.03$). Education was measured on a scale from 1 to 18, with 1 through 12

corresponding to grade graduated through secondary school, 13 through 16 corresponding to the number of years in college, 17 corresponding to a master's degree and 18 corresponding to a Ph.D. or professional degree ($M = 13.60$, $SD = 2.77$).

Wisconsin Longitudinal Study (WLS). WLS is a long-term study following a random sample of people who graduated from Wisconsin high schools in 1957 and some of their siblings (Herd, Carr, & Roan, 2014). Purpose in life was first assessed in 1992. At this time, 10,236 participants (53% female) had data on purpose in life, diabetes status and health outcomes. Racial identity was not included in the publicly available data set. The average age of participants was 53.31 ($SD = 4.27$). Participants had, on average, 13.71 years of education ($SD = 2.38$).

Measures

Purpose in Life. Nearly all studies measured purpose by adapting the Purpose in Life sub-scale of the Psychological Well-Being scale (Abbott et al., 2006; Ryff & Keyes, 1995). This measure included items like “I have a sense of direction and purpose in my life” and “I sometimes feel as if I’ve done all there is to do in life” (reverse scored). This scale has a total of XX items; individual studies administered as few as one item and as many as seven to their participants. Two studies (KGSS and SWAN) administered measures of purpose that were not based on the Purpose in Life sub-scale. The KGSS administered four items, including “I believe I can find the purpose of life, i.e., a reason to live for” and “I still have many things left to do”; SWAN administered three items including “I have a mission or purpose in life” and “My faith sustains me.” Exact items for each study and their relationship to the Ryff scales are presented in Supplementary File 1, Table XX. Descriptive statistics for each study are presented in Table 1. Response scales varied for each study; prior to analysis, purpose scores were scaled such that 1 represented the lowest possible level of purpose and 5 represented the highest. By rescaling purpose (and other continuous

covariates), regression coefficients are harmonized and comparable across studies.

Diabetes. All studies gathered data on whether or not participants had been diagnosed with diabetes. This was measured at the same time as purpose in life. Most studies used some form of the question, “Has a doctor [or other medical professional] ever told you that you have diabetes?” In the MIDUS and the MIDJA, participants were asked whether they had experience or been treated for diabetes in the last 12 months (as opposed to ever). In the ALSA, participants reported whether they were currently receiving treatment for diabetes. Responses for all studies were coded as 0 (not diagnosed/treated) and 1 (diagnosed/treated).

Self-rated health. All studies assessed health using a single-item measure general health. For nearly every study, this item was a variation of the question “In general, how would you rate your health?” with response options “excellent”, “very good”, “good”, “fair” and “poor.” The WLS included “very poor” and omitted “very good”. The MIDJA used a response scale from 1-10 (worst possible health to best possible health); this was rescaled to match the 1-5 scale in the other studies. Responses were coded such that larger values indicate better health.

Smoking status. Most studies included measurement of smoking, although the question wording and response choices varied widely between studies. Exact wording for each study is presented in Supplementary File 2. We recoded all variables such that 0 indicated a participant did not currently smoke and 1 indicated that they did currently smoke.

Heart Condition. Most studies gathered data on whether or not participants had been diagnosed with a heart condition of some kind. Most studies used some form of the question, “Has a doctor [or other medical professional] ever told you that you have heart disease?” Some studies included in this question specific forms of heart disease, such as heart attack, angina, coronary heart disease, and congestive heart failure. The MIDUS asked nine

different questions assessing various types of heart disease. Again all questions are available in Supplementary File 2. Responses for all studies were coded as 0 (not diagnosed/treated) and 1 (diagnosed/treated).

Covariates. For all regression models, we control for age, gender, education and race, when appropriate. For example, SWAN was a study of all women, so gender was not included. Gender was coded as male (0) and female (1). Age was centered at 50 and divided by 10, to improve convergence. Race was coded as white (0) and non-white (0). Education was often assessed as the number of years in school, although some studies preferred a shorter Likert scale. Again, all question text is available in Supplementary File 2.

Registered analyses

This study was preregistered on OSF (osf.io/dr862). We deviated from the pre-registration by adding several data sets that were identified during the original search. Those data sets were the ALSA, KGSS, MIDJA, and SWAN. We additionally deviated by dropping either gender or race as a covariate when a study was homogeneous on that variable.

Study 1 Results

First we examined the bivariate relationships between purpose in life and health outcomes for diabetic adults only. The relationship between self-rated health and purpose was consistently positive. Among these adults, purpose in life was positively correlated with self-rated health in all studies except the CLOC and the STRIDE. The bivariate relationships between purpose and smoking or heart conditions were consistently absent. Purpose in life was higher for non-smokers than for smokers only in the HRS and the USNHMS, and purpose was higher for individuals without heart conditions than for

individuals with heart conditions only in the HRS, the USNHMS and the WLS. All bivariate relationships among diabetic adults are shown in Table 2.

Next we examined the relationship between purpose and health outcomes, controlling for age, gender, education and race, for diabetic adults only. We next ran these same models for the sample of non-diabetic adults. Finally, we ran a test of the interaction of purpose and diabetes on each of the health outcomes, including covariates, to determine whether the relationship between purpose and health differed for those with diabetes than from non-diabetic or general populations. The coefficient estimates of the relationship between purpose and outcomes from the sub-sample regressions, as well as the interaction coefficients, can be seen in Figure 1.

After testing these relationships within each study, we examined the overall association using meta-analytic tools. That is, we calculated the weighted average effect, with standard errors accounting for the combined sample sizes. We also estimate the between-study heterogeneity, as differences between studies may reflect moderators of the effects. For each meta-analysis, we report the overall weighted effect and the heterogeneity of the effects. If the heterogeneity is significant, we also report which, if any, of the following variables explained this heterogeneity: mean age of participants, the earliest year of data collection, the number of items used to measure purpose in life and whether or not the study was run in the United States.¹

Self-rated health

Among diabetic adults, purpose was positively related to self-rated health overall ($b = 0.23$, $p < .001$) and in a majority of the studies: ALSA ($b = 0.23$, $p = 0.011$), ELSA ($b = 1.03$, $p = 0.019$), HRS ($b = 0.31$, $p < .001$), MIDJA ($b = 0.44$, $p = 0.011$), MIDUS

¹The moderation analyses were performed on all meta-analyses, regardless of significance, per the pre-registration. The results can be seen in Table XX in Supplementary File 1.

($b = 0.18$, $p = 0.005$), SWAN ($b = 0.14$, $p = 0.001$), USNHMS ($b = 0.30$, $p < .001$). The heterogeneity between effect sizes was significant ($I^2 = 58.29\%$, $Q = 31.62$, $df = 11$, $p = .001$). This heterogeneity was partially related to the number of purpose items used; for each additional item, the effect size increased by 0.03 ($p < .001$).

Among non-diabetic adults, purpose was positively related to self-rated health overall ($b = 0.24$, $p < .001$) and in all studies except STRIDE. The heterogeneity between effect sizes was significant ($I^2 = 96.72\%$, $Q = 308.73$, $df = 11$, $p < .001$). This heterogeneity was partially related to the number of purpose items used and to the average age of participants in the study. For each additional purpose item administered, the effect size increased by 0.03 ($p < .001$). Also, as the average age of the sample increased by one decade, the relationship between purpose and self-rated health increased by 0.06 ($p = .002$).

Finally, we examined the interaction between purpose and diabetes status on self-rated health, to determine whether purpose was differentially related to health for diabetic adults. This interaction was significant only in one study, the HRS ($b = -0.06$, $p = 0.005$), such that purpose was less strongly related to self-rated health for diabetic adults than for non-diabetic adults. Overall, the effect was non-significant ($b = -0.02$, $p = .257$). The heterogeneity between effect sizes was non-significant ($I^2 = 16.13\%$, $Q = 12.30$, $df = 11$, $p = .342$).

Smoking status

Among diabetic adults, purpose in life was associated with a lower likelihood of being a smoker only in the HRS ($b = -0.21$, $OR = 0.81$, 0.00) and the USNHMS ($b = -0.41$, $OR = 0.66$, 0.01). Overall, purpose was associated with lower rates of smoking among diabetic adults ($b = -0.18$, $OR = 0.84$, $p < .001$). The heterogeneity between effect sizes was nonsignificant ($I^2 = 0.01\%$, $Q = 5.56$, $df = 8$, $p = .697$). Given this lack of heterogeneity, combined with the lack of significance in the majority of the studies, we expect that testing

this hypothesis in one study alone would likely yield a non-significant result. By using a coordinated analysis approach, we are able to detect this effect and find little evidence that differences between the studies contribute to any variation in effect size.

Among non-diabetic adults, purpose in life was associated with a lower likelihood of being a smoker overall ($b = -0.22$, $OR = 0.81$, $p = .001$) and in the ALSA ($b = -0.51$, $OR = 0.60$, 0.00), ELSA ($b = -0.81$, $OR = 0.44$, 0.00), HRS ($b = -0.35$, $OR = 0.70$, 0.00), MIDUS ($b = -0.15$, $OR = 0.86$, 0.00), and USNHMS ($b = -0.25$, $OR = 0.78$, 0.00). The heterogeneity between effect sizes was significant ($I^2 = 90.72\%$, $Q = 95.96$, $df = 8$, $p < .001$) and partially accounted for by the age and country of origin. As the average age in the study increased, the relationship between purpose and smoking became more negative ($b = -0.15$, $OR = 0.86$, $p < .001$); American studies had less negative associations between purpose and smoking than non-American studies ($b = 0.33$, $OR = 1.39$, $p = 0.017$).

Finally, the interaction between purpose and diabetes status on smoking was non-significant overall ($b = 0.08$, $OR = 1.08$, $p = .213$) and only statistically significant in the HRS such that the relationship between purpose and smoking was stronger (i.e., more negative) for non-diabetic adults ($b = 0.18$, $OR = 1.20$, 0.01). The heterogeneity between effect sizes was nonsignificant ($I^2 = 14.98\%$, $Q = 6.02$, $df = 8$, $p = .645$).

Heart condition

Among diabetic adults, purpose in life was associated with lower likelihood of having a heart condition overall ($b = -0.25$, $OR = 0.78$, $p = .001$) and in the HRS ($b = -0.22$, $OR = 0.80$, $p < .001$), the USNHMS ($b = -0.37$, $OR = 0.69$, $p = 0.003$) and the WLS ($b = -0.61$, $OR = 0.54$, $p < .001$). The heterogeneity between effect sizes was nonsignificant ($I^2 = 45.72\%$, $Q = 12.84$, $df = 9$, $p = .170$).

Among non-nondiabetic adults, purpose in life was associated with lower likelihood of

having a heart condition overall ($b = -0.14$, $OR = 0.87$, $p = .001$) and in the HRS
 ($b = -0.16$, $OR = 0.85$, $p < .001$), the USNHMS ($b = -0.25$, $OR = 0.78$, $p = 0.007$) and the
 WLS ($b = -0.24$, $OR = 0.79$, $p < .001$). The heterogeneity between effect sizes was
 nonsignificant ($I^2 = 43.98\%$, $Q = 13.48$, $df = 9$, $p = .142$).

Finally, the interaction between purpose and diabetes status on the likelihood of
 having a heart condition was non-significant overall ($b = -0.07$, $OR = 0.93$, $p = 0.10$) and
 significantly only in the WLS ($b = -0.36$, $OR = 0.69$, $p = 0.029$). In this case, the purpose
 was associated with lower rates of heart conditions among diabetic adults than non-diabetic
 adults. The heterogeneity between effect sizes was nonsignificant ($I^2 = 0.00\%$, $Q = 8.33$,
 $df = 9$, $p = .501$).

Study 1 Conclusion

As hypothesized, sense of purpose was associated with better self-rated health and
 lower rates of smoking and cardiovascular disease. However, we did not find that the
 relationship between purpose and health differed for diabetic adults compared to nondiabetic
 adults. In addition, we found little evidence of heterogeneity between the studies, suggesting
 that these results are robust to year of assessment or culture. There is some evidence that
 the effects are stronger when longer measures of purpose are used.

Many of the data sets that contained measures of purpose and diabetes came from
 longitudinal studies. Consequently, we chose to further analyze the relationship between
 purpose and changes in the health measures of interest. Cross-sectional effects may be useful
 in clinical settings for identifying potential risk factor or indicators of poor health. In other
 words, if these effects hold, lower levels of purpose may indicate to a physician that a patient
 is at risk for a host of unhealthy indicators, behaviors and outcomes. Longitudinal effects, on
 the other hand, point to potential intervention targets. For example, if sense of purpose is

associated with declines in smoking, then purpose may be a fruitful intervention target among diabetic adults.

We hypothesized that purpose would be prospectively associated with higher levels of self-rated health, lower odds of smoking and lower rates of cardiovascular disease; we also hypothesized that purpose would be associated with less steep declines in self-rated health, stronger declines in rates of smoking and less steep increases in rates of cardiovascular disease. We hypothesized that these associations would be the same among diabetic and nondiabetic adults. This study was designed and preregistered after the results of study 1 were known.

Study 2 Methods

Data sets and measures

The same data sets that were used in Study 1 were used in Study 2, provided that the study had additional measures of the outcomes (self-rated health, smoking status and heart condition status) after the initial measurement of purpose in life. Studies included in these analyses were the ACL study, with a total of two waves of data collection across 11 years; the ALSA study, with three waves of data collection across 2 years; the ELSA study, with five waves of data collection across 9 years; the HRS study, with six waves of data collection across 10 years; the KGSS study, with four waves of data collection across 3 years; the MIDJA study, with two waves of data collection across 4 years; the SWAN study, with 11 waves of data collection across 10 years; and the WLS study, with three waves of data collection across 19 years.

Measures were identical to those described above. As in Study 1, we used the first measurement of purpose in life for each participant as their baseline. This was the only assessment of purpose used in these analyses. Self-rated health, smoking status and heart condition status were measured at baseline and subsequent waves. Self-rated health was

rescaled to be on a 1 to 5 scale (if it was not already), with larger numbers indicating better health. Smoking status and heart condition status were binary. Covariates, also measured at this baseline, were age, gender, race, and education. Within each study, age was centered at 50 and divided by 10, to improve convergence.

Registered analyses

Within-study. For each outcome (self-rated health, smoking status and heart condition status), we estimated growth models using a multilevel model format. Time was measured in years, centered at the individual's last wave of participation in a study. We chose to center at the end of the study, rather than the measurement of purpose-in-life. We chose this centering because centering at baseline (i.e., measurement of purpose in life) was redundant with the analyses in Study 1. By examining the last possible time point, we could estimate the long-term differences in health as a function of purpose and diabetes status. We build three models: (1) the linear growth model, (2) the linear growth model with purpose as a predictor of both slope and intercept, and (3) the linear growth model with purpose by diabetes status (and the partialled main effects of each) as predictors of the slope and intercepts. In all models, we control for age, gender, education and race.

We deviated from the preregistration and omitted the KGSS study from the heart condition analyses, as the base rates of heart conditions were too low in this data set and the analytic models could not converge.

Between-study. We estimate the weighted average estimates for the following coefficients. In the linear growth model (1), the weighted average intercept (i.e., final outcome assessment) and slope (i.e., average trajectory). In the model with purpose (2), the coefficient of purpose predicting the intercept and the coefficient of purpose predicting the slope. And finally, in the model with purpose by diabetes status (3), the interaction of

purpose and diabetes predicting the intercept and predicting the slope. Analyses were pre-registered on the OSF <https://osf.io/t6phe>.

Study 2 Results

Self-rated health

Results for the self-rated health models are displayed in Table 3. This table organizes the coefficients of interest from the three models described above. Specifically, we display the intercept and slope estimates from the linear growth models, the purpose coefficients on the intercept and slope (when purpose is added to the model), and the purpose by diabetes status coefficients on the intercept and slope (when this interaction is added to the model). Furthermore, we present the results from the individual studies, as well as the weighted average effects (labelled “meta”).

Self-rated health tended to decline over time, by an average of -0.02 units per year ($SE_b = 0.01$, $p = .033$). This pattern was consistently seen across the studies, with one notable exception. In the ELSA study, participants tended to increase in self-rated health ($b = 0.01$, $SE_b = 0.05$, 0.90). We also report the intercepts of the models in Table 3, although these are for reference rather than inference.

Purpose in life was a significant predictor of the intercepts (i.e., levels of self-rated health at the last measurement occasion) of self-rated health overall ($b = 0.17$, $SE_b = 0.03$, $p < .001$) and in nearly all individual study models. Specifically, purpose in life was associated with higher levels of purpose in the ACL ($b = 0.16$, $SE_b = 0.04$, $< .001$), the ALSA ($b = 0.15$, $SE_b = 0.02$, 0.00), the ELSA ($b = 0.35$, $SE_b = 0.06$, 0.00), the HRS ($b = 0.25$, $SE_b = 0.01$, 0.00), the MIDJA ($b = 0.17$, $SE_b = 0.04$, 0.00), the MIDUS ($b = 0.16$, $SE_b = 0.04$, 0.00), and the WLS ($b = 0.15$, $SE_b = 0.01$, 0.00). Purpose was associated with lower levels of self-rated health only in the KGSS, although this was not statistically

significant ($b = -0.42$, $SE_b = 0.24$, $p = 0.08$). The heterogeneity between effect sizes was significant ($I^2 = 93.04\%$, $Q = 128.69$, $df = 8$, $p = < .001$). None of the preregistered study-level moderators (average age in study, year of baseline purpose data collection, number of items in the purpose in life scale, whether the sample was from the United States, or the maximum number of years between purposes and the final health measurement) were associated with average trajectory.

The relationship of purpose in life to the intercepts of these models did not differ by diabetes status. In other words, the interaction of purpose in life and diabetes was not significant overall ($b = -0.02$, $SE_b = 0.01$, $p = .183$) or in any of the individual models (see Table 3 for exact values). The heterogeneity between effect sizes was not significant ($I^2 = 0.00\%$, $Q = 4.36$, $df = 8$, $p = 0.82$). Based on these results, we conclude that purpose in life is prospectively associated with self-rated health and this relationship does not differ between adults with diabetes and adults without.

Purpose in life may be prospectively associated with self-rated health, but it was not associated with changes in self-rated health overall ($b = -0.05$, $SE_b = 0.05$, $p = .308$). In individual studies, purpose in life was associated with greater declines in self-rated health in the HRS ($b = 0.00$, $SE_b = 0.00$, $.020$), the KGSS ($b = -0.65$, $SE_b = 0.11$, $p = 0.00$), the SWAN ($b = -0.01$, $SE_b = 0.00$, 0.01) and the WLS ($b = 0.00$, $SE_b = 0.00$, 0.00). The heterogeneity between effect sizes was significant ($I^2 = 99.99\%$, $Q = 45.64$, $df = 8$, $p = < .001$); the relationships between purpose in life and changes in self-rated health were not associated with any of the preregistered study-level moderators.

The relationship between purpose in life and trajectories of self-rated health (or lack thereof) was not associated with diabetes status ($b = 0.00$, $SE_b = 0.00$, $p = .321$). This interaction coefficient was nonsignificant in all the studies as well and showed no evidence of heterogeneity between the studies ($I^2 = 0.00\%$, $Q = 5.98$, $df = 8$, $p = .650$).

Smoking status

While across the studies there was no change in likelihood of being a smoker ($b_{logodds} = -0.49$, $SE_b = 0.64$, $p = .448$), there was significant heterogeneity between the average study trajectories ($I^2 = 99.79\%$, $Q = 645.27$, $df = 7$, $p < .001$). Most studies (i.e., the KGSS, the MIDJA, the MIDUS, the SWAN and the WLS) have significant negative slopes, indicating that participants are less likely to smoke over time. However, the other studies (the ACL, the ELSA and the HRS) had significant positive slopes, indicating that participants were more likely to smoke over time. We examined study-level moderators of trajectories and found that studies with older participants had more positive slopes or increases in smoking likelihood ($b = 0.13$, 95% CI [0.01, 0.25], $p = .030$). Again, we also present the intercepts from these growth models in Table 4 for reference.

Purpose in life was associated with lower odds of being a current smoker at the final measurement occasion overall ($b_{logodds} = -0.22$, $SE_b = 0.04$, $p < .001$). However, this coefficient was significant in only one individual study (the HRS). All effect sizes were in the same direction and there was no significant heterogeneity in the effect between studies ($I^2 = 0.00\%$, $Q = 3.62$, $df = 7$, $p = .823$). This suggests that individual studies may lack the power to detect this effect, and that the prospective relationship between purpose and smoking status is small. The prospective relationship between purpose and smoking status did not differ by diabetes status overall ($b_{logodds} = 0.09$, $SE_b = 0.08$, $p = .287$) or in any of the individual studies.

Purpose in life was not associated with the trajectories of smoking status across the studies ($b_{logodds} = 0.02$, $SE_b = 0.05$, $p = .707$). There was no heterogeneity in this effect ($I^2 = 37.35\%$, $Q = 9.75$, $df = 7$, $p = .203$). Finally, the relationship between purpose and trajectories of smoking status did not differ by diabetes status ($b_{logodds} = -0.02$, $SE_b = 0.06$, $p = .775$). Again, there was no heterogeneity in this effect ($I^2 = 0.00\%$, $Q = 0.74$, $df = 7$,

528 $p = .998$).

529 **Heart condition**

530 Overall, participants' likelihood to develop a heart condition increased over time
 531 ($b_{logodds} = 0.51$, $SE_b = 0.21$, $p = .015$), although there was significant heterogeneity in the
 532 average slopes between the studies ($I^2 = 99.96\%$, $Q = 1$, 258.79 , $df = 6$, $p = < .001$). None of
 533 the preregistered study-level moderators were associated with average trajectories of heart
 534 disease. In all studies, the likelihood of developing a heart condition increased. Exact slope
 535 estimates (in log odds) are presented in Table 5.

536 Individuals higher in purpose in life were less likely to have a heart condition at their
 537 last measurement occasion ($b_{logodds} = -0.11$, $SE_b = 0.05$, $p = .042$). However, this
 538 relationship was only significant in the HRS. All effect sizes were in the same direction and
 539 the heterogeneity between the effect sizes was nonsignificant ($I^2 = 42.68\%$, $Q = 9.74$, $df = 6$,
 540 $p = .136$). The relationship between purpose and the likelihood of having a heart condition
 541 was not associated with diabetes status ($b_{logodds} = -0.06$, $SE_b = 0.09$, $p = .481$). Again, the
 542 heterogeneity between studies of this effect was nonsignificant ($I^2 = 0.00\%$, $Q = 4.79$, $df = 6$,
 543 $p = .571$).

544 Purpose was not associated with trajectories of having a heart condition over time
 545 ($b_{logodds} = 0.01$, $SE_b = 0.01$, $p = .175$). The heterogeneity between the effect sizes was
 546 nonsignificant ($I^2 = 72.44\%$, $Q = 10.54$, $df = 6$, $p = .104$). The relationships between
 547 purpose and heart condition likelihood trajectories were unassociated with diabetes status
 548 ($b_{logodds} = 0.01$, $SE_b = 0.01$, $p = .337$). Again, the heterogeneity between studies of this effect
 549 was nonsignificant ($I^2 = 0.00\%$, $Q = 0.50$, $df = 6$, $p = .998$).

Study 2 Conclusion

Through longitudinal analyses, we conclude that purpose in life is prospectively associated with self-rated health, smoking status and heart condition status among diabetic adults. These associations do not appear to be significantly different than the prospective associations between purpose and these health indicators among non-diabetic adults. However, purpose was unassociated with changes in self-rated health or in smoking or heart condition likelihood over time.

Discussion

The current study found that purpose in life is concurrently and prospectively associated with self-rated health, smoking status and heart conditions among diabetic adults. Some of these associations replicated across multiple data sets. For example, the relationship between purpose in life and self-rated health was significant in eight of 12 data sets. Even when results did not replicate by way of being statistically significant, effect sizes were nearly always in the same direction and of similar magnitude, suggesting that lack of power drove “non-replications” in this sense. Importantly, the associations between purpose in life and health does not appear to be weaker for diabetic adults than for non-diabetic adults, nor does purpose in life buffer the harmful effects of diabetes. While purpose in life is associated with levels of self-rated health and other health indicators, purpose appears to be unassociated with changes in health status over time.

Positive associations between purpose and health among diabetic adults suggest that purpose in life may be an important psychological factor in the health of diabetic adults. For example, diabetic adults with a greater sense of purpose may be more successful in changing their health behaviors, given that purposeful adults generally have greater beliefs in their ability to overcome obstacles (Bronk et al., 2009; Burrow et al., 2014; Hill et al., 2016).

Accordingly, we might expect purpose to be associated with changes in physical activity and dieting, shortly after diabetes diagnoses. Moreover, we might expect purposeful diabetic adults to experience better long-term health than their non-purposeful counterparts. These results suggest that purpose in life may be a promising target of interventions. More specifically, the existing literature on purpose and health broadly may be useful in developing future research on the utility of changing purpose among diabetic adults , without need for repeat testing of these effects in the diabetic population. Being able to rely on existing findings reduces the burden on public health researchers, as it saves the time, money and resources necessary to replicate those results in special sub-populations. That being said, more research is needed on all aspects of purpose and health before the development of interventions is warranted.

However, those wishing to build on the existing purpose and health literature should take note of the heterogeneity found in the current study. Specifically, we found that the relationship between purpose and self-rated health in diabetic adults varied across study to a noteworthy degree. There was no consistent explanation for this variation: in the cross-sectional analyses, this variation was associated with length of purpose scales, while in the longitudinal analyses, variation was associated with participant age and country of origin. It is therefore difficult to pinpoint one or even a few theoretical reasons for the variation. On the one hand, these inconsistent and varied results may simply point to the nature of these two measures. Purpose in life and self-rated health are both self-reported variables, and so may be similarly influenced by psychological factors. Post-retirement adults, for example, are known to have different responses to purpose in life questionnaires (Hill & Weston, 2017) and are also more likely to report worse health. On the other hand, all of these moderators may point to the role of cultural norms, which would shape everything from one's changing role in society of the lifespan to the interpretation of purpose itself. We suggest that future research not only consider study-level demographics as moderators, but other methods of quantifying cultural norms (in terms of geographical location as well as time period) that may be at play.

Purpose was unassociated with changes in health over time. This may be due to a methodological issue. Changes in behavior and health perceptions among diabetic adults may occur most dramatically or with the greatest likelihood just following a diagnosis. If this is true, then greater declines in self-rated health and smoking should be seen in the months following a diagnosis. Few of the data sets used in the current study provided date of diagnosis, so we were unable to track time since diagnosis as a time-scale in the longitudinal analyses. Had we been able to select for participants newly diagnosed or better incorporate time since diagnosis into our analyses, we might have seen relationships between purpose and self-rated health or smoking. However, it would also be expected that the development of heart conditions would occur farther out, perhaps years or decades post-diagnosis, and so might be just as easily captured by our models. We cannot ignore the likely possibility that purpose in life is simply unassociated with changes in health.

One important caveat to this conclusion is that the outcomes examined in the current study are general health outcomes. While we chose these outcomes to be as relevant to diabetes as we could – smoking cessation being an especially important behavior for diabetics and heart disease a more common outcome than for the general population – we were limited in our capacity to examine indices and behaviors specific to diabetes. This was in part by design: examining general outcomes allows for comparison to general populations and the inclusion of more pre-existing studies in the coordinated analysis. However, there is more to be learned from studying biomarkers that more specifically track the health of diabetics, like hemoglobin A1c, or medication adherence in terms of glucose monitoring and insulin injections. Future research should examine the role of purpose in life to behaviors and outcomes such as these, as this will clarify the extent to which purpose might specifically impact the life of a diabetic adult.

The limitations of this study naturally limit the generalizability of our conclusions. All studies used self-report questionnaires to assess purpose and health, as well as all other

variables in this study. The use of self-report is common in these panel studies and often allows for larger and more representative samples (a clear advantage for these analyses). However, especially in the context of health, associations between psychological constructs and real-world behavior or objective outcomes should be documented before changing policy. In addition, the use of coordinated analysis requires some harmonization of measures, if studies are to be compared. To this end, we often dichotomized outcomes (smoking or heart condition) or covariates to facilitate comparisons. However, this necessarily means that in some studies, information and specificity was lost.

Conclusion

Purpose in life is concurrently and prospectively associated with some health outcomes and behaviors among diabetic adults. Purpose in life is likely an important psychological factor in the health of diabetic adults and may have utility in designing interventions to combat the negative outcomes of diabetes. Future research should consider the role of purpose in identifying diabetic adults in most of need of intervention.

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Table 1

Descriptive statistics for study 1

Study	N	Age	Gender	Education	Nonwhite	Purpose	Diabetic	SRH	Smoker	Heart
		M(SD) Range	(%F)		(%)		(%)		(%)	(%)
ACL	1,648	1.15 (1.43) -1.00-4.80	62.80	12.74 (2.31) 8.00-16.00	26.70	4.33 (1.01) 1.00-5.00	13.83	3.44 (1.04) 1.00-5.00	15.17	6.56
ALSA	1,522	2.93 (0.63) 1.70-5.50	50.46	9.28 (2.76) 0.00-20.00		3.39 (0.94) 1.00-5.00	9.53	3.06 (1.05) 1.00-5.00	6.05	
CLOC	202	2.54 (0.61) 0.70-4.20	90.59	12.04 (2.40) 4.00-17.00	15.35	3.86 (0.72) 2.07-5.00	13.37	2.98 (0.99) 1.00-5.00	11.39	18.81
ELSA	373	1.62 (0.93) 0.20-3.60	53.62	2.03 (1.09) 1.00-4.00	0.80	3.86 (0.63) 1.95-5.00	7.24	3.24 (1.07) 1.00-5.00	13.14	16.35
HRS	20,929	1.59 (1.11) -3.10-5.50	58.43	12.65 (3.15) 0.00-17.00	23.93	3.87 (0.77) 1.00-5.00	20.15	3.15 (1.10) 1.00-5.00	15.64	21.45
KGSS	1,587	-0.65 (1.52) -3.20-4.40	51.73	4.61 (1.49) 1.00-8.00		4.50 (0.96) 1.00-5.00	4.54	3.48 (1.12) 1.00-5.00		3.97
MIDJA	1,001	0.42 (1.40) -2.00-2.90	51.05	4.48 (2.07) 1.00-8.00		3.22 (0.53) 1.00-5.00	6.69	3.49 (0.79) 1.00-5.00	30.73	5.58
MIDUS	6,116	-0.31 (1.29) -3.00-2.50	52.57	6.87 (2.48) 1.00-12.00	9.24	4.01 (0.80) 1.00-5.00	5.04	3.55 (0.98) 1.00-5.00	42.11	6.35
STRIDE	524	-1.79 (0.93) -3.20-0.30	49.81	13.40 (4.10) 5.00-16.00	50.00	2.28 (0.89) 1.00-5.00	3.24	2.35 (0.66) 1.00-5.00		
SWAN	15,442	-0.29 (0.43) -1.00-0.50		3.02 (1.21) 1.00-5.00	49.79	4.67 (0.67) 1.00-5.00	6.57	3.48 (1.07) 1.00-5.00	22.82	2.91
USNHMS	3,801	1.02 (1.40) -1.50-3.90	57.33	13.60 (2.77) 0.00-18.00	33.02	4.09 (0.71) 1.00-5.00	18.94	3.30 (1.09) 1.00-5.00	35.92	12.66
WLS	10,236	0.33 (0.43) -2.10-2.90	53.43	13.71 (2.38) 0.00-21.00		4.05 (0.66) 1.00-5.00	4.30	4.14 (0.67) 1.00-5.00	17.44	6.50

Table 2

Bivariate associations between purpose and health among diabetic adults

Study	Self-rated health			Smoker			Non-Smoker			Heart Condition			No Heart Condition			<i>d</i>	<i>p</i>
	<i>N_{Diabetic}</i>	<i>r</i>	<i>p</i>	<i>N</i>	<i>M(SD)</i>		<i>N</i>	<i>M(SD)</i>		<i>N</i>	<i>M(SD)</i>		<i>N</i>	<i>M(SD)</i>			
ACL	228	0.15	.020	24	4.22(1.03)		204	4.22(1.17)		26	4.23(1.14)		201	4.22(1.16)		-0.01	.478
ALSA	145	0.21	.012	9	3.19(0.94)		136	3.34(0.90)	0.16								
CLOC	27	-0.03	.892	1	4.73(NA)		26	3.66(0.82)		4	3.27(1.16)		23	3.78(0.76)			
ELSA	27	0.39	.043	5	3.88(0.26)		22	3.72(0.65)	-0.25				20	3.89(0.52)		-0.81	.043
HRS	4218	0.27	< .001	547	3.63(0.82)		3586	3.73(0.78)	0.12				2838	3.77(0.78)		-0.22	< .001
KGSS	72	0.35	.003							18	3.44(1.65)		54	3.76(1.33)		0.22	.209
MIDJA	67	0.35	.004	23	3.13(0.58)		35	3.37(0.65)	0.38				46	3.30(0.64)		-0.22	.219
MIDUS	308	0.20	< .001	49	3.65(0.82)		130	3.76(0.86)	0.13				279	3.76(0.86)		0.25	.103
STRIDE	17	0.32	.213														
SWAN	1014	0.10	.002	228	4.66(0.67)		784	4.71(0.68)	-0.07				897	4.70(0.68)		0.03	.385
USNHMS	720	0.27	< .001	116	3.65(0.87)		265	3.94(0.70)	-0.36				535	3.91(0.77)		0.27	.001
WLS	440	0.30	< .001	66	3.81(0.92)		370	3.87(0.75)	0.08				342	3.95(0.75)		-0.46	< .001

Table 3

Results of individual self-rated health trajectory analyses and meta-analyses in Study 2

Study	Intercept				Slope				N_{people}	N_{obs}
	Est	CI_{lb}	CI_{ub}	p	Est	CI_{lb}	CI_{ub}	p		
Average estimates of self-rated health intercepts and slopes										
acl	2.23	1.90	2.56	< .001	-0.02	-0.03	-0.01	0.00	1152	2304
alsa	3.65	3.42	3.87	< .001	-0.08	-0.11	-0.06	0.00	1522	3969
elsa	3.14	2.76	3.52	< .001	0.04	0.02	0.05	0.00	262	800
hrs	2.02	1.95	2.09	< .001	-0.04	-0.04	-0.04	0.00	15523	67471
kgss	3.07	2.80	3.34	< .001	-0.08	-0.13	-0.02	0.01	351	1404
midja	3.18	3.04	3.32	< .001	-0.01	-0.02	0.01	0.37	1001	1645
midus	2.66	2.58	2.73	< .001	-0.01	-0.01	-0.01	0.00	6116	13770
swan	2.75	2.70	2.81	< .001	-0.02	-0.03	-0.02	0.00	15428	39343
wls	3.22	3.14	3.29	< .001	-0.01	-0.01	-0.01	0.00	10228	24733
meta	2.88	2.54	3.21	< .001	-0.02	-0.05	0.00	0.03		
Relationship of purpose to self-rated health intercepts and slopes										
acl	0.16	0.08	0.24	< .001	0.00	-0.01	0.01	0.87	1152	2304
alsa	0.15	0.11	0.20	< .001	0.00	-0.03	0.02	0.72	1522	3969
elsa	0.35	0.23	0.48	< .001	0.01	-0.01	0.02	0.51	262	800
hrs	0.25	0.24	0.27	< .001	0.00	0.00	0.00	0.02	15523	67471
kgss	-0.42	-0.88	0.05	.080	-0.65	-0.86	-0.43	0.00	351	1404
midja	0.17	0.10	0.25	< .001	-0.01	-0.03	0.01	0.41	1001	1645
midus	0.11	0.08	0.14	< .001	0.00	0.00	0.00	0.26	6116	13770
swan	0.08	0.00	0.17	.064	-0.01	-0.02	0.00	0.01	15428	39343
wls	0.15	0.13	0.17	< .001	0.00	0.00	0.00	0.00	10228	24733
meta	0.17	0.12	0.22	< .001	-0.05	-0.15	0.05	0.31		
Relationship of purpose x diabetes to self-rated health intercepts and slopes										
acl	-0.04	-0.28	0.19	.705	0.00	-0.02	0.02	0.96	1152	2304
alsa	-0.01	-0.16	0.15	.914	0.00	-0.08	0.08	0.99	1522	3969
elsa	-0.15	-0.72	0.43	.614	0.06	-0.05	0.17	0.26	262	800
hrs	-0.02	-0.05	0.01	.301	0.00	-0.01	0.00	0.49	15523	67471
kgss	0.15	-1.16	1.47	.818	-0.08	-0.73	0.57	0.81	351	1404
midja	-0.14	-0.40	0.12	.290	-0.06	-0.12	0.01	0.08	1001	1645
midus	-0.01	-0.15	0.13	.900	0.00	-0.01	0.01	0.74	6116	13770
swan	0.29	-0.07	0.64	.115	0.01	-0.02	0.05	0.40	15428	39343
wls	-0.04	-0.13	0.04	.320	0.00	-0.01	0.00	0.27	10228	24733
meta	-0.02	-0.04	0.01	.183	0.00	0.00	0.00	0.32		

Table 4

Results of individual smoking status trajectory analyses and meta-analyses in Study 2

Study	Intercept				Slope				N_{people}	N_{obs}
	Est	CI_{lb}	CI_{ub}	p	Est	CI_{lb}	CI_{ub}	p		
Average estimates of smoking status intercepts and slopes										
acl	0.80	-0.68	2.27	.288	0.27	0.10	0.44	.002	1152	1815
elsa	-0.66	-2.91	1.59	.567	2.17	1.24	3.10	< .001	262	1033
hrs	-0.05	-0.41	0.31	.780	0.99	0.86	1.12	< .001	15366	62590
kgss	-2.04	-2.93	-1.15	< .001	-0.49	-0.85	-0.14	.006	351	701
midja	-11.10	-18.51	-3.69	.003	-2.88	-4.72	-1.05	.002	945	1497
midus	-5.19	-5.86	-4.52	< .001	-0.31	-0.34	-0.27	< .001	6116	12599
swan	-35.23	-39.74	-30.72	< .001	-3.51	-3.96	-3.06	< .001	15377	39414
wls	-8.74	-11.62	-5.86	< .001	-0.52	-0.68	-0.37	< .001	3376	5095
meta	-7.62	-15.77	0.54	.067	-0.49	-1.75	0.77	.448		
Relationship of purpose to smoking status intercepts and slopes										
acl	-0.29	-0.59	0.01	.062	-0.02	-0.26	0.22	.858	1152	1815
elsa	-0.61	-1.35	0.14	.112	0.06	-0.91	1.02	.907	262	1033
hrs	-0.21	-0.28	-0.14	< .001	0.16	0.04	0.29	.012	15366	62590
kgss	0.06	-2.58	2.69	.967	-0.68	-2.30	0.94	.410	351	701
midja	-2.98	-10.77	4.80	.452	-0.70	-2.64	1.24	.479	945	1497
midus	-0.55	-1.30	0.21	.157	-0.02	-0.06	0.02	.287	6116	12599
swan	-7.61	-21.78	6.56	.292	-0.76	-2.18	0.65	.291	15377	39414
wls	-0.66	-5.30	3.99	.782	-0.03	-0.29	0.23	.812	3376	5095
meta	-0.22	-0.29	-0.15	< .001	0.02	-0.09	0.13	.707		
Relationship of purpose x diabetes to smoking status intercepts and slopes										
acl	-0.15	-1.12	0.82	.758	-0.03	-0.78	0.71	.930	1152	1815
elsa	2.68	-2.85	8.20	.343	1.40	-3.85	6.65	.601	262	1033
hrs	0.09	-0.07	0.26	.277	-0.03	-0.16	0.10	.634	15366	62590
kgss	1.34	-8.18	10.86	.783	-0.54	-6.76	5.68	.865	351	701
midja	-0.27	-24.27	23.74	.983	-0.05	-6.02	5.93	.988	945	1497
midus	1.09	-3.72	5.90	.658	0.05	-0.21	0.32	.702	6116	12599
swan	3.57	-33.40	40.55	.850	0.37	-3.32	4.06	.844	15377	39414
wls	-4.07	-29.70	21.55	.756	-0.22	-1.65	1.20	.758	3376	5095
meta	0.09	-0.08	0.25	.287	-0.02	-0.13	0.10	.775		

Table 5

Results of individual heart condition status trajectory analyses and meta-analyses in Study 2

Study	Intercept				Slope				N_{people}	N_{obs}
	Est	CI_{lb}	CI_{ub}	p	Est	CI_{lb}	CI_{ub}	p		
Average estimates of heart condition status intercepts and slopes										
acl	-1.64	-3.32	0.03	.054	0.83	0.16	1.50	.016	1152	2259
elsa	-3.03	-4.75	-1.31	.001	0.03	-0.49	0.54	.925	262	1034
hrs	-1.28	-1.88	-0.68	< .001	0.81	0.76	0.85	< .001	15518	67440
midja	-3.71	-5.23	-2.19	< .001	2.97	-5.56	11.49	.495	977	1555
midus	-0.54	-0.78	-0.29	< .001	0.08	0.07	0.09	< .001	6113	13760
swan	-2.18	-3.02	-1.34	< .001	1.23	0.95	1.52	< .001	15437	40055
wls	-0.25	-0.71	0.21	.282	0.11	0.11	0.12	< .001	10233	26055
meta	-1.63	-2.55	-0.72	< .001	0.51	0.10	0.92	.015		
Relationship of purpose to heart condition status intercepts and slopes										
acl	0.20	-0.20	0.61	.328	0.07	-0.85	0.99	.878	1152	2259
elsa	-0.29	-0.86	0.27	.311	-0.03	-0.58	0.52	.910	262	1034
hrs	-0.23	-0.35	-0.11	< .001	0.06	0.01	0.10	.013	15518	67440
midja	-0.40	-0.97	0.17	.172	-0.34	-9.97	9.28	.945	977	1555
midus	-0.04	-0.14	0.05	.361	0.00	-0.01	0.01	.750	6113	13760
swan	-0.18	-0.83	0.47	.595	-0.43	-1.39	0.52	.374	15437	40055
wls	-0.06	-0.17	0.05	.289	0.01	0.01	0.02	.001	10233	26055
meta	-0.11	-0.21	0.00	.042	0.01	-0.01	0.03	.175		
Relationship of purpose x diabetes to heart condition status intercepts and slopes										
acl	-0.21	-1.13	0.71	.653	-0.31	-2.57	1.94	.785	1152	2259
elsa	-1.84	-5.18	1.51	.281	-0.18	-3.70	3.35	.922	262	1034
hrs	-0.10	-0.33	0.13	.377	0.00	-0.09	0.08	.945	15518	67440
midja	0.61	-0.81	2.02	.400	1.21	-8.69	11.11	.811	977	1555
midus	0.25	-0.21	0.72	.279	0.02	-0.01	0.05	.299	6113	13760
swan	-0.68	-2.29	0.92	.402	0.33	-6.30	6.95	.923	15437	40055
wls	-0.17	-0.62	0.28	.454	0.01	-0.02	0.03	.667	10233	26055
meta	-0.06	-0.25	0.12	.481	0.01	-0.01	0.03	.337

Figure 1. Forest plot of regression models. Columns for purpose coefficient are from models without interactions, run on subsamples of the data sets. Specifically, ‘Diabetic Adults’ refers to the relationship (odds ratio) of purpose to health outcomes only among diabetic adults. ‘Non-diabetic Adults’ refers to the relationship of purpose (OR) to health outcomes only among non-diabetic adults. The interaction coefficient estimates and the plotted values and bars represent the interaction between purpose and diabetes, estimated in models on the full samples. All confidence intervals are 95 percent. All models control for age, education, gender and race.