

The Anatomy of Loneliness

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Abstract

Loneliness is a potent but little understood risk factor for broad-based morbidity and mortality. We review five social neurobehavioral mechanisms that may account for this association. The evidence suggests that different mechanisms explain short-term and long-term effects, and that the long-term effects operate through multiple pathways. Implications for the design of interventions are discussed.

Keywords

loneliness; stress; physiology; health

Dramatic changes have occurred in the age distribution of the population and the structure of social relationships in the United States. Within the past decade, for instance, the proportion of single-parent households rose 21%, while the number of people living alone increased by 20% (Hobbs & Stoops, 2002). As objective social isolation increases, the likelihood that intimate and social needs are met decreases, and the prevalence of loneliness increases (de Jong-Gierveld, 1987). In light of epidemiological research showing that loneliness is a risk factor for broad-based morbidity and mortality (Seeman, 2000), identifying the mechanisms underlying this association may be important.

TRANSDUCTION PATHWAYS

We have examined five mechanisms through which loneliness, or

related factors, may contribute to broad-based morbidity and mortality across the life span: (a) evolutionary fitness, (b) medical decision making, (c) health behaviors and life-styles, (d) stressful lives, and (e) repair and maintenance physiology.

Evolutionary Fitness

The evolutionary-fitness account, which derives from evolutionary psychology, posits that nonlonely individuals are healthier and more physically appealing and intelligent than lonely individuals are. Buss and Schmitt (1993) have argued that features judged to be physically attractive are also features associated with health and fertility. To assess this hypothesis, we used scores on the UCLA Loneliness Scale to categorize young adults as either lonely or nonlonely. Contrary to the hypothesis, the two groups did not differ significantly in physical attractiveness, height, weight, body mass index, education, age, scholastic aptitude, grade-point average, or number of roommates (Cacioppo et al., 2000).

Medical Decision Making

According to this account, the health care system provides better medical care for obviously nonlonely individuals than for lonely individuals. Developments in medicine have made it possible to maintain an individual's life for extended periods of time, but the cost of doing so demands strategies more rational than "maximum care for all" when making decisions

about the allocation of limited health resources. Therefore, the association between loneliness and health may arise subtly from differences in medical decisions and care provisions for patients who appear socially connected versus those who appear isolated.

To address this possibility, we conducted a national study, randomly sampling physicians whose practice would place them in frequent contact with patients who were over 55 years of age and therefore more likely than average to be facing serious health concerns. The results were clear: Physicians reported not only that they themselves provided better or more complete medical care to patients who had supportive families than to patients who appeared to be socially isolated, but also that, in their experience, other doctors, nurses, and ancillary staff did the same.

Health Behaviors

If people simply avoid smoking, a sedentary lifestyle, and obesity, they add years to their life expectancy (Committee on Future Directions for Behavioral and Social Sciences Research, 2001). According to the health-behavior (or social-control) account of the association between loneliness and health, compared with people who are socially connected, those who are lonely are exposed to weaker pressures from and control by friends and loved ones to perform healthy behaviors and to access health care when needed.

In our survey of more than 2,600 young adults and our more intensive study of 135 of these individuals, we found that individuals who scored high versus low on the UCLA Loneliness Scale did not differ in the amount of weekly exercise in which they engaged, their use of tobacco, or their consump-

tion of caffeine and soda; high scorers consumed slightly more alcohol than individuals who scored average or low on this loneliness scale. The comparability of health behaviors does not appear to be limited to a sample of young adults, either; a study of older adults in south Chicago revealed comparable levels of daily tobacco use, weekly caffeine consumption, weekly alcohol consumption, medical compliance, use of seat belts, and healthiness of diet across the full range of scores on the UCLA Loneliness Scale (Cacioppo et al., 2000; Cacioppo, Hawkley, Berntson, et al., 2002; cf. Cacioppo, Hawkley, Crawford, et al., 2002). Epidemiological studies, too, find health behaviors account for only a small portion of the association between loneliness and health (Seeman, 2000).

Unlike the health behaviors typically examined—such as exercise, diet, and smoking—suicide is a deliberate behavior that has a short rather than long time course from the time of the act to the point of death. Does suicide contribute to higher death rates in lonely than nonlonely individuals? The extant evidence, though limited, suggests it does. In the United States, suicide rates are highest among individuals aged 65 years and older, and within this group, suicide rates are highest for those who are divorced or widowed. Social isolation and bereavement are also risk factors for suicide for young people ages 15 to 24, for whom suicide is the third leading cause of death. Overall, living alone increases the risk of suicide across the life span (Goldsmith, Pellmar, Kleinman, & Bunney, 2002).

Cumulative Stress

A third family of mechanisms through which loneliness may operate to affect health involves stress. The notion is that lonely in-

dividuals have higher levels of stress in their lives than nonlonely individuals do, and that this stress contributes to wear and tear on individual organs (e.g., the heart) and deterioration of regulatory mechanisms (e.g., homeostasis) in the brain and body. As a consequence, the health of lonely individuals fails sooner than the health of nonlonely individuals.

Stress has tended to be treated as if it represented a single mechanism, although, in fact, it represents a family of mechanisms that serve to mobilize and defend the body (e.g., fight or flight). Each mechanism comprises a different set of operations that could contribute to higher levels of stress in the lives of lonely than nonlonely individuals. According to the *added-stress hypothesis*, loneliness is associated with perceptions of social rejection and exclusion, which are themselves stressors that produce negative affect and lowered feelings of self-worth and, in turn, promote chronic elevations in activity in the sympathetic nervous, sympathetic adrenomedullary (SAM), and hypothalamic-pituitary-adrenocortical (HPA) systems.² According to the *differential-exposure hypothesis*, lonely individuals are exposed to stressful events more frequently than nonlonely individuals, so that they experience more frequent sympathetic, SAM, and HPA activation; over time, the greater wear and tear on the regulatory mechanisms of lonely individuals promotes chronic elevations in sympathetic, SAM, and HPA activity. The *differential-reactivity hypothesis* posits that the stressors to which lonely individuals are exposed may not be more frequent than the stressors nonlonely individuals experience, but are more intense, eliciting stronger sympathetic, SAM, and HPA activation and, over time, chronic elevations in such activation. Finally, the *differential-stress-buffering hypothesis* posits that

lonely individuals are less likely than nonlonely individuals to have other people to whom they can turn for assistance. Therefore, the stressors to which lonely individuals are exposed, even if objectively comparable in frequency and intensity, tend to be perceived as more severe.

We have collected evidence from four sources to test these hypotheses: (a) questionnaires about life events, major life stressors, daily uplifts and hassles, and perceived stress (Cacioppo et al., 2000; Cacioppo, Hawkley, Crawford, et al., 2002); (b) participants' reports about the people and events to which they were exposed and the stresses they were feeling when queried at random times during a normal day (a method referred to as experience sampling; Hawkley, Burleson, Berntson, & Cacioppo, in press); (c) physiological measures taken before, during, and after participants were exposed to acute psychological stressors and postural adjustments (e.g., the transition from sitting to standing; Cacioppo, Hawkley, Crawford, et al., 2002); and (d) physiological measurements taken at random times as participants went about their activities during the course of a normal day (Hawkley et al., in press). Our results were consistent with the added-stress hypothesis, in that lonely individuals reported higher levels of perceived stress than nonlonely individuals even when the frequency and intensity of the stressors did not differ and even when they were relaxing. However, little evidence for the differential-exposure hypothesis was found in the experience-sampling study, and lonely and nonlonely participants did not differ in the reported number of major life stressors, number of life events the prior year, and number of daily hassles or uplifts.

Despite the similarities in the frequency of exposure to objective stressors, analyses indicated that

lonely, relative to nonlonely, individuals reported more severe hassles, less intense uplifts, and more stressful everyday events—a pattern consistent with the differential-reactivity hypothesis. Some support for the operation of stress buffering was found, as well. Lonely and nonlonely individuals were just as likely to interact with other people, but for lonely individuals the interactions were of poorer quality and provided less support and comfort (Hawkey et al., in press). The detrimental effects of loneliness were only partly attributable to weaker buffers in times of stress, however. In the experience-sampling study, the difference between lonely and nonlonely individuals' ratings of the severity of stressors did not vary as a function of the presence of other people; instead, social interactions, themselves a potential uplift and a source of pleasure for most individuals, were experienced less positively by lonely than by nonlonely individuals, as might be expected from the added-stress hypothesis.

In healthy, resilient young adults, physiological regulation is robust to a variety of assaults. We therefore expected regulated end points such as blood pressure to be normal in lonely young adults but to rise in lonely older adults as physiological resilience declines with age. Blood pressure reflects two component processes, the amount of blood per minute flowing from the heart into the circulatory system (cardiac output) and the total resistance to blood flow from the heart throughout the circulatory system (total peripheral resistance). The greater the total peripheral resistance or the cardiac output, the greater the blood pressure. Total peripheral resistance and cardiac output are components of a regulatory feedback system that serves to maintain normal blood pressure, so they may show signs of cumulative stress before blood pressure does.

As expected, among young peo-

ple blood pressure was comparable in lonely and nonlonely individuals, but lonely individuals had higher total peripheral resistance and lower cardiac output than did nonlonely individuals. These differences were apparent when participants were at rest and when they performed postural adjustments and psychological stressors (Cacioppo, Hawkey, Crawford, et al., 2002), and both during the course of a normal day and in the laboratory (Hawkey et al., in press).

Chronic elevations in total peripheral resistance mean not only that the heart muscle must work harder to distribute the same amount of blood through the circulatory system, but also that the vasculature may become damaged by blood flow turbulence induced by blood vessels with a reduced diameter. Further, physiological mechanisms in the brain and in the body that serve to maintain normal blood pressure may undergo wear and tear over time, leading to elevated blood pressure. Consistently elevated levels of vascular resistance, coupled with age-related decreases in vascular compliance (e.g., elasticity), may set the stage for the development of hypertension—a risk factor for a variety of diseases. We hypothesized that lonely older adults would, on average, have higher blood pressure than nonlonely older adults. Our study in south Chicago confirmed this hypothesis: Age was positively and significantly correlated with blood pressure in the group of lonely participants, but age and blood pressure were unrelated in the nonlonely group (Cacioppo, Hawkey, Crawford, et al., 2002).

Kiecolt-Glaser et al. (1984) reported that lonely, relative to nonlonely, individuals had higher urinary measures of cortisol, a powerful steroid secreted by the body, for instance, in response to stress. Using measures that reflected more momentary levels of cortisol than the

measures Kiecolt-Glaser et al. used, and a momentary measure of the precursor of cortisol (adrenocorticotrophic hormone, or ACTH), we found that lonely individuals had higher morning levels of ACTH than nonlonely individuals, and slightly but nonsignificantly higher levels of cortisol (Cacioppo, Hawkey, Crawford, et al., 2002).

Repair and Maintenance Physiology

The final general transduction pathway, termed the *repair-and-maintenance hypothesis*, posits that loneliness weakens constructive or restorative processes that serve to repair, maintain, recover, and enhance physiological capacities. Sleep is the quintessential restorative behavior, and sleep deprivation has dramatic effects on metabolic, neural, and hormonal regulation that mimic those of aging. In one study (Cacioppo, Hawkey, Berntson, et al., 2002), lonely and nonlonely young adults had their sleep recorded during a night in the hospital and during several subsequent nights in their residence. At both sites, total time in bed did not differ as a function of loneliness, but the time in bed spent asleep was lower and wake time after sleep onset was higher for lonely than nonlonely individuals. Moreover, on the Pittsburgh Sleep Quality Inventory, lonely young adults reported poorer sleep quality, longer time in bed before falling asleep, longer perceived sleep duration, and greater daytime dysfunction due to sleepiness compared with nonlonely participants. These effects were replicated in our study of older adults in Chicago (Cacioppo, Hawkey, Crawford, et al., 2002, Study 2). Together, these results indicate that the restorative act of sleep is more efficient and effective—that is, salubrious—in nonlonely individuals than in lonely individuals.

CONCLUSION

The research on loneliness suggests that different mechanisms operate to explain short-term and long-term effects of loneliness on health and well-being. We have further found that slowly unfolding pathophysiological processes triggered by loneliness are the consequence of multiple physiological systems. An important question for future research is whether the specific disease that develops from the higher levels of cumulative wear and tear in lonely, compared with non-lonely, individuals reflects each individual's diathesis.

An important implication for intervention studies is that careful attention needs to be given to the different time courses of an intervention's effects on behavioral versus health outcomes. In a recent large multisite intervention study (Sheps, Freedland, Golden, & McMahon, 2003), patients who had had a myocardial infarction received standard medical care or standard care plus treatment for depression and social deprivation. Despite improvements in depression and social support in the latter group, no differences in survival were found. Our review suggests that postintervention measurement periods of weeks or months may allow time to detect changes in people's feelings but too little time for societal, community, interpersonal, and mental events to filter down to measurable pathophysiological and health outcomes.

Recommended Reading

- Berscheid, E., & Reis, H. (1998). Attraction and close relationships. In D.T. Gilbert, S.T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (4th ed., pp. 193–281). New York: McGraw-Hill.
- Cacioppo, J.T., Hawkley, L.C., Crawford, L.E., Ernst, J.M., Burleson, M.H., Kowalewski, R.B., Malarkey, W.B., Van Cauter, E., & Berntson, G.G. (2002). (See References)
- House, J.S., Landis, K.R., & Umberson, D. (1988). Social relationships and health. *Science*, 241, 540–545.

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Notes

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2. The sympathetic nervous system is a major division of the autonomic nervous system that prepares the body for action and responding to stressors. Both the SAM axis and the HPA axis are components of the endocrine system that also prepare the body for action and responding to stressors, but they do so through different hormones. The effects of the SAM system are similar to those of the sympathetic nervous system, but are typically slower and longer lasting. The effects of the HPA system take longer to occur, apply more generally, and require more time to dissipate than the effects of the SAM system or the sympathetic nervous system.

References

- Buss, D.M., & Schmitt, D.P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review*, 100, 204–232.
- Cacioppo, J.T., Ernst, J.M., Burleson, M.H., McClintock, M.K., Malarkey, W.B., Hawkley, L.C., Kowalewski, R.B., Paulsen, A., Hobson, J.A., Hugdahl, K., Spiegel, D., & Berntson, G.G. (2000). Lonely traits and concomitant physiological processes: The MacArthur Social Neuroscience Studies. *International Journal of Psychophysiology*, 35, 143–154.
- Cacioppo, J.T., Hawkley, L.C., Berntson, G.G., Ernst, J.M., Gibbs, A.C., Stickgold, R., & Hobson, J.A. (2002). Do lonely days invade the nights? Potential social modulation of sleep efficiency. *Psychological Science*, 13, 384–387.
- Cacioppo, J.T., Hawkley, L.C., Crawford, L.E., Ernst, J.M., Burleson, M.H., Kowalewski, R.B., Malarkey, W.B., Van Cauter, E., & Berntson, G.G. (2002). Loneliness and health: Potential mechanisms. *Psychosomatic Medicine*, 64, 407–417.
- Committee on Future Directions for Behavioral and Social Sciences Research at the National Institutes of Health. (2001). *Health and behavior*. Washington, DC: National Academy Press.
- de Jong-Gierveld, J. (1987). Developing and testing a model of loneliness. *Journal of Personality and Social Psychology*, 53, 119–128.
- Goldsmith, S.K., Pellmar, T.C., Kleinman, A.M., & Bunney, W.E. (2002). *Reducing suicide: A national imperative*. Washington, DC: National Academy Press.
- Hawkley, L.C., Burleson, M.H., Berntson, G.G., & Cacioppo, J.T. (in press). Loneliness in everyday life: Cardiovascular activity, psychosocial context, and health behaviors. *Journal of Personality and Social Psychology*.
- Hobbs, F., & Stoops, N. (2002). *Demographic trends in the 20th century* (U.S. Census Bureau, Census 2000 Special Reports, Series CENSR-4). Washington, DC: U.S. Government Printing Office.
- Kiecolt-Glaser, J.K., Ricker, D., George, J., Mesnick, G., Speicher, C.E., Garner, W., & Glaser, R. (1984). Urinary cortisol levels, cellular immunocompetency, and loneliness in psychiatric inpatients. *Psychosomatic Medicine*, 46, 15–23.
- Seeman, T.E. (2000). Health promoting effects of friends and family on health outcomes in older adults. *American Journal of Health Promotion*, 14, 362–370.
- Sheps, D.S., Freedland, K.E., Golden, R.N., & McMahon, R.P. (2003). ENRICHD and SADHART: Implications for future biobehavioral intervention efforts. *Psychosomatic Medicine*, 65, 1–2.