

## Do Stressors Explain the Association Between Income and Declines in Self-Rated Health? A Longitudinal Analysis of the National Population Health Survey

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*Although there is considerable evidence documenting the relationship between lower socioeconomic status (SES) and poorer health, longitudinal research is needed to study mechanisms that may explain this relationship. This study investigated whether income was associated with decline in self-rated health over a 2-year period and whether stressors mediated part of this social gradient. Participants in the National Population Health Survey (NPHS) who rated their health as excellent, very good, or good in 1994 and 1995 were followed over 2 years. Analyses demonstrated that individuals in the 2 lowest household income quintiles had significantly greater odds of experiencing a decline in health status as compared to the highest quintile. Seven of 8 reported stressors at baseline were each associated with a significantly increased odds of experiencing a decline in self-rated health. Furthermore, these stressors explained 16% and 10% of the relationship between the lowest and 2nd lowest income quintiles and decline in self-rated health, respectively. These results suggest that stressors may be 1 mechanism underlying the social gradient in health.*

*Key words: income, self-rated health, social gradient, stress, longitudinal, National Population Health Survey*

A considerable body of research demonstrates the pervasiveness of the graded relationship between increasing socioeconomic status (SES) and better health status, whether using so-called objective measures of income, education, or occupation, or subjective measures of perceived SES (Adler & Ostrove, 1999). However, to act to attenuate socioeconomic differences in health, the mechanisms that drive this association must be understood. Proposed mechanisms of the social gradient in health include both health selection and social causation explanations (Elstad, 2000). In health selection, health is a factor that leads to the ability to attain education or occupational achievement, and to earn in-

come. In contrast, social causation explanations propose that SES affects health through material, behavioral, and psychosocial pathways. If this is the case, then intervention at the level of SES status itself or at points on these pathways could act to attenuate socioeconomic differences in health.

Research focusing on determining the direction of the SES health relationship generally points to social causation explanations. For example, through analysis of the 1958 Birth Cohort longitudinal dataset, Manor, Matthews, and Power (2003) concluded that although poor health was associated with being more likely to experience declines in social standing, the effect of health selection on the social gradient in health was variable and of modest size. In both the 1958 and 1946 Birth Cohorts, ill health in childhood had little effect on adult social standing (Blane, Davey Smith, & Bartley, 1993; Power, Manor, & Fox, 1991). In the aggregate, these studies suggest that although health-selective mobility does occur, health selection cannot be considered a major explanation of the social gradient in health, especially not among employed individuals.

Given that social causation seems to be driving an important part of the social gradient in health, the underlying mechanisms that cause this gradient need to be identified. Major explanations have included physical environment–material, behavioral–lifestyle, and

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This research was supported by the Canadian Institutes of Health Research and the National Health Research and Development Program through a doctoral fellowship to the first author. Data was obtained thanks to the Data Liberation Initiative of Statistics Canada. Two anonymous reviewers provided very helpful feedback on earlier versions of this manuscript.

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psychosocial causes of the social gradient in health (Elstad, 2000; Townsend & Davidson, 1982). Studies examining the contribution of these mechanisms to the social gradient in health generally support the role of each of these causes; however, there is little longitudinal research using nationally representative samples studying the contribution of these causes.

Lantz et al. (2001) examined socioeconomic disparities in changes in health over 7.5 years using a population survey and concluded that health behaviors explained only a modest proportion of the increased odds of decline in health associated with lower education or income. A study examining decline in health over 4 years in French and U.K. public employees demonstrated that early childhood environment, health behaviors, and job strain explained 56% and 42% of the increased odds of poor self-rated health associated with lower employment grade, in men and women respectively among the UK sample. In contrast, these factors explained only 27% of the increased odds of poor self-rated health by employment grade for women in the French cohort, and nothing for men (Fuhrer et al., 2002). In a study of U.K. civil servants, Martikainen, Stansfeld, Hemingway, and Marmot (1999) reported that material problems and decision latitude explained 43% and 25% of employment grade differences in 3-year changes in physical functioning for men, but did not explain employment grade differences in physical functioning change among women. In the Danish National Work Environment Cohorts study, the socioeconomic gradient in a worsening of self-reported health status over 5 years was largely explained by work factors (59%) and behavioral factors (17%; Borg & Kristensen, 2000). It is interesting to note that although social class was an important predictor of worsening self-reported health, it was not a significant predictor of improved self-reported health. Finally, Mustard, Vermeulen, and Lavis (2003) demonstrated that among employed Canadians, men in the two lowest occupational classes had approximately 1.8 the odds of experiencing a decline in health status over 4 years, whereas no association was observed among women. Health behaviors and psychosocial job characteristics explained only a modest proportion of the increased odds among men. Adjusting for income did not alter these findings.

These occupational studies add important knowledge to the literature. The variables explaining the relationship between socioeconomic position and decline in health ranged from having no explanatory power, to explaining over half of the excess odds. Generally, effects observed were more consistent among men than among women, indicating that different mechanisms may be at play for men and for women. However, in many cases the mechanisms were not studied individually, and thus it is difficult to determine where interven-

tion efforts may be targeted. Furthermore, only the study by Lantz et al. (2001) included unemployed participants; thus, this body of research has limited generalizability. There is need for longitudinal research, examining employed and unemployed individuals, and examining the contribution of specific mechanisms.

In a previous article, we demonstrated an income gradient in self-rated health that was partially accounted for by self-reported stressors (Orpana & Lemyre, 2004). However, because the data were cross-sectional, it was not possible to ascertain the temporal ordering of the association. Did health problems precede low household income, or did low household income precede the health problems? Fortunately, longitudinal data is now available by which we can better determine the direction of this effect. The goal of the present study was to investigate whether there was a relationship between income quintile at baseline and subsequent decline in self-rated health from good, very good, or excellent to fair or poor over a 2-year period, and whether stressors reported at baseline mediated the relationship between baseline income and decline in self-rated health.

## Method

Data from 17,276 individuals in the National Population Health Survey (NPHS) longitudinal file were analyzed. The NPHS is a longitudinal survey administered by Statistics Canada, with the first cycle taking place in 1994 to 1995 and follow-up surveys every 2 years thereafter for 20 years. It samples individuals over the age of 12 years living in households in all provinces, excluding individuals living on Indian reserves, Canadian Forces bases, and a few remote areas. Households were chosen from a stratified multistage sample of dwellings selected from within clusters of households, based on the sample design of the Labour Force Survey (except for in Quebec, where the Enquête sociale et de santé sample frame was used). Data were collected by computer-assisted interviewing. For these analyses, the longitudinal square subset available by remote data access was studied, consisting of 17,276 individuals who were surveyed initially in 1994. Data from the 1994 to 1995 and 1996 to 1997 cycles were analyzed.

The response rate at Cycle 1 in 1994 to 1995 was reported to be 83.65% at the Canada level for the health component of the survey (Statistics Canada, 2002b). The response rate at Cycle 2 in 1996 to 1997 was 93.6%. Participants 20 years or older with complete data on the studied variables who selected *good*, *very good*, or *excellent health* in response to the self-reported health question in 1994 to 1995 were included, comprising 11,447 of the original 17,276 participants. We excluded 2,178 participants because of nonresponse, death, or institutionalization at Cycle 2,

or due to missing data on the studied variables. The final studied sample size was 9,269.

## Measures

**Household income.** Household income was chosen as the indicator of SES for this study. We chose household income because it has a concrete meaning: Household income provides access to material goods and services. Although household income is often employed in studies investigating material explanations of the social gradient in health, it is also useful in examining psychosocial explanations because income is proximally related to many stressors; for example, it determines the quality of neighborhood a family can afford to live in. It is also relevant to both the employed and unemployed populations, in contrast to measures of occupational prestige. For our study, *household income* was defined as the income of all working adults in a household and was grouped into five approximate income quintiles. (All income figures are expressed in Canadian dollars.) The lowest income quintile ranged from \$0 to \$19,999; the second lowest from \$20,000 to \$39,999; the middle from \$40,000 to \$49,999; the second highest from \$50,000 to \$79,999; and the highest had household incomes of \$80,000 or more.

**Self-rated health.** Health is a broad concept, but here we chose to use a global assessment of self-rated health that has been shown to be predictive of future change in disability (Idler & Kasl, 1995), increasing illness (Ferraro, Farmer, & Wybraniec, 1997), and hospitalization (Romelsjo, Kaplan, Cohen, Allebeck, & Andreasson, 1992) in people of all ages. A significant body of research has also shown that self-rated health is associated with increased risk of mortality for up to 12 years after a single report (Idler & Angel, 1990) and even after controlling for a comprehensive set of empirically measured risk factors for disease (Idler & Benyamini, 1997). Self-rated health has concurrent and predictive validity with numerous measures of health (Hansen, Fink, Frydenberg, & Oxhoj, 2002).

In the NPHS, self-rated health is assessed by a single question at each cycle, asking respondents, "In general, would you say that your health is: poor, fair, good, very good, or excellent?" For these analyses, the responses were dichotomized into poor and fair versus good, very good, or excellent. Change in self-rated health between cycles was measured as new cases of fair or poor health subsequent to Cycle 1.

**Stressors.** Recent life events, chronic stressors, and job strain were each assessed in the first cycle of the NPHS. Recent life events and chronic stressors were measured using questions developed by Turner, Wheaton, & Llyod (1995). Job strain was

measured using an abbreviated version of the Job Content Questionnaire (Schwartz, Pieper, & Karasek, 1988).

The Chronic Stressors scale consisted of a series of 18 questions about situations that the respondent reported he or she was faced with. The Chronic Stressors scale was validated by Wheaton (1994), and demonstrates good convergent validity with indicators of difficult social circumstances and discriminant validity with measures of psychological distress (Wheaton, 1994). These questions covered numerous domains (variable names are included in parentheses), including stressors related to the individual (personal), relationship problems with a spouse (marital), problems with one's children (children), family health problems (family health), a poor physical and social environment (neighborhood), and financial problems (finance). A dichotomous variable was created for each stressor domain, with 1 indicating a positive response to any question on the subscale, and 0 indicating all negative responses to those questions. An aggregate chronic stressors scale was created, summing the dichotomous chronic-stressor variable responses, which created a variable representing the number of domains in which an individual reported a chronic stressor.

Recent life events were measured by asking the respondent a series of 10 questions about major negative life events that had happened to the respondent or his or her close others during the previous 12 months. Questions were selected from a longer list based on the research of Turner and Wheaton (Turner et al., 1995). Scores ranged from 0 to 8, 9, or 10 depending on marital and parental status. In addition to the aggregate score, a dichotomous life-events variable was created, with individuals reporting no life events ascribed a value of 0, and individuals reporting any life events ascribed a value of 1.

Seven questions were used to measure the concept of job strain and were a simplified version of those used by Schwartz et al. (1988), which in turn are based on Karasek's work (Karasek, Baker, Marxer, Ahlborm, & Theorell, 1981) and the U.S. Quality of Employment Surveys. Five questions measured decision latitude and two measured psychological demands. Individuals falling in both the top tertile of demands and the lowest tertile of decision latitude were coded as experiencing job strain.

**Control variables.** All analyses controlled for age (in 5-year groups from age 20 to 70 and over); gender; household size; the social roles of marital, parental, and employment status; and the health behaviors of smoking status (daily smokers vs. occasional and non-smokers) and physical activity level (sedentary vs. all others).

## Analyses

Mediation can be demonstrated when an association between a predictor and an outcome is attenuated by inclusion of the mediator in the regression model, after having shown an association between the predictor and the mediator, and between the mediator and the outcome (Baron & Kenny, 1986). The association between household income group (the predictor) and stressors (the mediator) was demonstrated through age-adjusted prevalences of reported stressor exposures according to income quintile, including *p* for the test for trend. The association between stressors and incident fair or poor health was demonstrated through logistic regression in SPSS 11.5. Then, incident cases of fair or poor health were predicted from household income group at baseline (Model 1). The highest income group was used as the reference group. Finally, the aggregate Chronic Stressor scale, the Life Events scale, and the dichotomous job strain variable were entered into the regression (Model 2).

Mediation was demonstrated by comparing fully standardized logistic regression coefficients from Models 1 and 2. The method proposed by Menard (2002) was used to standardize coefficients, as per the following formula:

$$b_{YX}^* = (b_{YX})(s_X) / \text{square root}(s_{\text{predicted logit}(\hat{Y})}^2 / R^2) \\ = (b_{YX})(s_X)(R) / S_{\text{predicted logit}(\hat{Y})}$$

Because of the complex sample design of the NPHS, variance estimates of parameters can not be calculated either directly or through the application of weights because of design effects. Therefore, the bootstrap method of estimating variance was used (Statistics Canada, 2002a). This method repeatedly subsamples the initial sample using special bootstrap weights to obtain more precise variance estimates. Bootstrapping was performed by remote data access through the Data Liberation Initiative of Statistics Canada.

## Results

From 1994 to 1996, declines in self-rated health among the entire sample were as frequent as increases: 3.9% reported a change in their self-rated health from good or better to fair or poor and 4.0% reported a change from fair or poor to good or better. During the 2-two year period of the study, 287 respondents died and 62 were institutionalized. Although respondents in these groups who were healthy at baseline and who were subsequently institutionalized or died could be considered as having a decline in health status, we chose to exclude these individuals because they may

represent different health pathways than those who remained alive and living in a household.

Women comprised 52% of the study sample. The median age group was 35 to 39 years. Seventeen percent of the participants had incomes less than \$20,000; 27% had incomes from \$20,000 to \$39,999; 14% from \$40,000 to \$49,999; 26% from \$50,000 to \$79,999; and 13% had incomes of \$80,000 or more. Seventy percent of respondents reported being married or in a common-law relationship, or living with a partner. Sixty-six percent of respondents were working. Sixty percent of respondents were inactive, and 25% smoked daily.

As shown in Table 1, in comparison to individuals in the highest income group, individuals in the lowest and second lowest income groups had significantly greater odds of declining self-rated health. Although the pattern of odds ratios for the middle and second highest income groups follows a stepped pattern, these odds ratios are not significantly different from 1. Age was also significantly associated with higher odds of decline in health, as were having children and being a smoker. Being active or employed was associated with lower odds of decline in health.

As shown in Table 2, the prevalence of reported stressors varied according to stressor type, with a high of 59% of respondents reporting personal stress and a low of 8% of respondents being classified as having high job strain. Stressor prevalence also varied as a function of income: 5 of the 8 stressors demonstrated a significant income gradient. Personal stress, problems with children, and family health problems did not. Each reported stressor in 1994 was associated with greater odds of moving from good or better to fair or poor self-rated health, except for marital problems. Adjusting for income had little effect on these odds ratios. Job strain had the largest association, with individuals reporting job strain in 1994 having greater odds (OR = 2.02) of experiencing a decline in health as compared to those not reporting job strain. The smallest significant effect was observed for life events, with an odds ratio of 1.47. The consistency of results across seven of eight diverse stressor domains suggests that a common mechanism may underlie these observed associations, and that this is independent of income.

As shown in Table 1, a test for mediation demonstrated a reduction in odds ratios for both the lowest and the second lowest income groups, the only groups for which the OR in Model 1 was significant. The percentage reduction in fully standardized logistic regression coefficients were 16% for the lowest income group and 10% for the second lowest income group, after including stressors in the model (Model 2). This reduction in odds ratios suggests that reported stressors may be responsible for a small but important part of the observed association between income quintile and new

**Table 1.** Incident Poor Self-Rated Health From 1994 to 1996

	Model 1 <sup>a</sup>		Model 2 <sup>b</sup>		% Reduction
	OR	CI 95%	OR	CI 95%	
Income					
1 (lowest)	2.76	1.51–5.04	2.32	1.25–4.34	16
2	2.24	1.24–4.05	2.05	1.12–3.75	10
3	1.54	0.82–2.90	1.47	0.77–2.79	10
4	1.49	0.85–2.62	1.43	0.81–2.52	9
5 (highest)	1.0		1.0		
Age	1.16	1.10–1.21	1.20	1.15–1.26	
Sex					
Male	1.00		1.00		
Female	0.92	0.72–1.19	0.88	0.68–1.13	
Marital status					
Not married	1.00		1.0		
Married	1.09	0.83–1.42	1.01	0.77–1.31	
Parental status					
No children	1.00		1.00		
Children	1.14	0.82–1.56	0.96	0.69–1.32	
Employment					
Not employed	1.00		1.00		
Employed	0.71	0.52–0.98	0.62	0.45–0.86	
Activity level					
Inactive	1.00		1.0		
Active	0.66	0.51–0.86	0.67	0.51–0.87	
Smoking status					
Nonsmoker	1.00		1.00		
Smoker	1.81	1.40–2.34	1.61	1.24–2.10	
Work stress	—		1.83	1.16–2.87	
Chronic stressors	—		1.33	1.20–1.46	
Life events	—		1.04	0.93–1.17	

Note. *N* = 9,269. <sup>a</sup>Data adjusted for age, gender, household size, social roles, and health behaviours. <sup>b</sup>Data adjusted for age, gender, household size, social roles, health behaviours, and stressor exposures.

**Table 2.** Crude Prevalence of Reported Stressors by Income Quintile and Odds Ratios for Incident Poor Health by Stressors

Stressor Type	Prevalence %						<i>p</i>	OR <sup>b</sup>	CI 95%
	Total Sample <sup>a</sup>	Income Quintile							
		1 (lowest)	2	3	4	5 (highest)			
Personal	59	58	58	58	57	62	ns	1.74	1.36–2.24
Marital	14	11	15	15	15	14	<.05	1.42	1.00–2.01
Children	24	23	26	25	23	23	ns	1.66	1.25–2.19
Family health	20	21	19	19	19	17	ns	1.57	1.19–2.07
Job strain	8	6	9	8	10	5	<.05	2.02	1.28–3.18
Neighborhood	27	35	27	24	24	20	<.01	1.61	1.24–2.08
Financial	37	58	41	34	31	21	<.01	1.61	1.20–2.17
Life events	38	48	38	37	34	34	<.01	1.47	1.16–1.87

Note. OR = odds ratio; CI = confidence interval; *ns* = not significant.

<sup>a</sup>*N* = 9,269. <sup>b</sup>Adjusted for age, gender, household size, social roles, health behaviors, and income quintile.

cases of fair and poor self-rated health. Stressors explain an increasing proportion of the variance as income quintile decreases.

Neither gender-stratified analyses nor analyses restricted to unemployed participants yielded significant odds ratios for decline in self-rated health by income quintile. The smaller number of cases of decline in

self-rated health may have resulted in insufficient power to observe effects after splitting the sample. However, in employed participants, the lowest and second lowest income quintiles had significantly higher odds of decline in health, with odds ratios of 3.00 (95% CI 1.19–7.58) and 3.04 (95% CI 1.31–7.10), respectively. Adding stressors to the model reduced the odds

ratios to 2.82 (95% CI 1.08–7.39) and 2.88 (95% CI 1.20–6.89) for the lowest and second lowest income groups, respectively.

### Discussion

This study demonstrated that individuals living in households with combined incomes of less than \$20,000 have almost three times the odds of experiencing a decline in self-rated health over 2 years than do individuals in the highest income quintile. Furthermore, increased odds of declining health status were observed even among those in the \$20,000 to \$40,000 income group, suggesting that mechanisms beyond absolute poverty and material deprivation may be at work, because most incomes in this range are clearly above the point at which absolute material deprivation is of issue in Canada. Reported stressors were significant predictors of decline in self-rated health, and our study demonstrated a modest but important mediating effect of stressors on the relationship between income and health decline. Stressors explained 16% and 10% of this association for the lowest and second lowest income groups, respectively.

Unfortunately because of sample size, gender-stratified analyses, and those examining the unemployed did not yield significant results, possibly due to the limited number of cases. However, among employed individuals, the pattern of results were similar to that for the entire sample, with the two lowest income groups having significantly elevated odds of decline in self-rated health. It may be fruitful to use the present analytical framework with future cycles of the NPHS after the accumulation of more cases of incident fair or poor health.

A surprisingly consistent magnitude of association between a wide range of stressors and subsequent decline in self-rated health emerged, with most stressors associated with an approximately 50% greater likelihood of a decline from good or better to fair or poor health. The exception was job strain, which was associated with greater than twice the odds of a decline in self-rated health. Adjusting for income quintile had almost no effect on the magnitude of the odds ratios, underlining that the health effects of these stressors do not appear to function through the material deprivation that is associated with some of them. Because these stressors have been shown to be differentially distributed across income groups, with lower income individuals being more likely to report stressors (Orpana & Lemyre, 2004; Turner et al., 1995), stressors are a good candidate explanatory mechanism for the social gradient in health.

The magnitude of mediation by stressors in our study can not easily be compared to those reported in

other studies. In contrast to the literature reviewed that examined numerous mediating factors simultaneously, we examined only a single type of mediating factor. As well, we compared fully standardized logistic regression coefficients instead of using a reduction-in-excess-odds approach to quantifying mediation. Nevertheless, our results concur with those of other researchers, in that psychosocial mechanisms appear to mediate a modest but important part of the social gradient in health.

Reporting biases must be considered when examining the relationship between SES, stressors, and self-rated health. Humphries and van Doorslaer (2000) found that individuals in lower socioeconomic groups reported worse self-rated health given a certain Health Utility Index score than did individuals in higher socioeconomic groups, supporting that reporting biases should be taken into account when examining social gradients in self-rated health. However, in longitudinal analyses, reporting biases will affect associations only if they change over time. For example, a lower socioeconomic group would have to report their health status at baseline as being better than it actually was and then to report their actual and less favorable health status in 1996 for the bias to inflate gradients in incident poor health. If anything, if lower SES participants underestimate their true health at baseline, gradients have been attenuated through the exclusion of individuals reporting fair or poor health at baseline.

Another artefactual explanation of our findings stems from the way we measured decline in health. Individuals who were reported as in good, very good, or excellent health in 1994 to 1995 and fair or poor health in 1996 to 1997 were considered to have experienced a decline in health status, and this method of measuring change is frequently used by other researchers (Lantz et al., 2001). However, because lower income groups have a higher prevalence of the marginal category of good health at baseline (with prevalences of 28%, 27%, 24%, 21%, and 16% in the lowest to highest income groups, respectively), a higher odds of moving to fair or poor health may be a result of there being a greater pool of individuals in lower income groups in the good health group and there being fewer categories to cross to be considered a case of decline in health status. We ran a logistic regression restricting the analysis to just participants reporting good health in 1994 to 1995. Results indicate that as income quintile increased, the odds of moving from good to fair or poor health decreased. Thus, we can conclude that the observed effects are not due only to the higher prevalence of good as opposed to better than good health in the lower income groups.

One of the strengths of this study is its longitudinal nature. By measuring the predictor variables be-

fore the event of interest occurs, we can be certain of the temporal sequencing of these events. In a previous article (Orpana & Lemyre, 2004), we examined the contemporaneous effects of household income on self-rated health and mediation of this by stressors. Whereas the social gradient in poor self-rated health across income at the same time was approximately of the same magnitude as the social gradient in 2-year decline in self-rated health, the mediating effect of stressors estimated in this longitudinal study was somewhat smaller than that observed among men in the cross-sectional study and similar to that observed among women. The mediating effect of stressors may be smaller because the time factor was not been accounted for adequately and interpretation of these results depends on the hypothesized lag between stressors and their effect on health. Many of the stressors studied may have been present prior to 1994 to 1995 when they were measured, and may have already acted on the individual resulting in a state of fair or poor health. Such individuals would not be identified in the present analyses, and thus the relationship between stressors and health, and the mediating effect of stressors may have been underestimated. In a similar manner, because income and stressors are measured at the same point in time, it is possible that stressors existing prior the observation period affected income. Ideally, income would be measured prior to the occurrence and reporting of stressors, to have greater confidence in the direction of the observed effects.

Several recommendations stem from these analyses. First, social gradients in health observed in Canada do reflect some degree of social causation. Thus, identifying the factors that lead to greater odds of declining health status among lower SES groups is paramount to attenuate socioeconomic differentials in health. Our study suggests that stressors may be one mechanisms contributing to poorer health among poorer people. Indeed, the odds of declining from good or better to fair or poor self-rated health among individuals reporting a stressor are higher by about 50%. Intervening to reduce stressors or to buffer their impact may affect individuals' health status, regardless of their SES. However, because these stressors are more common among lower SES individuals (Orpana & Lemyre, 2004), reducing these stressors will have a greater impact on the health of lower income populations. For example, adjusting workplace policies to increase decision latitude may yield benefits for the population as a whole, with a greater impact on lower SES groups.

Given its importance as a social issue, further research is necessary to better determine the mechanisms underlying the social gradient in health. Longitudinal research is perhaps the best way to identify potential

mechanisms. Improvements in longitudinal research could include collecting information about stressor duration and the use of longer follow-up periods. However, once potential mechanisms are supported by longitudinal research, intervention research is called for to provide stronger evidence for the causality of identified mechanisms.

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