

## EXPLANATIONS FOR EDUCATION GRADIENTS IN DEPRESSION

### **Abstract**

Our objective is to examine educational gradients in depression and to identify underlying mechanisms of how education might affect depression. We use a nationally representative sample of community-residing older adults aged 45 and older from the 2006 Korean Longitudinal Study of Aging, which collected information about depressive symptoms and education. Using tobit regression, we estimate the effect of education on depression and examine what can explain the education gradients by controlling for proxy variables of different pathways linking education to depression. We found strong age-adjusted education gradients in depression. We were able to explain all of education gradients by cognitive ability, economic resources, social status, social network, and health behavior. Spouse's education is found to be particularly important for women. Children's educational achievement influences parents' depression as well. Education affects depression through different underlying mechanisms, and the single most important pathway is through developing cognitive ability. One's educational attainment strongly influences not only his/her own but also spouse's and parents' depression.

## **INTRODUCTION**

A large and persistent association between education and health has been observed in many countries, including the Republic of Korea (hereafter Korea), and for a wide variety of health measures, including mental health (Lorant et al., 2003; Muntaner et al., 2004). As a result, substantial attention has been paid to gradients in health by education, and reducing health inequalities has become policy goals for many countries, including Korea. However, the mechanisms underlying the link between education and mental health have not been conclusive (Cutler and Lleras-Muney, 2006).

In this paper, we investigate the relationship between education and depression, in particular about the possible causal mechanisms behind them. Using newly available micro data, which provide information on different mechanisms, we examine the relative magnitude of different explanations for the educational gradients in mental health. Understanding the mechanism by which education affects health is important for policy. Without a clear understanding of such mechanism, it is difficult to know what interventions will be most effective.

## **PREVIOUS LITERATURE**

### **Theoretical Explanations for How Education Affects Health**

Some recent evidence from natural experiments suggests that at least part of the correlation between education and health is causal. For example, Lleras-Muney (2005) and Arendt (2005) find that increases in compulsory education laws in the U.S. and Denmark improved the health of population. There is also evidence of a causal effect of maternal education on infant health. Currie and Moretti (2003) find that women in counties where colleges opened were more likely to attend college and had healthier babies than women in counties where the supply of college did not increase. This causal effect of education on health is the focus of this study, and particularly we examine possible mechanisms of how education affects health.

First, education may improve health because it results in higher earnings and therefore greater resources including access to health care. Autor, Katz and Kearney (2005) support this economic explanation by showing that health returns to education were increasing in the 1980s and 1990s at the same time that the earnings returns to education were rising. Previous studies that controlled income in estimating the effect of education on health find that education coefficients remain significant (Smith, 2007).

Second, education leads to better jobs, in addition to higher earnings, offering safer work environments and less exposure to adversity. Social epidemiologists posit that lack of education contributes to the initial causes of depression, such as injury, psychological trauma, and chronic adversity (Dave, Rashad, and Spasojevic, 2006; Eaton et al., 2001), and such prevalence of adversity and stress fosters psychopathology resulting in depression (Kasl and Jones, 2000; Muntaner et al., 2004).

Third, education provides individuals with better access to information and improved critical thinking skills, leading to health promoting behaviors. The more educated tends to be better informed and to make use of new health related information first. For example, the educated were more likely to quit smoking after the 1964 Surgeon General Report first publicized the dangers of smoking (de Walque, 2004). The more educated are also more likely to comply with AIDS and diabetes treatments (Goldman and Smith, 2002).

Fourth, education changes one's relative position in a society, and this social status might affect health (Marmot, 2002). It is hypothesized that this relationship emerges because individuals at the lower end of the hierarchy have lower control over their lives and are constantly subjected to arbitrary demands by others, causing poor health. Particularly, for women, more education is associated with the likelihood of finding more educated spouse, and spouse's education can be a proxy for social status of women.

Finally, social network is another mechanism posited linking education to health. Berkman (1995) explains that the more educated have larger social networks that provide

greater social support. For example, marriage has protective health effects (Cacciopo et al., 2006), predicting lower levels of depression. Marriage is found to provide greater protection for men than for women (Weissman et al., 1996). Social support, not only through informal networks of family and friends, but also through formal networks such as employment, clubs and other social engagements have been identified as protective factors of depression (Michael et al., 2001).

In this study, we examine these possible mechanisms, in particular the relative magnitude of these different explanations for the educational gradients. First, we document the basic educational gradients in depression by estimating the following regression:

$$H_i = c + \beta E_i + X_i \delta + \varepsilon_i$$

Where  $H_i$  is a measure of individual  $i$ 's mental health,  $E_i$  stands for individual  $i$ 's education,  $X_i$  is a vector of individual characteristics, such as gender and age,  $c$  is a constant term, and  $\varepsilon$  is the error term. The coefficient on education  $\beta$  (also referred to as the education gradient) is the object of interest, and it measures the effect of education on health.

Once we obtain the age adjusted raw education gradient, we then assess the ability of each of the above five mechanisms outlined above to account for education gradients in depression in isolation and collectively. The central question we ask is not whether they are related to depression, but whether it reduces the estimated education gradient. Significant reductions in the estimated education gradients indicate that the underlying mechanisms account for some of education gradients.

### **Depression in Korea**

Depression is a leading cause of disability worldwide, because of its high prevalence, chronicity, and high degree of resultant impairment (Institute of Medicine, 2000). Although most of the burden attributable to depression is disability related, premature mortality, especially from suicide and physical illness, is significant (Hyman et al., 2006; Institute of Medicine, 2000): depression is associated with about 90 percent of all suicide cases. Korea has the highest

suicide rate among the industrialized countries, and the rates are particularly higher among older adults (WHO, 2008)..

Both community-based and clinical studies indicate that women often are affected disproportionately by depression in developed and developing countries, including Korea (Blehar & Oren, 1997; Hyman *et al.*, 2006; Park *et al.*, 2006). Gender gap in education may have contributed to women's vulnerability to depression. Although gender difference in education has disappeared in recent years in developed countries (or even women surpassing men in educational achievement), the older cohorts of women were less educated than men in the developed countries. And in many developing countries, women are still less educated than men. Furthermore, female labor force participation is still lower than male labor force participation. For women, education often is not directly linked to earnings, instead it may be indirectly linked to higher income and social status through marriage.

Especially, Korea has a long tradition of Confucian values, where families observe strict gender differentiation and patriarchy (Deuchler, 1992). Traditional Korean women's responsibility was restricted to the domestic sphere, and consequently, women tend to develop a "relational" concept of self (Park, 2007): they define themselves in terms of someone's daughter, someone's wife and someone's mother. Married women would receive residual respect from all those who respect her husband, and therefore, her husband's success would have a strong effect on women's self-fulfillment. Also, traditionally, children are the providers for old-age support for parents (Lee *et al.*, 2004), and children's financial transfers are still the main source of income for large number of elderly parents in Korea (Lee and Lee, 2009). Consequently, children's achievement has significant influence on parents' later life.

Physical illness often accompanies depression (NIMH, 2007). Diseases such as stroke, heart attack, cancer, diabetes, Parkinson's disease, and hormonal disorders as well as disability, are found to be associated with depression, although the direction of causality has not been clearly established. Some empirical studies suggest that disease and disability affects

depression (Carney et al., 2003; Oxman & Hull, 2001), while others find the evidence of depression increasing risk of diseases (for example, heart disease (Shiotani et al., 2002), stroke (Gump et al., 2005), for review, see (Clarke & Currie, 2009)). Therefore, we control for these physical health variables when we estimate educational gradients in depression..

## **METHODS**

### **Data**

Data for this study were drawn from the 2006 baseline wave of the KLoSA , a large-scale, longitudinal survey of the South Korean population, ages 45 and older residing in the community. The baseline survey instrument was modeled after the *Health and Retirement Survey*, and included questions on demographics, family and social networks, health, employment and retirement, income and assets. Baseline data were collected from August 1 to December 22, 2006. The study sample was drawn from the 2005 Census. To account for design effects created by stratified multi-stage area probability sampling, weights and strata were used in estimation. A total of 10,255 respondents completed the interview; and among them, 10,180 respondents reported their depressive symptoms and are the sample for this study.

### **Measures**

Depression was measured using the Korean version of the 10-item *Center for Epidemiologic Studies Depression* (CESD) Scale. CESD is a self-report scale for depressive symptoms developed to identify high-risk individuals for epidemiological studies (Randloff, 1977). Reliability and validity of CES-D have been established, and the measure has been used within various populations, including Koreans (Lee and Farran, 2004). The 10 items ask about symptoms experienced during the past week, and responses were scored according to how often symptoms were experienced, using a 4-point Likert scale. CESD-10 scores range from 0 to 30 with higher scores representing more frequent depressive symptoms.

Educational attainment was divided into five groups: no formal schooling (no school); elementary school (1~6<sup>th</sup> grade, ES); middle school (7~9<sup>th</sup> grade, MS); high school (10~12<sup>th</sup> grade, HS); and some college education or more (BS).

Possible mechanisms of how education affects health: The following groups of variables motivated by the previous literature are included: (1) Household income and household net-worth are divided into three equally-sized income terciles, so that one third of the population is in each group. Household income and net-worth variables have missing values, which were replaced with the sample mean values. To capture any bias associated with such replacements, we included two flag variables, indicating the observation had missing values of income or net-worth. Korea has the national public health insurance, which provides universal coverage so health insurance variable is not included.

(2) A set of categorical variables of job characteristics are included as the proxy to capture exposure to adversity and stress; stressed at work (very stressed, somewhat stressed, and no stress as base), dissatisfied with job (very dissatisfied, somewhat dissatisfied, and no dissatisfaction as base); and poor work environment (very poor, poor, and not poor as base).

(3) Cognitive ability is measured using the Korean version of the Mini Mental State Exam (K-MMSE), which is a brief global instrument assessing the cognitive status of the elderly (Folstein et al., 1975; Kang et al., 1997). The total K-MMSE score is calculated by summing the correct responses, ranging from 0 to 30.

(4) Health promoting behaviors include: not smoking, regular exercise, and the use of preventative health care service. Categorical variables of smoking and regular exercise are included: current smoker, quit smoking, and never smoked (base); regular exercise more than once a week for less than a year, for 1 to 6 years, more than 7 year, and no regular exercise (base). A binary variable of the use of preventative health care service indicates that a respondent took health screening exam in the past 2 years (base: did not take health screening

exam). The national public health insurance provides a free health screening exam in every 2 years for everyone at age 40 and older.

(5) As a proxy for social status, we include number of years of schooling for spouse and the most educated child (defined for children above age 25). As we expect gender difference in spouse's education, we also include interaction terms in the analysis.

(6) Social network variables include; a binary variable of marriage (not married as base) and its interaction with gender (as previous literature suggests more protective marriage effect on men than women); a binary variable for childlessness and a count of number of children; binary variables of having a sibling (counting for only living siblings); a close friend; working; participating in any organized social activities (e.g., attending church or social clubs, and volunteering).

Finally, we control for one's age, gender, and physical health. For age, we include age and age quadratic terms to capture potential non-linearity. A set of binary variables assessing *disease prevalence* and *functional ability* are included for physical health. Respondents reported whether they were diagnosed with specific types of chronic disease (i.e., diabetes, hypertension, cancer, lung disease, heart problems, and stroke); whether they had difficulties performing activities of daily living (ADLs) (i.e., dressing, bathing and eating).

## **Statistical Methods**

We first present descriptive data (accounting for sampling design) on the distribution of educational attainment for men and women across age groups and the mean CESD score for each level of educational attainment. The Korean population's educational attainment has risen with the introduction of compulsory elementary school education in 1954.

We also describe the association between education and the proxy variables for underlying mechanisms: (1) household income and net-worth; (2) job characteristics; (3) cognition; (4) health-related behaviors; (5) education levels for spouse and the most educated child as proxy for social status; and (6) social network.



Next, we separately estimate impacts of these individual groups of proxy variables indicating each underlying mechanisms on CESD. Tobit estimation censored at both lower and upper limits is used to model CESD. Starting with only age, gender, and education to obtain the age adjusted raw education gradient, we then assessed the ability of each of the six groups of proxy variables outlined above to account for education gradients in depression in isolation and collectively. The central question we ask is not whether a proxy variable is related to depression, but whether it reduces the estimated education gradient in CESD. Significant reductions in the regression education coefficients indicate that the underlying mechanism accounts for some of education gradients.

## **RESULTS**

Table 1 presents the distributions of education and the mean CESD scores across educational attainment. First, we see a huge gender gap in educational attainment. About one in five men at age 45 and older in Korea were college educated compared with 6 percent of women at the same age. In contrast, one of five women had no formal schooling compared with 6 percent of men. Across age groups, two notable patterns emerge: younger generations are more educated than older generation, and gender gap is much narrower for younger age group than the older one. A sharp negative CESD gradient is observed with the most educated having CESD scores almost half that of the least educated.

To help explain an education gradient in depression, proxy variables must be associated with education. Table 2 presents distributions of these proxy variables by education. Those with high school and college education had higher household income than those without, while the mean income difference is not pronounced below that level. Household net-worth, on the other hand, shows a linear association with schooling.

Among current workers, the less educated are more likely to report poor work environment and dissatisfaction with job, but less stress than the more educated. However, the labor force participation rate of the less educated is much lower than that of the more educated.

Cognitive ability shows a strong linear correlation with the educational attainment. In terms of smoking, the more educated are more likely to smoke than the less educated, although they are also more likely to quit smoking. The more educated are much more likely to engage in regular exercise for longer period of time than the less educated are. Those without any formal schooling are much less likely to take preventative health screening exam than those with formal schooling, but preventative health screening behavior did not vary across the level of schooling beyond that.

The mean year of schooling for spouse is closely related to respondent's own educational attainment, providing the evidence of assortive mating. The mean year of schooling for the most educated child is also linearly related to the respondent's education, but the slope is much flatter due to overall increase in schooling for younger generation.

Those at the bottom of the education ladder are less likely to be married or living with partner but have more children. The less educated are less likely to have a living sibling or close friend, although the difference in having a close friend is very small. Education was strongly associated with participation in organized social activities. The data in Table 2 show a portrait of Koreans with less schooling as less socially integrated across several salient dimensions including family, friends, and social organizations. All could contribute to the strong education gradient in depression but that evaluation depends on multivariate analysis to isolate the independent influence of each factor.

Table 3 presents our summary of the education gradients in depression estimated by tobit regression models for CESD. CESD had 1,129 left-censored observations at zero, and 10 right-censored observations at 30. We start with the base Model A from Table 3, which estimated the effects of education on depression only controlling for age and gender. The base Model A demonstrates a strong age and gender adjusted education gradient.

From this base model, we separately introduce each of the following six set of proxy variables to ascertain whether they account for educational gradients in Model B: (1) household

income and net-worth, (2) job characteristics, (3) cognitive ability, (4) health behavior, (5) social status, and (6) social network. In each case, we compare education gradient in depression with this subset of variables included to the age and gender standardized education gradient.

Comparing the regression education coefficients of Model B with Model A, we observed the reductions, with the exception of job characteristics. The reductions in the education gradient indicate that the corresponding underlying mechanisms account for some of education gradients, and the reduction is the greatest when we control for cognitive ability. Comparing those with college education with no formal education, the size of the education in Model B (3) compared to Model A is reduced about a half. And the reduction is even greater for less educated groups.

The introduction of spouse and children's educational attainment variables (Model B5) lowers the education gradient by about 40 percent. Income and net-worth (Model B1) account for about 27 percent of the education gradient compared with the base model, and social network variables (Model B6) lower the education gradient by about 23 percent. Finally, health behavior (Model B4) accounts for about 16% of the education gradient.

This result suggests that education affects depression as it provides more economic resources, heightens cognitive ability, leads to health promoting behaviors and higher social status, and brings more social support. Whereas we did not find that adversity associated with job characteristics explains the education gradients in depression, this result is not conclusive given the limitation of our proxy variables: we were only able to capture the characteristics of the current job, but not accounting for past job characteristics nor exposures to adversity.

Finally, in Model C, we control for all of the above six set of variables collectively in addition to age and gender, and we find that the regression coefficients for education variables are no longer significant, suggesting that the proposed mechanisms collectively explain all of the education gradients in depression.

Table 4 presents the results of Tobit regression after controlling for all of the proxy variables in Model C and physical health variables. Education, age, and gender are no longer significant, while the proxy variables capturing different pathways linking education to depression are significant. Specifically, household income and net-worth, dissatisfaction with job and stress at work, cognitive ability, smoking, exercise, taking preventative health screening exam, years of schooling for spouse and most educated child, marriage, childlessness, working, and engaging in organized social activities, are significant. As proposed, the effect of spouse's education is greater for women than men, but the gender difference is not significant for the effect of children's education.

## **Discussion**

We found a strong age and gender adjusted education gradient in depression. Education heightens one's cognitive ability, and we find that cognitive ability explains about 60 percent of the education gradient in depression. When we introduced the spouse's educational attainment in addition to one's own education, we were able to explain some of the education gradient. Spouse's education matters more for women than men, and this result can be understood within the culture where women's social status is determined by her husband. Children's education also explains some of the education gradient in depression, and we find that it matters for both parents' depression even after controlling for all potential risk factors of depression.

We also found empirical evidence that education influences through other underlying mechanisms, such as economic resources, social network, and health behaviors. The introduction of household income and net-worth explained about 27 percent of the education gradient, and their effects remain significant once we controlled for all potential risk factors of depression. Social network variables also explained about 23 percent of the education gradient, and we find that the more educated are more likely to be married, have less number of children, more likely to work and engage in organized social activities than the less educated, and such

social network protects them against depression. Consistent with previous empirical literature, we find that marriage provides more protection for men than women.

Education is hypothesized to lead to health promotion behavior. We find that the more educated are more likely to quit smoking, exercise regularly, and take preventative health screening exam than the less educated. However, the more educated were more likely to once experience smoking, as the country's first anti-smoking campaign was introduced in 1995. We found that health behavior also explains some of the education gradient. Once we controlled for all these proxy variables for underlying pathways, we were able to explain all of the education gradient in depression.

## REFERENCES

- Arendt, J. N. (2005). Does education cause better health? A panel data analysis using school reform for identification, *Economics of Education Review*, 24, 149-160.
- Autor, D., Katz, L. F., & Kearney, M. S. (2005). Trends in U.S. wage inequality: Re-assessing the revisionists, *NBER Working Paper No. 11627*, National Bureau of Economic Research: Cambridge, MA.
- Blehar, M. D., & Oren, D. A. (1997). Gender differences in depression. *Medscape Women's Health*, 2: 3. Revised from: Women's increased vulnerability to mood disorders: Integrating psychobiology and epidemiology. *Depression*, 1995; 3, 3-12.
- Carney, R. M., Blumenthal, J. A., Catellier, D., Freedland, K. E., Berkman, L. F., Watkins, L. L., Czajkowski, S. M., Hayano, J., & Jaffe, A. S. (2003). Depression as a risk factor for mortality after acute myocardial infarction, *American Journal of Cardiology*, 92: 1277-1281.
- Clarke, D. M., & Currie, K. C. (2009). Depression, anxiety and their relationship with chronic diseases: A review of the epidemiology, risk and treatment evidence, *The Medical Journal of Australia*, 190, S54 – S60.

- Currie, J., & Moretti, E. (2003). Mother's education and the international transmission of human capital: evidence from college openings, *Quarterly Journal of Economics*, 118 (4), 1495-1532.
- Cutler, D. M., & Lleras-Muney, A. (2006). Education and health: Evaluating theories and evidence, *NBER Working Paper Series*, Working Paper 12352, National Bureau of Economic Research: Cambridge, MA.
- Deuchler, M. (1992). The Confucian transformation of Korea: A study of society and ideology, *Harvard Yenching Institute Monograph Series 36*, Cambridge, MA and London: Council on East Asia Studies, Harvard University.
- De Walque, D. (2004). Education, information and smoking decision: Evidence from smoking histories, 1940 – 2000, *Policy Research Working Paper No. 3362*, World Bank; Washington D.C.
- Eaton, W., Muntaner, C., & Bovasso, G. (2001). Socioeconomic status and depression, *Journal of Health and Social Behavior*, 42, 277-293.
- Folstein, MF, Folstein SE, McHugh PR (1975). "Mini-mental state,: A Practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12: 189~198.
- Goldman, D. P., & Smith, J. P. (2002). Can patient self-management explain the SES health gradient, *Proceedings of the National Academy of Science*, August 6, 99 (16), 10929 – 10934.
- Gump, B. B., Matthews, K. A., Eberly, L. E., Chang, Y. F., & MRFIT Research Group (2005). Depressive symptoms and mortality in men: results from the Multiple Risk Factor Intervention Trial, *Stroke*, 36, 98 – 102.
- Hyman, S., Chisholm, D., Kessler, R., Patel, V., & Whiteford, H. (2006). Mental disorder, In *Disease Control Priorities Related to Mental, Neurological, Developmental and Substance Abuse Disorders*, second edition, Geneva: World Health Organization.

- Institute of Medicine (2000). *Neurological, Psychiatric, and Developmental Disorders: Meeting the Challenge in the Developing World*, Washington, D.C.: National Science Academy.
- Kang, Y. W., Na, D. L., & Han, S. H. (1997). A validity study on the Korean Mini-Mental State Examination (K-MMSE) in dementia patients, *Journal of Korean Neurological Association*, 15: 300~308.
- Kasl, S. V., & Jones, B. A. (2000). The impact of job loss and retirement on health, In *Social Epidemiology*, L. F. Berkman & I. Kawachi (eds.), Oxford University Press, 137-173.
- Lee, E. E., & Farran, C. J. (2004). Depression Among Korean, Korean American, and Caucasian American Family Caregivers. *Journal of Transcultural Nursing*, 15, 18-25.
- Lee, J., & Lee, Y. (2009). Old-age income security and private transfers in Korea," *Journal of Population Aging and Social Policy*, 21 (4), forthcoming.
- Lee, K.-J., Um, C. C., & Kim, S. (2004). Multiple roles of married Korean women: effect on depression. *Sex Roles: A Journal of Research*, 51, 469 – 478.
- Lleras-Muney, A. (2005). The relationship between education and adult mortality in the United States, *Review of Economic Studies*, 72, 189-221.
- Lorant, V., Deliege, D., Eaton, W., Robert, A., Philpott, P., & Anseau, M. (2003). Socioeconomic inequalities in depression: A meta-analysis, *American Journal of Epidemiology*, 157, 98 – 112.
- Marmot, M. G. (2002). The influence of income on health: Views of an epidemiologist, *Health Affairs*, 21 (2), March/April, 31 – 46.
- Michael, Y. L., Berkman, L. F., Colditz, G. A., & Kawachi, I. (2001). Living arrangements, social integration, and change in functional health status, *American Journal of Epidemiology*, 153, 123-131.
- Muntaner, C., Eaton, W. W., Miech, R., & O'Campo, P. (2004). Socioeconomic position and major mental disorders, *Epidemiologic Reviews*, 26, 53 – 62.

- NIMH, National Institute of Mental Health (2007). *Older Adults: Depression and Suicide Facts*. NIH Publication No. 4593, Bethesda, MD: National Institute of Mental Health, National Institutes of Health, US Department of Health and Human Services.
- Oxman, T. E., & Hull, J. G. (2001). Social support and treatment response in older depressed primary care patients, *Journal of Gerontology: Psychological Sciences*, 56B, P35-P45.
- Park, I. S. (2007). Korea: A new look at the fertility transition and its impact on women, *Family Health International*, <http://www.FHI.org/en/RH/Pubs/wsp/fctshts/Korea1.htm>, retrieved on Apr 11, 2009.
- Park, J-H., Yoon, S-J., Lee, H-Y., Cho, H-S., Lee, J-Y., Eun, S-J., Park, J-H., Kim, Y., Kim, Y-I., & Shin, Y-S. (2006). Estimating the burden of psychiatric disorder in Korea, *Journal of Preventive Medicine and Public Health*, 39, 39-45.
- Randloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1, 385-401.
- Shiotani, I., Sato, H., Kinjo, K., Nakatani, D., Mizuno, H., Ohnishi, Y., Hishida, E., Kijima, Y., Hori, M., Osaka Acute Coronary Insufficiency Study (OACIS) Group (2002). Depressive symptoms predict 12 month prognosis in elderly patients with acute myocardial infarction, *Journal of Cardiovascular Risk*, 9, 153 – 160.
- Smith, J. P. (2007). The Impact of Social Economic Status on Health over the Life-Course, *Journal of Human Resources*, 42, 739–764.
- Weissman, M. M., Bland, R. C., Canino, G. J., Faravelli, C., Greenwald, S., Hwu, H.-G. (1996). Cross-national epidemiology of major depression and bipolar disorder. *Journal of the American Medical Association*, 276, 293-299.
- WHO, World Health Organization (2008). *Suicide and Suicide Prevention in Asia*, Department of Mental Health and Substance Abuse, WHO: Geneva, Switzerland.



Table 1. Distribution of educational attainment and Mean CESD

	N	no school	es	ms	hs	bs
All	10172	14.4	25.4	17.9	29.6	12.7
Men	4437	6.0	19.0	18.2	36.2	20.6
Women	5735	21.9	31.2	17.6	23.6	5.7
Age 45 – 54						
Men	1440	0.7	7.8	15.2	47.3	29.1
Women	1846	2.2	18.2	23.2	45.8	10.6
Age 55 – 64						
Men	1272	4.6	21.5	22.9	34.3	16.6
Women	1495	15.2	42.1	21.8	16.4	4.4
Age 65 – 74						
Men	1198	11.7	33.8	17.4	23.8	13.3
Women	1460	39.6	42.5	9.4	6.6	1.9
Age 75+						
Men	527	28.8	32.5	13.8	13.9	11.0
Women	934	68.7	24.8	3.4	2.9	0.2
Mean CESD	10172	9.2	7.0	6.1	5.3	4.9

Table 2. Descriptive Statistics by Education

	No school	ES	MS	HS	BS
Mean household income (U.S. dollars)	24,076	22,410	23,405	28,380	43,725
Mean household net-worth (U.S. dollars)	81,988	118,665	129,846	179,380	361,762
% very poor work environment among workers	19.3	9.6	8.7	5.5	2.0
% poor work environment among workers	46.2	44.1	46.5	39.4	20.0
% very dissatisfied with job among workers	15.5	4.9	6.4	4.3	1.1
% dissatisfied with job among workers	44.2	43.1	41.0	35.6	22.0
% very stressed at work among workers	8.3	8.2	10.2	10.4	11.5
% stressed at work among workers	37.3	43.3	45.6	50.5	53.3
Mean cognitive ability score (K-MMSE)	19.1	25.2	27.2	28.0	28.6
% ever smoked	16.1	25.6	33.6	37.6	41.9
% quit smoking among those ever smoked	28.4	30.4	30.4	30.2	32.3
% regularly exercise more than once a week for less than a year	3.2	4.8	5.7	4.8	5.3
% regularly exercise more than once a week for 1 to 6 years	7.4	17.0	21.8	24.5	30.4
% regularly exercise more than once a week for 7 years or more	5.7	9.3	13.3	17.4	27.3
% took health screening exam	39.7	48.8	45.5	46.1	45.9
Mean years of schooling for spouse among married	3.6	6.6	8.9	11.1	13.3
Mean years of schooling for the most educated child among parents with child age 25+	13.0	14.6	15.3	15.7	16.2
% married or living with a partner	51.3	76.0	85.3	91.7	92.7
% childless	3.0	3.2	4.1	3.1	3.0
Mean number of children among parents	4.1	3.3	2.7	2.4	2.3
% no sibling alive	25.9	12.9	7.8	6.4	5.9
Mean number of siblings	2.9	3.5	3.8	3.7	3.7
% having close friends	85.2	87.9	88.9	89.8	89.7
% currently working	16.4	33.5	46.9	55.5	62.9
% involving organized social activities	47.5	67.2	74.6	79.0	83.7
N	1,814	2,789	1,740	2,695	1,141

Table 3 What explains the education gradients?

	ES	MS	HS	BS
Base Model controlling for age and gender only (Model A)	-1.456***	-2.030***	-2.698***	-3.123***
After controlling for each of the following set of proxy variables (Model B)				
(1) household income and net-worth	-1.145***	-1.532***	-1.940***	-2.048***
(2) job characteristics: poor work environment, dissatisfaction with job, stress at work	-1.437***	-2.045***	-2.682***	-2.953***
(3) cognitive ability	-0.341	-0.614*	-1.178***	-1.495***
(4) health behavior: smoking, regular exercise, use of preventative health care	-1.266***	-1.750***	-2.293***	-2.487***
(5) social status: years of schooling for spouse and the most educated child	-0.882***	-1.158***	-1.686***	-1.997***
(6) social network: married, childless, number of children, sibling, friend, working, engaging in organized social activity	-1.123***	-1.560***	-2.064***	-2.408***
After controlling for all of the above variables in Model 2 (Model C)	0.171	0.206	-0.044	-0.008

\*p<.05; \*\*p<.01; \*\*\*p<.001

Table 4 Tobit regression of CESD

	Coef.	t	P>t
ES	0.033	0.15	0.882
MS	0.070	0.28	0.778
HS	-0.156	-0.61	0.541
BS	-0.120	-0.40	0.688
Age	0.112	1.58	0.114
Age square	-0.001	-1.63	0.103
Female	-0.369	-0.78	0.433
Mid income	-0.833	-4.98	0.000
High income	-1.142	-6.74	0.000
Mid net-worth	-0.558	-3.03	0.002
High net-worth	-0.745	-3.69	0.000
Very poor work environment	0.536	1.57	0.118
Poor work environment	0.167	0.93	0.352
Very dissatisfied with job	1.607	3.41	0.001
Dissatisfied with job	0.388	2.13	0.033
High stress at work	0.685	2.37	0.018
Some stress at work	0.649	3.78	0.000
Cognitive ability (K-MMSE)	-0.161	-8.53	0.000
Current smoker	0.454	2.66	0.008
Quit smoking	0.551	2.63	0.009
Regular exercise less a year	-0.144	-0.51	0.608
Regular exercise for 1 - 6 years	-0.763	-5.25	0.000
Regular exercise more than 7 years	-0.717	-3.93	0.000
Took health screening exam	-0.318	-2.49	0.013
Spouse's years of schooling	0.037	1.83	0.067
Female x Spouse's years of schooling	-0.100	-4.39	0.000
Most educated child's years of schooling	-0.100	-2.68	0.007
Female x Most educated child's years of schooling	-0.019	-1.42	0.155
Married	-2.550	-6.05	0.000
Female x Married	2.019	3.95	0.000
Childless	1.029	2.23	0.026
Number of children	0.104	1.83	0.067
Having sibling alive	0.331	1.75	0.080
Having a close friend	0.019	0.07	0.944
Currently working	-1.616	-7.73	0.000
Engaged in organized social activities	-0.343	-2.00	0.046

\* Figures for control variables are not shown

N = 9,955, F (46, 902) = 22.0, Prob > F = 0.000