

Living Healthier and Longer Lives: Subjective Well-Being's Association with Better Health

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Abstract:

To fully understand how psychological functioning is related to health and longevity, it is important to not only consider psychological distress, but also subjective well-being (i.e., the presence of positive thoughts and feelings). This chapter reviews the most recent and highest quality evidence for whether and how subjective well-being is linked with living healthier and longer lives. Accumulating evidence has begun to suggest that initially healthy individuals with higher versus lower levels of subjective well-being are less likely to be diagnosed with incident disease including coronary heart disease, stroke, diabetes, arthritis, and, to a lesser extent, cancer. The reoccurrence of disease in individuals who have already been diagnosed shows a similar although less robust pattern. Associations are comparable for mortality, with fairly persuasive evidence demonstrating that higher levels of subjective well-being in initially healthy individuals are associated with longevity, but a somewhat less compelling body of work supporting the association among cohorts of patients. Underlying pathways for these associations are discussed – including mechanisms related to stress buffering and physiological and behavioral processes – and suggestions for future research are provided.

Keywords: health, longevity, morbidity, mortality, subjective well-being, life satisfaction, positive emotions

The notion that psychological states and physical states are connected has endured across the ages. Most empirical research on this topic has focused on how psychological distress is related to poor health outcomes. For example, compared to people with low levels of depression, anxiety, and stress, people with high levels have an increased risk of incident coronary heart disease and mortality (Nicholson, Kuper, & Hemingway, 2006; Pratt, Druss, Manderscheid, & Walker, 2016; Richardson et al., 2012; Roest, Martens, de Jonge, & Denollet, 2010; Rugulies, 2002; Steptoe & Kivimaki, 2013). However, most people are not psychologically distressed. In fact, most people report feeling happy most of the time (Diener & Diener, 1996; Diener, Kanazawa, Suh, & Oishi, 2015). Thus, to understand how the full range of psychological functioning is related to health and longevity, it is important to not only consider psychological distress, but also the presence of positive thoughts and feelings.

The frequent experience of positive thoughts (like satisfaction with life) and feelings (like positive emotions) comprise the construct of subjective well-being (Diener, Suh, Lucas, & Smith, 1999). Subjective well-being – which is colloquially known as happiness – inherently feels good. Moreover, evidence suggests that subjective well-being is also associated with beneficial outcomes in a variety of life domains such as in the workplace and in social relationships (Boehm & Lyubomirsky, 2008; Lyubomirsky, King, & Diener, 2005). In the last decade or so, an explosion of research has explored whether the benefits of subjective well-being are apparent with regards to health and longevity as well. Thus, this chapter reviews the most recent and highest quality evidence for whether and how positive thoughts and feelings are linked with living longer and healthier lives.

The strongest evidence for associations between subjective well-being and health-related outcomes come from studies that are methodologically rigorous, as indicated by the following characteristics: 1)

prospective longitudinal design that takes baseline health into account and follows individuals across many years; 2) assessment of subjective well-being with a well-validated and multi-item questionnaire or an objective measure; 3) objective assessment of a health outcome (e.g., via medical records); 4) analyses that control for confounding variables (e.g., socioeconomic status); 5) analyses that consider possible underlying pathways (e.g., health behaviors); and 6) analyses that test whether subjective well-being's associations are independent from psychological distress (e.g., depression, anxiety). The selective review that follows describes studies that are characterized by most or all of these criteria. I first describe evidence linking subjective well-being with a variety of disease outcomes, then I describe evidence linking subjective well-being with mortality. Because correlates and underlying processes may differ for people who are initially free from disease and those who have been diagnosed with a medical condition, I review evidence for both groups separately. This chapter ends with a discussion of the mechanisms by which subjective well-being may be linked with better health and longevity, as well as considerations for future research.

Note that although evidence also exists regarding how other indicators of positive psychological functioning are associated with health outcomes – such as purpose in life or optimism (e.g., Cohen, Bavishi, & Rozanski, 2015; Rasmussen, Scheier, & Greenhouse, 2009) – here I focus exclusively on the positive indicators that comprise subjective well-being (i.e., life satisfaction and positive affect) to maintain a manageable scope. In addition, low levels of negative emotions are sometimes included as part of subjective well-being's conceptualization, but I do not consider negative emotions here because there is a very large and separate literature that has focused on the relationship between various negative emotions and poor health (see selected references above).

Morbidity

In Initially Healthy People

Evidence is accumulating to suggest that happy and satisfied people have lower risk for being diagnosed with a variety of medical conditions. Cardiovascular disease has been the most frequently studied outcome, in part because it is a well-defined disease with objective indicators (Boehm & Kubzansky, 2012). For example, 1,700 Canadian men and women over 18 years old had their positive affect assessed via the facial expressions they displayed during a clinical interview (Davidson, Mostofsky, & Whang, 2010). Relative to people showing fewer positive emotions in their faces, people showing more positive emotions had a 22% reduced risk of being diagnosed with coronary heart disease across 10 years. These findings were robust to adjustment for a variety of confounders and possible behavioral mechanisms, as well as to adjustment for hostility and symptoms of depression and anxiety. Another study reported similar findings based on a cohort of nearly 8,000 British civil servants. Individuals with greater initial life satisfaction across a variety of domains (including satisfaction with work, family, and one's sex life) tended to have a reduced risk of incident coronary heart disease (Boehm, Peterson, Kivimaki, & Kubzansky, 2011). This study had a follow-up period of approximately 5 years and controlled for a range of variables including sociodemographic characteristics, health behaviors, blood pressure, lipids, body mass index, diabetes, and psychological ill-being.

However, positive affect was not related to incident coronary heart disease in the same cohort of British civil servants followed across a mean of 12 years (Nabi, Kivimaki, De Vogli, Marmot, & Singh-Manoux, 2008). The null association between positive affect and heart disease was evident regardless of which covariates were included in the models. With nearly 9,000 participants and more than 600 cases of heart disease, statistical analyses were adequately powered to detect associations. Yet, there has been some criticism of the Affect Balance Scale (Bradburn, 1969), which was used to assess baseline positive affect. Reliability is relatively low (e.g., alpha less than .70), some of the items may be outdated or otherwise problematic (e.g., feeling "on top of the world"), and there is a focus on personal accomplishment rather than pure positive feelings (McDowell, 2006). Thus, null findings could have been due to a relatively poor assessment of positive affect.

Other work has also reported a null association between subjective well-being and coronary heart disease though (Feller, Teucher, Kaaks, Boeing, & Vögl, 2013). In one prospective study that followed more than 6,000 Dutch men and women over age 55 for a dozen years, neither positive affect nor negative affect were significantly associated with incident cardiovascular disease in minimally-adjusted models and fully-adjusted models (Freak-Poli et al., 2015). Null associations persisted when stroke, heart failure, and coronary heart disease were investigated separately, as well as after stratification by age and gender. One possible explanation for the null findings in both the British and Dutch studies was the relatively homogenous cohort of participants. In both cases, socioeconomic status did not vary much and participants were relatively well off. Notably, however, the study with British civil servants found an association between negative affect and heart disease whereas the Dutch study did not. The null findings for negative

affect are inconsistent with other work (e.g., Kubzansky, 2007).

Another possibility in the latter study is that the measure of positive affect – a 4-item composite of positive emotions derived from the Center for Epidemiologic Studies-Depression [CESD] scale (Radloff, 1977) – did not adequately capture positive emotional experience. Although deriving indicators of subjective well-being from measures originally designed to assess psychological distress is not ideal (Boehm & Kubzansky, 2012), other studies have used this approach and found evidence for an association between positive affect and cardiovascular disease. For example, positive affect derived from the CESD scale was related to reduced risk of incident stroke among nearly 2,500 people over the age of 65 (Ostir, Markides, Peek, & Goodwin, 2001). These participants were followed for 6 years, and associations were evident for men and women and blacks and whites. Moreover, the inverse association between positive affect and stroke risk held after accounting for sociodemographic characteristics, body mass index, smoking status, and other health conditions (all participants were free from stroke at baseline). (For other stroke-related findings, see also Feller et al., 2013; Lambiase, Kubzansky, & Thurston, 2015). Another study using the positive affect items from the CESD scale also reported inverse associations with hypertension in a cohort of older Mexican Americans (Ostir, Berges, Markides, & Ottenbacher, 2006). For individuals who were not on antihypertensive medication, every unit increase in positive affect was associated with 9% reduced odds of belonging to a higher blood pressure category, controlling for sociodemographic factors, health behaviors, diabetes, and even negative affect. The association between well-being (specifically, emotional vitality) and hypertension has since been replicated in a British cohort (Trudel-Fitzgerald, Boehm, Kivimaki, & Kubzansky, 2014).

Apart from cardiovascular-related outcomes, other health conditions have been investigated in relation to subjective well-being. For example, one review of the literature has suggested that well-being is tied with diabetes (Celano, Beale, Moore, Wexler, & Huffman, 2013). A study of almost 100 older women who were initially free from diabetes demonstrates this. Women with higher levels of baseline positive affect tended to have healthier levels of glycosylated hemoglobin – a marker of glycemic control in recent months – two years later, controlling for negative affect and depression diagnosis (Tsenkova, Love, Singer, & Ryff, 2007). More recently, a prospective study of nearly 8,000 British civil servants showed that higher levels of both life satisfaction and emotional vitality were associated with reduced odds of self-reporting a physician diagnosis of diabetes (Boehm, Trudel-Fitzgerald, Kivimaki, & Kubzansky, 2015). These findings held after adjusting for demographic characteristics, health behaviors, blood pressure, and body mass index, but were attenuated for emotional vitality after adjusting for depressive symptoms (findings were maintained for life satisfaction when adjusting for depressive symptoms). No gender differences were reported in the study, although a separate study of more than 50,000 German participants followed across 8 years found an association between life satisfaction and incident diabetes among women but not men (Feller et al., 2013). More specifically, women who were unsatisfied with their lives had a 17% increased risk of developing Type II diabetes compared with their very satisfied counterparts.

In addition to examining incident diabetes in the very large German cohort, incident cancer was also considered. Cancer outcomes are less frequently investigated in connection with psychological predictors because of the numerous different types of cancer and somewhat less precise way to define diagnoses. However, in this case, an association was apparent between life satisfaction and cancer across 8 years. Unsatisfied women had a 45% increased chance of incident cancer relative to satisfied women (Feller et al., 2013). These findings held when controlling for sociodemographic factors and health behaviors, but not when controlling an indicator of psychological distress. Moreover, there was no association between life satisfaction and incident cancer in men. In a different study of approximately 12,000 Finnish women, the relationship between life satisfaction and breast cancer was investigated. No relationship existed between life satisfaction and incident breast cancer across 21 years in age-adjusted and multivariable-adjusted models (Lillberg et al., 2002). Such null findings for cancer have been reported in other studies as well (Bai et al., 2016; Okely & Gale, 2016).

Nonetheless, subjective well-being has been found to be related to incident arthritis. In one 9-year study of more than 13,000 older adults throughout Europe, higher levels of well-being were associated with reduced risk of reporting a doctor diagnosis of arthritis (Okely, Cooper, & Gale, 2016). Other studies have also investigated the extent to which subjective well-being is related to functional status. In one example of this, more than 3,000 older men and women from England responded to a baseline questionnaire about how much they enjoyed life, and then were followed for 8 years (Steptoe, de Oliveira, Demakakos, & Zaninotto, 2014). Relative to those with high levels of enjoyment, those who reported low levels of enjoyment had increased odds of experiencing impaired physical functioning, as indicated by self-reported activities of daily life and objective assessment of gait speed. Findings were robust to statistical adjustment for sociodemographic characteristics, health-related factors including behaviors, and depression. To extend these results even further, another group of researchers investigated how well-being was associated with

incident frailty, which tends to be preceded by impaired physical function. Using the same cohort of older English men and women, models adjusting for a variety of confounders (including depressive symptoms) indicated that those people with higher versus lower baseline levels of well-being were less likely to experience incident frailty across a 4-year follow-up period (Gale, Cooper, Deary, & Aihie Sayer, 2014). These findings have been replicated in another study of elderly caregivers (Park-Lee, Fredman, Hochberg, & Faulkner, 2009).

In People Already Diagnosed with Disease

A meta-analysis has reported that well-being is related to recovery among people who have been diagnosed with disease (Lamers, Bolier, Westerhof, Smit, & Bohlmeijer, 2012). Another meta-analysis specific to cardiovascular disease showed that well-being appears to be associated with reduced risk of hospitalization and mortality in cardiac patients (DuBois et al., 2015). For example, more than 800 patients undergoing percutaneous coronary intervention with stent implantation had their positive affect assessed. Those with low versus high levels of positive affect were more likely to experience myocardial infarction or death 2 years later (Denollet et al., 2008). There is some conflicting evidence though. For example, in age-adjusted analyses that followed more than one thousand individuals diagnosed with coronary heart disease for 7 years, there was only a marginally significant relationship between positive affect and cardiovascular events (heart failure, myocardial infarction, stroke, or transient ischemic attack; Hoen, Denollet, de Jonge, & Whooley, 2013). Moreover, positive affect in patients who had undergone cardiac rehabilitation was not associated with hospitalizations or all-cause mortality an average of approximately 3 years later (Meyer, von Kanel, Saner, Schmid, & Stauber, 2015). However, negative affect was also included in statistical models and the two types of affect were very strongly correlated.

In cohorts of individuals with non-cardiovascular diagnoses, subjective well-being also appears to be related to healthier outcomes. Among elderly patients who experienced a hip fracture, those with high levels of positive emotion demonstrated better physical performance (i.e., walking speed and chair stands) during a 2 year follow-up period than their peers with high levels of depressive symptoms (Fredman, Hawkes, Black, Bertrand, & Magaziner, 2006). Similarly, increases in positive emotions in the 3 months following a stroke were associated with improved functional performance in the patients (Seale, Berges, Ottenbacher, & Ostir, 2010).

Mortality

In Initially Healthy People

Beyond whether happier people have lower risk for disease, reviews of prospective studies indicate that happier people tend to live longer than less happy people (Chida & Steptoe, 2008; Diener & Chan, 2011; Martin-Maria et al., 2017). For example, one meta-analysis synthesized findings through 2008 and reported that higher levels of well-being were associated with 18% reduced risk of mortality in initially healthy cohorts (Chida & Steptoe, 2008). Such findings have been replicated in more recent research as well. In one case, more than 31,000 U.S. adults ages 18 and over responded to the question: “Taken all together, how would you say things are these days – would you say that you are very happy, pretty happy, or not too happy?” (Lawrence, Rogers, & Wadsworth, 2015). Compared to those people who reported being very happy, those who reported being not happy were 14% more likely to die during as many as 30 years of follow-up. These findings accounted for sociodemographic characteristics, geographic region, and religious attendance, but not psychological distress. Similar results have been replicated in more than 9,000 men and women representative of those over 50 years old living in England (Steptoe & Wardle, 2012). Individuals who reported the highest versus lowest levels of life enjoyment had a 28% reduction in mortality risk across an average of 7 years of follow-up, accounting for sociodemographic factors, disease diagnoses, health behaviors, and depression.

In the same cohort of older English men and women, subjective well-being was assessed with ecological momentary assessment in nearly 4,000 participants (Steptoe & Wardle, 2011). This type of measurement asked participants to report on their positive feelings at four points throughout the day to capture “experienced” subjective well-being rather than the more conventional retrospective assessment. Across an average of 5 years, individuals with the highest level of positive affect had a 35% reduction in mortality risk compared to those with the lowest levels of positive affect. Notably, these analyses statistically controlled for sociodemographic factors including education and wealth, as well as negative affect, depressive symptoms, presence of disease, cigarette smoking, physical activity, and alcohol intake. Moreover, negative affect was not related to increased risk of mortality in this study, but depressive symptoms were (although positive affect’s association with mortality persisted when statistically controlling for depressive symptoms).

The work reviewed thus far indicates that there is a consistent relationship between subjective well-being and longevity in Western participants, but does the relationship generalize to other groups? Work on this topic with diverse samples of participants is limited, but one notable study followed more than 5,000 older Taiwanese adults across 10 years (Collins, Gleib, & Goldman, 2009). Individuals who were more satisfied at baseline had lower risk of mortality than their less satisfied peers, controlling for sociodemographic factors, indicators of health and health behaviors, and depression. This initial evidence suggests that the association between subjective well-being and longevity exists for other cultural groups as well (see also Kimm, Sull, Gombojav, Yi, & Ohrr, 2012; Yiengprugsawan, Seubsman, & Sleight, 2014).

Other moderators of the association between subjective well-being and longevity have been increasingly explored, including the extent to which subjective well-being remains stable over time. Although subjective well-being – in particular, life satisfaction – is often thought of as being relatively consistent across time, it can change due to life circumstances such as divorce or unemployment (Lucas, Dyrenforth, & Diener, 2008). Thus, single assessments of subjective well-being at one point in time may not capture the whole story of a person's sense of well-being. Several studies have now investigated how fluctuations in subjective well-being are related to longevity. In one study, more than 9,000 older men and women living in England reported their life enjoyment on three separate occasions across 6 years (Zaninotto, Wardle, & Steptoe, 2016). Those who reported enjoying life at all three occasions had a 24% lower risk for death up to 7 years later compared to those who reported not enjoying life at any occasion. Furthermore, there was a graded relationship such that those who reported enjoying life at only two occasions had a 17% reduced risk of death relative to those who did not enjoy life at any occasion. Findings held after controlling for demographic factors, health, and depression.

Another study of more than 4,000 Australian men and women ages 50 and over used a different approach to conceptualize maintenance of subjective well-being across time (Boehm, Winning, Segerstrom, & Kubzansky, 2015). A single item of life satisfaction was assessed annually across as many as nine years. The mean and standard deviation of each person's life satisfaction ratings were then calculated to get a sense of the stability and variability of life satisfaction across time. Consistent with past research, higher versus lower mean levels of life satisfaction were associated with reduced risk of mortality during the follow-up period. However, the variability in satisfaction that a person experienced across time modified the relationship such that the least satisfied people who also had fluctuating levels of life satisfaction had the highest risk of mortality. These results further confirm that sustaining high levels of SWB across time are important to associations with longevity, while variability may be detrimental. Moreover, these studies highlight the importance of looking at subjective well-being across time rather than as a static phenomenon, as most studies do (for another example that considers time-varying subjective well-being, see Collins et al., 2009).

Although the vast majority of studies have assessed subjective well-being via self-reported questionnaires – including single item ratings or multi-item questionnaires that have been validated such as the Satisfaction With Life Scale (Diener, Emmons, Larsen, & Griffin, 1985; Pavot & Diener, 2008) – sometimes subjective well-being is assessed via indirect methods. Such studies also point to an association between subjective well-being and longevity. For example, one group of researchers evaluated the intensity of smiles that Major League Baseball players displayed in their photographs (Abel & Kruger, 2010). Those players with Duchenne, or genuine smiles, were half as likely to die when compared to those players without a smile. Likewise, another study assessed the subjective well-being of nuns in their twenties by evaluating autobiographies the nuns had written for content related to positive emotions (Danner, Snowden, & Friesen, 2001). There was a 2.50-fold difference in the relative risk of mortality between nuns who wrote with great positive emotion and those who wrote with little positive emotion, controlling for age and education. In short, nuns who expressed more positive emotions early in life lived longer than those who expressed fewer positive emotions. In other work, the use of activated positive emotion words (e.g., lively, vigorous) but not less activated positive emotion words (e.g., calm, peaceful) were related to longevity in famous psychologists (Pressman & Cohen, 2012).

Lest it seem that all studies have reported associations between subjective well-being and longevity, there is one notable and well-publicized study that reported conflicting evidence (Liu et al., 2016). More than 700,000 women from England and Scotland (median age of 59 years) were asked about their happiness with the single item: "How often do you feel happy?" Responses ranged from "most of the time" to "rarely/never." Mortality was assessed during a follow-up period across an average of nearly 10 years. In models adjusting for sociodemographic characteristics, body mass index, health behaviors, and religious participation, women who were unhappy had an increased risk of mortality compared with women who were happy most of the time. However, when self-rated health was also included in the analytic models, happiness was no longer associated with mortality. The authors attribute the null association to the fact that bad health can foster both less happiness and increased risk of death.

Yet other researchers have noted limitations in this study, the primary one being that the statistical analyses adjusted for too many variables (Diener, Pressman, Hunter, & Delgado-Chase, 2017; Kubzansky, Kim, Salinas, Huffman, & Kawachi, 2016). In particular, self-reported happiness and self-reported health are known to be robustly correlated, and judgments of one may be informed by judgments of the other (Benyamini, Idler, Leventhal, & Leventhal, 2000). To compound matters in this study, self-rated happiness and health were assessed at the same time with similar, single item self-report questions (so they not only shared common variance due to methodology, but were also less reliably measured). Thus, it is not surprising that self-reported health attenuated the association between happiness and longevity. Nonetheless, this study provides a helpful reminder for researchers to be thoughtful about which covariates are included in analyses when examining associations between subjective well-being and longevity, with a particular caution about how to interpret attenuation that could occur as a result of including highly correlated variables or potential pathway variables (Diener et al., 2017). Moreover, optimal analyses would incorporate repeated, reliable assessments of both the exposure and covariates that allow for consideration of mechanistic relationships more explicitly (Stringer & Veldkamp, 2016). Such causal modeling has not yet been done in this area of research but is greatly needed (Diener et al., 2017).

In People Already Diagnosed with Disease

Consistent with findings in initially healthy populations, happy people who have been diagnosed with a disease seem to have a reduced risk of mortality compared with unhappy people diagnosed with a disease. Notably, however, the effect seems to be smaller. One meta-analysis estimated that on average, there was a 2% reduced risk of mortality for happy versus unhappy patients (compare that with the 18% reduced risk for initially healthy people; Chida & Steptoe, 2008). A second, more recent meta-analysis came to a similar conclusion that a small but meaningful relationship existed between well-being and survival in people with existing disease (Lamers et al., 2012). However, both meta-analyses note the heterogeneity in the studies with patient cohorts – for example, different patient populations with varying types and severity of disease, follow-up periods, and quality – all of which could contribute to smaller effects.

As an example, one year-long study found an association between a single item about enjoying life and reduced risk of all-cause mortality (Scherer & Herrmann-Lingen, 2009). Participants were medical inpatients, and statistical models controlled for physicians' estimate of the patients' prognosis, primary diagnosis, and comorbidity. In another study of more than 400 men who were HIV positive, those with higher baseline levels of positive affect – as assessed by the CESD – had a reduced risk of mortality compared to those with lower levels of positive affect (Moskowitz, 2003). Results were robust to statistical adjustment for indicators of illness progression, as well as negative affect. The same researcher has reported similar findings for people diagnosed with diabetes. That is, in more than 700 individuals who reported having a physician-diagnosis of diabetes, those with higher levels of positive affect had a reduced risk of mortality across 10 years (Moskowitz, Epel, & Acree, 2008). However, the association was attenuated when negative affect was simultaneously included in the models.

Among individuals with stable coronary heart disease, positive affect was associated with a 13% reduced risk of death across an average of 7 years (Hoen et al., 2013). These findings held when adjusting for baseline disease severity, as well as depression. However, when health behaviors – particularly physical activity – were added to the models, the association was attenuated to non-significance. Similar findings were evident in a study of six hundred Danish individuals with ischemic heart disease. People with higher versus lower levels of positive emotions had a lower risk of all-cause mortality across as many as five years, however, that relationship was mediated by physical activity (Hoogwegt et al., 2013). In contrast, baseline positive affect was not related to mortality within 3 years in nearly six hundred Dutch patients with implantable cardioverter defibrillators (van den Broek et al., 2013).

Pathways Linking Subjective Well-Being

With Morbidity and Mortality

Given subjective well-being's apparent associations with health and longevity, it is worth considering the mechanisms by which it may operate to influence morbidity and mortality. Past work has identified three primary pathways: 1) buffering against the harmful effects of stress on physiological processes, 2) directly affecting physiological processes, and 3) impacting behavioral processes (Boehm & Kubzansky, 2012; Ong, 2010; Pressman & Cohen, 2005). With regards to stress buffering, evidence suggests that subjective well-being can help ameliorate the physiological effects of stress (Fredrickson & Levenson, 1998; Papousek et al., 2010; Tugade & Fredrickson, 2004). For example, during acute stressor tasks in the laboratory, higher levels of positive emotions hasten blood pressure recovery and attenuate

cortisol responses (Bostock, Hamer, Wawrzyniak, Mitchell, & Steptoe, 2011). This buffering effect may occur outside of the laboratory as well. In one study, cardiac patients with high levels of negative emotions and high levels of positive emotions did not have the same increase in mortality risk as those with high levels of negative emotions and low levels of positive emotions, which suggests that positive emotions may buffer against the detrimental effects of negative emotions (Meyer et al., 2015).

Numerous studies have also established that subjective well-being has links to underlying physiological processes that have implications for disease (Ryff et al., 2006; Steptoe, Demakakos, de Oliveira, & Wardle, 2012; Steptoe, Wardle, & Marmot, 2005). For example, in the cardiovascular domain, life satisfaction has shown protective associations with cardiometabolic markers of risk including blood pressure, lipids, glycosylated hemoglobin, waist circumference, and C-reactive protein (which is an indicator of inflammation; Boehm, Chen, Williams, Ryff, & Kubzansky, 2016). Other work has also reported that subjective well-being is associated with lower levels of inflammation (Prather, Marsland, Muldoon, & Manuck, 2007; Stellar et al., 2015; Steptoe, O'Donnell, Badrick, Kumari, & Marmot, 2008), as well as healthier heart rate variability, which indexes sympathetic and parasympathetic activation (Bhattacharyya, Whitehead, Rakhit, & Steptoe, 2008; Oveis et al., 2009; Shiota, Neufeld, Yeung, Moser, & Perea, 2011; Wang, Lü, & Qin, 2013). Notably, most of this work has examined linear relationships between subjective well-being and biomarkers, although limited work suggests that not all relationships between subjective well-being and physiological processes may be linear in nature (Kogan, Gruber, Shallcross, Ford, & Mauss, 2013).

In the behavioral domain, accumulating evidence has also shown that subjective well-being is linked with preventive behaviors that protect against disease (Grant, Wardle, & Steptoe, 2009; Sin, Moskowitz, & Whooley, 2015; Strine, Chapman, Balluz, Moriarty, & Mokdad, 2008). Moreover, often subjective well-being precedes the healthy behavior (although healthy behavior sometimes precedes subjective well-being too, e.g., Mujcic & Oswald, 2016). For example, greater levels of subjective well-being are tied with more frequent exercise (Baruth et al., 2011; Kim, Kubzansky, Soo, & Boehm, 2017; Lathia, Sandstrom, Mascolo, & Rentfrow, 2017; Melin, Fugl-Meyer, & Fugl-Meyer, 2003; Rangul et al., 2011; Schnohr, Kristensen, Prescott, & Scharling, 2005; Schwerdtfeger, Eberhardt, Chmitorz, & Schaller, 2010), healthier diets comprised of fruits, vegetables, and whole grains (Lengyel, Tate, & Obirek Blatz, 2009; van Loon, Tijhuis, Surtees, & Ormel, 2001; Yamasaki, Nagai, & Uchida, 2007), reduced likelihood of cigarette smoking (Kaprio & Koskenvuo, 1988; Leventhal, Ramsey, Brown, LaChance, & Kahler, 2008), higher quality sleep (Lacruz et al., 2016; Ong et al., 2013; Steptoe, O'Donnell, Marmot, & Wardle, 2008), and more preventive health care visits (Kim, Kubzansky, & Smith, 2015; Kim, Park, Sun, Smith, & Peterson, 2014).

Conclusions and Future Directions

The reviewed evidence suggests that there is a consistent association between subjective well-being and both incident disease and longevity such that people with greater life satisfaction and positive emotions have healthier outcomes in adulthood. Protective effects for subjective well-being often remain when psychological distress is taken account, which indicates that subjective well-being has independent associations above and beyond those already known for distress. Furthermore, associations in initially healthy people often persist when taking into account confounders like socioeconomic status. The associations between subjective well-being and disease progression and survival in people with existing disease are not quite as consistent or strong. This group of studies tended to be more diverse with numerous different types of diseases and studies taking place at different points in the disease process. Disease severity, in particular, may be an important moderating factor because as severity increases, more powerful effects are needed to overcome entrenched disease processes and other factors such as treatment become relevant (Tay, Tan, Diener, & Gonzalez, 2013). Nonetheless, overall findings seem to indicate modest relationships between subjective well-being and disease prognosis, but these are often attenuated when statistical analyses are adjusted for covariates such as psychological distress or health behaviors. Until more empirical evidence is available with similar patient types, firm conclusions about links with subjective well-being in patient populations may not be warranted.

Relatedly, it is also important to consider the extent to which findings from both the healthy and patient populations generalize to more diverse groups of people (Diener et al., 2017). For the most part, the available evidence to date has focused predominantly on white, older adults from Westernized countries (cf. Collins et al., 2009). Although some evidence suggests that positive emotions may be important to health for people from a wide variety of countries (Pressman, Gallagher, & Lopez, 2013), future research is needed to consider the extent to which the associations described here generalize to individuals from other countries, cultural groups, ages, and generations.

In addition to considerations regarding *who* associations between subjective well-being and health may be relevant for, it is critical to consider *how* subjective well-being is measured. Because much of the work to date has relied on epidemiological cohorts in which participant burden is a concern, indicators of subjective well-being have often been single items or derived from existing depression inventories (Boehm & Kubzansky, 2012). Although such measures may be better than nothing, the time has come to move away from less reliable single items or conceptually unclear scales that were originally designed with another purpose. More purposeful selection of which subjective well-being measure to include in cohort studies will shed light on conceptual issues as well. For example, does experienced subjective well-being, as assessed via ecological momentary assessment, show stronger associations with health outcomes compared with trait assessments of subjective well-being? Does the cognitively oriented facet of life satisfaction matter more for health than the affectively oriented facet of positive emotions? Are there specific positive emotions – whether high arousal ones like excitement or low arousal ones like calm – that are especially relevant for health? To date, such comparisons have rarely been made because well-being indicators have typically been selected based on convenience. Future research is ripe for such considerations though. Moreover, moving beyond assessment of subjective well-being at a single point in time to consider changes in well-being over time may provide further insight into health processes. As noted earlier, the stability in subjective well-being across substantial periods of time may itself be an important predictor of both physical and mental health (Boehm, Winning, et al., 2015; Gruber, Kogan, Quoidbach, & Mauss, 2013; Zaninotto et al., 2016). Another outstanding issue is under what circumstances too much subjective well-being could be bad for health. High levels of positive emotions are not adaptive in every circumstance (Gruber, 2011; Gruber, Mauss, & Tamir, 2011), so a more precise look at the exact levels that are beneficial may be warranted.

Another consideration in the association between subjective well-being and health is the size of the relationship that is reported. Although effect sizes are typically in the small to moderate range, these effects are comparable with other well-established risk factors for disease. Moreover, the determinants of coronary heart disease, diabetes, cancer, and other diseases are numerous, so any one factor (whether subjective well-being, cigarette smoking, or family history) is likely to contribute rather modestly. However, at the population level, such associations can have a measurable impact, especially if effects of subjective well-being compound over time to further strengthen effects (Abelson, 1985; Friedman & Booth-Kewley, 1987).

Although the evidence reviewed in this chapter primarily assumed that subjective well-being precedes and leads to healthier outcomes, it is also possible that poor health negatively impacts subjective well-being (Diener et al., 2017). For example, one study of older adults followed across 8 years found that self-reported health predicted life satisfaction, but that life satisfaction did not predict health (Gana et al., 2013). Although this study was limited by a subjective assessment of health, it is likely that the relationship could go in either direction or is bi-directional. Nevertheless, the prospective longitudinal studies described in this chapter provide some of the strongest possible evidence available to support the idea that subjective well-being comes before and brings about healthier outcomes. The only other stronger evidence available would be a randomized experiment; however, such designs come with their own drawbacks (Diener et al., 2017). Although perhaps not feasible over the years or decades that are usually seen in prospective designs, accumulating evidence suggests that interventions designed to improve subjective well-being are effective, at least in the short-term (Bolier et al., 2013; Weiss, Westerhof, & Bohlmeijer, 2016). Moreover, well-being interventions are being developed to impact downstream health-related outcomes for healthy individuals (Jackowska, Brown, Ronaldson, & Steptoe, 2016) and individuals diagnosed with chronic conditions (Huffman et al., 2015; Moskowitz et al., 2017; Moskowitz et al., 2012; Nikrahan, Laferton, et al., 2016; Nikrahan, Suarez, et al., 2016; Ogedegbe et al., 2012; Peterson et al., 2012; Sanjuán et al., 2016). Although future research is necessary to determine whether or not well-being interventions can translate into improved health outcomes over the long-term, a large body of evidence reviewed here indicates that among initially healthy people – and to a lesser extent in people who have already been diagnosed with a disease – robust associations exist between higher levels of subjective well-being and healthier and longer lives. As the empirical evidence continues to grow, the boundary conditions and mechanistic pathways by which such associations occur will also come into clearer focus.

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