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A replication of the relationship between elderly suicide rates and the human development index in a cross-national study

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ABSTRACT

Background: A recent cross-national study demonstrated a curvilinear (inverted U-shaped curve) between elderly male suicide rates and the Human Development Index (HDI) fitting the quadratic equation $y = a + bx - cx^2$ where y is the elderly male suicide rate, x is the HDI and a, b and c are constants). This study used only one-year cross-sectional data on suicide rates, and suicide rates can randomly fluctuate year on year.

Methods: A study designed to replicate this curvilinear relationship between elderly suicide rates and the HDI was undertaken by: (i) using one-year average of five years data on suicide rates; and (ii) using more recent data on both elderly suicide rates than used in the previous study. Data were ascertained from the World Health Organization and the United Nations.

Results: There was a significant curvilinear (inverted U-shaped curve) relationship between suicide rates in males aged 65–74 years, males aged 75+ years, females aged 65–74 years and the HDI fitting the quadratic equation $y = a + bx - cx^2$. A similar curvilinear relationship was observed in females aged 75+ years, but the significance level only approached 0.05 level.

Conclusions: The replication of the curvilinear (inverted U-shaped curve) relationship between elderly suicide rates and the HDI by using one-year average of five years data on suicide rates suggests that the observed relationship is robust and accurate.

Key words: elderly suicides, life expectancy, socioeconomic status, educational status

Introduction

Income inequality is associated with increased suicide rates in men over the age of 55 years (Cutright and Fernquist, 2000), in those up to the age 75 years (Fukuda *et al.*, 2005), in those over the age of 65 years (Shah *et al.*, 2008a), and in the general population (Kowalski *et al.*, 1987; Lorant *et al.*, 2005). Gross national domestic product (GDP) is positively correlated with suicide rates in the general population (Zhang, 1998) and in men aged 75+ years (Shah *et al.*, 2008a). However, in a study of 47 medium and high income countries, elderly suicide rates were negatively correlated with GDP (Kiemo, 2004). A decline in elderly suicide rates over time in England and Wales was associated with an increase in GDP (Gunnell *et al.*, 2003). These observations collectively suggest that socioeconomic status may differentially influence suicide rates in different age and sex groups in different countries. Life expectancy was positively correlated with suicide rates in the elderly (Shah *et al.*, 2008a) and the general population (Zhang, 1998). Life expectancy and GDP have a highly significant strong inter-correlation (Shah *et al.*, 2008a). However, due to difficulties with multiple collineality, it has not been possible to determine the independent effects of these two variables on elderly suicide rates using multiple regression techniques (Shah *et al.*, 2008a). Moreover, previous studies have developed sequential models whereby increased GDP leads to increased life expectancy and increased life expectancy, in turn, leads to a greater number of people reaching old age, where the risk of suicide is the highest (Shah, 2007a; Shah *et al.*, 2008a). However, other factors, including income inequality and education, may also influence life expectancy independent of GDP (Shah, 2007a; Shah *et al.*, 2008a), and it is also

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possible that both GDP and life expectancy may have an independent and cumulative effect on elderly suicide rates.

Elderly suicide victims have poor educational attainment (Rubenowitz *et al.*, 2001). However, male African American suicide victims aged 55+ years had higher levels of educational attainment (Fernquist, 2001). General population suicide rates in the U.S.A., including those among African Americans, have been both positively (Kowalski *et al.*, 1987; Stack, 1998) and negatively (Willis *et al.*, 2003; Abel and Kruger, 2005) correlated with educational attainment. Also, general population suicide rates in Japan (Otsu *et al.*, 2004) and in men in ten European countries (Lorant *et al.*, 2005) were negatively correlated with educational attainment. These findings collectively suggest that educational attainment may differentially influence suicide rates in different age and ethnic groups in different countries.

The Human Development Index (HDI), developed by the United Nations, is a composite index measuring the average achievements in a given country on three basic dimensions of human development: a long and healthy life, as measured by life expectancy; educational attainment, as measured by the adult literacy rate and the combined gross enrolment ratio for primary, secondary and tertiary schools; and, a decent standard of living, as measured by GDP. A recent cross-national study examining the relationship between the composite and cumulative effect of these three variables, measured by the HDI, and suicide rates in both sexes, in the age-bands 65–74 years and 75+ age-band, demonstrated a curvilinear (inverted U-shaped curve) relationship between elderly male suicide rates and the HDI fitting the quadratic equation $y = a + bx - cx^2$ (where y is the elderly male suicide rate, x is the HDI and a, b and c are constants) (Shah, 2009a). A similar relationship was observed in females, but only approached statistical significance. These findings, including the composite effect of life expectancy, education and socioeconomic status, were explained by the development of a hypothetical sequential four-stage model adapted from similar models that have been proposed to explain the relationship between socioeconomic status and cross-national variations in the prevalence of dementia (Suh and Shah, 2001), other mental disorders in old age (Shah, 2007b) and elderly suicides (Shah, 2010).

Low elderly suicide rate – low human development society stage

Low elderly suicide rates are associated with poor socioeconomic status and greater income inequality in cross-national studies (Simpson and Conklin, 1989; Zhang, 1998; Vijaykumar *et al.*, 2005; Shah *et al.*, 2008a) and within-country studies (Kowlaski *et al.*, 1987). Societies with low socioeconomic status and greater income inequality have poorly developed healthcare services (Shah, 2007b; 2009b; Jacob *et al.*, 2007; Shah *et al.*, 2008a; Shah and Bhat, 2008a; 2008b). Poorly developed healthcare services will increase child mortality rates (Suh and Shah, 2001; Shah, 2007b; Shah *et al.*, 2008a), which leads to reduced life expectancy (Zhang, 1998; Shah, 2007b; Shah *et al.*, 2008a). Given that suicide rates generally increase with age (Shah and De, 1998; Shah, 2007c), reduced life expectancy will result in fewer people reaching the age of increased risk for suicide in countries with low socioeconomic status, and result in a reduced number of elderly suicides in such countries (Zhang, 1998; Shah *et al.*, 2008a). Moreover, in societies with low socioeconomic status, the elderly may be at reduced risk of suicide because they may have greater tolerance of additional hardship in old age due to life-long exposure to adversity (Seiden, 1981; McIntosh, 1984; Lindesay, 1991; Shah and Bhat, 2009).

In addition, poor socioeconomic status may be associated with poor educational attainment. Low suicide rates were positively correlated with poor educational attainment in individual-level studies (Fernquist, 2001; Kung *et al.*, 2004) and aggregate-level studies (Kowalski *et al.*, 1987; Gillis, 1994; Lester 1990–1991; Stack, 1998), but they were from socioeconomically well-developed countries and of younger age groups.

High elderly suicide rate – low human development society stage.

The improvement in the socioeconomic status of countries will improve the development of healthcare services (Zhang, 1998; Shah, 2007b; 2009b; Jacob *et al.*, 2007; Shah *et al.*, 2008a; Shah and Bhat, 2008a; 2008b) leading to reduced child mortality rates (Shah *et al.*, 2008a; Shah, 2007b) and increased life expectancy (Zhang, 1998; Shah *et al.*, 2008a). This, in turn, will result in a greater number of subjects reaching the age of increased risk of suicide and an increase in elderly suicide rates. This is supported by positive correlations between life expectancy and suicide rates in the elderly (Shah *et al.*, 2008a) and general population (Zhang, 1998). This will lead to a gradual transition from low elderly suicide rate–low human development society stage to a high elderly suicide rate–low human development society stage.

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High elderly suicide rate – high human development society stage

As societies develop, a change from lower to higher human development status will occur. Further improvements in the development of healthcare services as observed by positive correlations between GDP and markers of development of healthcare, and negative correlations between the Gini coefficient and these variables (Shah, 2007b, 2009b; Jacob *et al.*, 2007; Shah *et al.*, 2008a; Shah and Bhat, 2008a; 2008b). Such improvement will further reduce child mortality rates (Zhang, 1998; Shah *et al.*, 2008a; Shah, 2007b) and further increase the life expectancy (Zhang, 1998; Shah *et al.*, 2008a; Shah, 2007b). This, in turn, will increase the number of subjects reaching the age of increased risk of suicide (Zhang, 1998; Shah *et al.*, 2008a). Moreover, the protective effects of life-long adversity on elderly suicide rates (Seiden, 1981; Lindesay, 1991; McIntosh, 1984) are likely to be less prevalent in countries with higher socioeconomic status. The composite effect of these changes will increase the number of individuals at increased risk of suicide in old age in socioeconomically more developed countries. This will lead to a gradual transition from the high elderly suicide rate–low human development society stage to a high elderly suicide rate–high human development society stage.

Low elderly suicide rate – high human development society stage

Theoretically, in socioeconomically well-developed countries, due to further reduction in child mortality rates and increase in life expectancy, a greater number of people would reach the age of increased of suicide, and consequently lead to higher elderly suicide rates. However, in socioeconomically well developed countries, including Italy, Netherlands, Norway, U.K. and U.S.A., elderly suicide rates are comparatively low (Shah *et al.*, 2007) and have declined over time (Shah *et al.*, 2008b). In socioeconomically very well-developed societies, elderly suicide rates may progressively decline over many years due to improved efforts to control the risk factors for elderly suicides, enhance protective factors for elderly suicides, advances in medical care, prompt resuscitation of those who attempt suicide, better provision of healthcare (including mental health) services and public health initiatives to reduce suicide rates (Gunnell *et al.*, 2003; Kua *et al.*, 2003; Lodhi and Shah, 2004; 2005; Yip *et al.*, 2005; Shah and Coupe, 2009; Shah, 2009c). Ultimately, this will lead to a gradual transition from a high elderly suicide rate–high human development society stage to a low elderly suicide rate–high human development society stage.

Also higher socioeconomic status is likely to be associated with higher educational attainment. There is evidence that low suicide rates are associated with higher educational attainment in individual-level (Fernquist, 2001) and aggregate-level studies (Willis *et al.*, 2003; Abel and Kruger, 2005; Otsu *et al.*, 2005; Lorant *et al.*, 2005) from socioeconomically well-developed countries, although they are mainly of younger age groups.

The earlier study (Shah, 2009a) demonstrating a curvilinear relationship between elderly suicide rates and the HDI used only one-year cross-sectional data on elderly suicide rates, and suicide rates can randomly fluctuate year on year (Shah and Coupe, 2009). Therefore, in order to replicate the findings of this earlier study, the relationship between elderly suicide rates and the HDI was examined: (i) by using a one-year average of five years data on elderly suicide rates; and (ii) using the latest available (and, therefore, a more recent) data set on elderly suicide rates.

Methods

Data on elderly suicide rates for males and females in the age-bands 65–74 years and 75+ years were ascertained from the World Health Organization (WHO) website (http://www.who.int/whosis/database/mort/table1.cfm). For a small number of countries only the raw figures for the number of suicides were available from the WHO website. Suicide rates for these countries were calculated by dividing the number of reported suicides by the population size in the relevant age-band and sex group available on the same website. Data were ascertained for the latest five consecutive years. The one-year average suicide rate was calculated by dividing the sum of suicide rates for the latest five consecutive years by five. The median (range) for the latest year for the suicide rate data was 2005 (1983–2007).

The HDI, developed by the United Nations, is a composite index measuring the average achievements in a given country on three basic dimensions of human development: a long and healthy life, as measured by life expectancy; educational attainment, as measured by the adult literacy rate and the combined gross enrolment ratio for primary, secondary and tertiary schools; and, a decent standard of living, as measured by the GDP. The United Nations Development Programme website provided data on the HDI for the year 2004 (http://hdr.undp.org/en/media/HDI_2008_EN_Tables.pdf). The HDI

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Table 1. Curve estimation regression models for the relationship between elderly suicide rates and the HDI

	R^2	DEGREES OF FREEDOM	F VALUE	SIGNIFICANCE	REGRESSION EQUATION
Males 65–74 years	0.09	82	3.79	P = 0.027	$y = -437.36 + 1068.41x - 607.98x^2$
Males 75+ years	0.15	82	7.47	P = 0.001	$y = -681.30 + 1617.62x - 896.22x^2$
Females 65–74 years	0.12	82	5.4	P = 0.006	$y = -28.10 + 59.01x - 20.38x^2$
Females 75+ years	0.06	82	2.7	P = 0.074	$y = -119.04 + 282.76x - 152.09x^2$

y = Suicide rates.
x = HDI.
a, b and c are constants.

is scored on a scale of 0 to 1 (given up to three decimal points), with higher scores reflecting higher degree of human development on measures of life expectancy, educational attainment and socioeconomic status.

The relationship between elderly suicide rates, in both sexes and both elderly age-bands, and the HDI was examined with curve estimation regression model to test the previously observed inverted U-shaped curvilinear relationship fitting the quadratic equation $y = a + bx - cx^2$ (where y is the elderly suicide rate, x is the HDI and a, b and c are constants) (Shah, 2009).

Results

Data on elderly suicide rates and the HDI were available for 85 countries. Table 1 illustrates the characteristics of the curve regression models. The relationship between suicide rates in males aged 65–74 years, males aged 75+ years and females aged 65–74 years and the HDI was curvilinear (inverted U-shaped curve) and fitted the quadratic equation $y = a + bx - cx^2$; the significance level was at least at the 0.05 level. A similar curvilinear relationship was observed in females aged 75+ years, but the significance level only approached the 0.05 level.

Discussion

Some methodological issues need consideration. Cross-national data on suicide rates should be viewed cautiously because: data are not available from all countries (Moscicki, 1995; Wasserman *et al.*, 2005); the validity of this data is unclear (Diekstra, 1989; Wasserman *et al.*, 2005); the legal criteria for the proof of suicide vary between countries (Shah and Ganesvaran, 1994; Wasserman *et al.*, 2005); some countries have poor death registration facilities (Shah and Ganesvaran, 1994); and, cultural and religious factors and stigma attached to suicide may lead to under-reporting (Wasserman *et al.*, 2005; Abrahams *et al.*, 2005). Data on life expectancy, health-related measures, educational attainment and socioeconomic status should also be viewed cautiously because: the validity of these data is unclear; and, some countries have poor infrastructure to collect data on health-related measures and finances. There are no specific data on the reliability of the HDI, although it has previously been examined as a potential protective and risk factor for elderly suicides (Shah, 2009a). However, the best and the latest available data set were obtained from the WHO and the UN and a one-year average of five years' data on suicide rates was used.

The curvilinear (inverted U-shaped curve) relationship between elderly suicide rates and the HDI, using one-year average of five years' data on suicide rates and the latest available data set (different from the earlier study), confirmed the findings of the earlier study using only one-year cross-sectional data on suicide rates (Shah, 2009a). This suggests that this relationship is robust and accurate. These findings, including the composite effect of life expectancy, education and socioeconomic status, may be explained by the four sequential stage model described in the Introduction, which was developed following the earlier study with similar findings (Shah, 2009a). This developmental model has the following four sequential stages: (i) low elderly suicide rate–low human development society; (ii) high elderly suicide rate–low human development society; (iii) high elderly suicide rate-high human development society; and (iv) low elderly suicide rate–high human development society. This model relies on several previous observations: (i) low socioeconomic countries have poorly developed healthcare services (Shah, 2007b, 2009b; Jacob *et al.*, 2007; Shah *et al.*, 2008a; Shah and Bhat, 2008a; 2008b); (ii) poorly developed healthcare services lead to increased child mortality rates (Suh and Shah, 2001; Shah *et al.*, 2008a; Shah, 2007b); (iii) increased child mortality will lead to reduced life expectancy (Zhang, 1998; Shah *et al.*, 2008a;

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Shah, 2007b); reduced life expectancy will result in fewer people reaching the age of increased risk of suicide (Zhang, 1998; Shah *et al*., 2008a); and (v) elderly suicide rates may progressively decline over many years due to improved efforts to control the risk factors for elderly suicides, enhance protective factors for elderly suicides, advances in medical care, prompt resuscitation of those who attempt suicide, better provision of healthcare (including mental health) services and public health initiatives to reduce suicide rates in socioeconomically very well-developed countries (Gunnell *et al*., 2003; Kua *et al*., 2003; Lodhi and Shah, 2004; 2005; Yip *et al*., 2005; Shah and Coupe, 2009; Shah, 2009c). The findings of this study and the previously proposed four-stage model are both consistent with these observations.

Caution should be exercised in the application of this model because of the cross-sectional and ecological study design whereby the findings are subject to ecological fallacy and require rigorous testing in within-country longitudinal studies over time. It is likely that different countries will be at different stages of development, and each country would progress through each of these four developmental stages over time. This model can be formally tested by following up countries that are currently at the low elderly suicide rates – low human development society stage over time to observe if they progress through the four developmental stages of the proposed model. This model is complimentary to, and does not preclude, other proximal and distal etiological risk factors for elderly suicides including economic growth, health and welfare services for the elderly, psychosocial environment and religion – although some of these factors are discussed under subheadings of the four stages of the model above.

Conflict of interest

None.

References

Abel, E. L. and Kruger, M. L. (2005). Educational attainment and suicide rates in the United States. *Psychological Reports*, 97, 25–28.

Abrahams, V. J., Abrahams, S. and Jacob, K. S. (2005). Suicide in the elderly in Kanyambadi block, Tamil Nadu, South India. *International Journal of Geriatric Psychiatry*, 20, 953–955.

Cutright, P. and Fernquist, R. M. (2000). Effects of social integration, period, region, and culture of suicide on male age-specific suicide rates: 20 developed countries, 1955–1998. *Social Science Research*, 29, 148–172.

Diekstra, R. F. W. (1989). Suicide and attemptede suicide: an international perspective. *Acta Psychiatrica Scandinavica*, 80 (Suppl 354), 1–24.

Fernquist, R. M. (2001). Education, race/ethnicity, age, sex, and suicide: individual level data in the United States, 1991–1994. *Current Research in Social Psychology*, 3, 277–290.

Fukuda, Y., Nakamura, K. and Takano, T. (2005). Cause-specific mortality differences across socioeconomic position of municipalities in Japan, 1973–1977 and 1993–1998: increased importance of injury and suicide in inequality for ages under 75. *International Journal of Epidemiology*, 34, 100–109.

Gillis, A. R. (1994). Literacy and the civilisation of violence in 19th century France. *Sociological Focus*, 9, 371–401.

Gunnell, D., Middleston, N., Whitley, E., Dorling, D. and Frankel, S. (2003). Why are suicide rates rising in young men but falling in the elderly? A time-series analysis of trends in England and Wales 1950–1998. *Social Science and Medicine*, 57, 595–611.

Jacob, K. S., Sharan, P., Mirza, I., Garrido-Cumbrera, M., Seedat, S., Mari, J. J. and Sreen, V. (2007). Global mental health 4. Mental health systems in countries: where are we now?. *Lancet*, 370, 1061–1077.

Kiemo, K. (2004). Towards a socio-economic and demographic theory of elderly suicides: a comparison of 49 countries at various stages of development. www.soc.ou.se/publications/fulltext/diss2003–3.pdf. Last accessed 2 February 2007.

Kowalski, G. S., Faupel, C. E. and Starr, P. D. (1987). Urbanisation and suicides: a study of American counties. *Social Forces*, 66, 85–101.

Kua, E. H., Ko, S. M. and Ng, T. P. (2003). Recent trends in elderly suicide rates in a multi-ethnic Asian city. *International Journal of Geriatric Psychiatry*, 18, 533–536.

Kung, H. C., Liu, X. and Juon, H. S. (2004). Risk factors for suicide in Caucasians and in African Americans: a matched case-control study. *Social Psychiatry and Psychiatric Epidemiology*, 33, 155–161.

Lester, D. (1990–1991). Mortality from suicide and homocide for African Americans in the U.S.A.: a regional analysis. *Omega: Journal of Death and Dying*, 22, 216–226.

Lindesay, J. (1991). Suicide in the elderly. *International Journal of Geriatric Psychiatry*, 6, 355–361.

Lodhi, L. and Shah, A. K. (2004). Psychotropic prescriptions and elderly suicide rates. *Medicne, Science and the Law*, 44, 236–244.

Lodhi, L. and Shah, A. K. (2005). Factors associated with the recent decline in suicide rates in England and Wales. 1985–1998. *Medicne, Science and the Law*, 45, 115–120.

Lorant, V., Kunst, A. E., Huisman, M., Costa, G. and Mackenbach, J. (2005). Socio-economic inequalities in suicide: a European comparative study. *British Journal of Psychiatry*, 187, 49–54.

McIntosh, J. L. (1984). Components of the decline in elderly suicides: suicide in young old and old old by race and sex. *Death Education*, 8, 113–124.

Moscicki, E. K. (1995). North American perspectives: epidemiology of suicide. *International Psychogeriatrics*, 7, 137–148.

Otsu, A., Araki, S., Sakai, R., Yokoyama, K. and Voorhees, A. S. (2004). Effects of urbanization, economic

https://doi.org/10.1017/S1041610210001110 Published online by Cambridge University Press

development, and migration of workers on suicide mortality in Japan. *Social Sciences and Medicine*, 58, 1137–1146.

Rubenowitz, E., Waern, M., Wilhelmson, K. and Allebeck, P. (2001). Life events and psychosocial factors in elderly suicides: a case control study. *Psychological Medicine*, 31, 1193–1202.

Seiden, R. H. (1981). Mellowing with age: factors affecting the non-white suicide rate. *International Journal of Ageing and Human Development*, 13, 265–284.

Shah, A. K. (2007a). The relationship between suicide rates and age: an analysis of multinational data from the World Health Organization. *International Psychogeriatrics*, 19, 1141–1152.

Shah, A. K. (2007b). The importance of socio-economic status of countries for mental disorders in old age: a development of an epidemiological transition model. *International Psychogeriatrics*, 19, 785–787.

Shah, A. K. (2007c). The relationship between suicide rates and age: an analysis of multinational data from the World Health Organization. *International Psychogeriatrics*, 19, 1141–1152.

Shah, A. K. (2009a). The relationship between elderly suicide rates and the Human Development Index: a cross-national study of secondary data from the World Health Organization and the United Nations. *International Psychogeriatrics*, 21, 69–77.

Shah, A. K. (2009b). The relationship between socio-economic status and mental health funding, service provision and national policy: a cross-national study. *International Psychiatry*, 6, 44–46.

Shah, A. K. (2009c). Attempted suicide in the elderly in England: age-associated rates, time trends and methods. *International Psychogeriatrics*, 5, 889–895.

Shah, A. K. (2010). The possible evidence for epidemiological transition hypothesis for elderly suicides. *International Psychogeriatrics*, 22, 219–226.

Shah, A. K. and Bhat, R. (2008a). The relationship between elderly suicide rates and mental health funding, service provision and national policy: a cross-national study. *International Psychogeriatrics*, 20, 605–615.

Shah, A. K. and Bhat, R. (2008b). Are elderly suicide rates improved by increased provision of mental health service resources? *International Psychogeriatrics*, 20, 1230–1237.

Shah, A. K. and Bhat, R. (2009). Does adversity earlier in life affect elderly suicide rates? Cross-national study. *International Journal of Psychiatry in Clinical Practice*, 13, 273–277.

Shah, A. K. and Coupe, J. (2009). A comparative study of elderly suicides in England and Wales, Scotland and Northern Ireland: trends over time and age-associated trends. *International Psychogeriatrics*, 21, 581–587.

Shah, A. K. and De, T. (1998). Suicide and the elderly. *International Journal of Psychiatry in Clinical Practice*, 2, 3–17.

Shah, A. K. and Ganesvaran, T. (1994). Suicide in the elderly. In E. Chiu and D. Ames (eds.), *Functional Psychiatric Disorders of the Elderly* (pp. 221–244). Cambridge: Cambridge University Press.

Shah, A. K., Bhat, R., MacKenzie, S. and Koen, C. (2007). Elderly suicide rates: cross-national comparisons and association with sex and elderly age-bands. *Medicine, Science and the Law*, 47, 244–252.

Shah, A. K., Bhatt, R., MacKenzie, S. and Koen, C. (2008a). A cross-national study of the relationship between elderly suicide rates and life expectancy and markers of socio-economic status and healthcare. *International Psychogeriatrics*, 20, 347–360.

Shah, A. K., Bhat, R., MacKenzie, S. and Koen, C. (2008b). Elderly suicide rates: cross-national comparisons over a ten year time period. *International Psychogeriatrics*, 20, 673–686.

Simpson, M. E. and Conklin, G. H. (1989). Socioeconomic development, suicide and religion: a test of Durkhiem's theory of religion and suicide. *Social Forces*, 67, 945–964.

Stack, S. (1998). Education and risk of suicide: an analysis of African Americans. *Sociological Focus*, 31, 295–302.

Suh, G. K. and Shah, A. K. (2001). A review of epidemiological transition in dementia: cross-national comparisons of the indices related to Alzheimer's disease and vascular dementia. *Acta Psychiatrica Scandinavica*, 104, 4–11.

Vijayakumar, L., Nagaraj, K., Pirkis, J. and Whiteford, H. (2005). Suicide in developing countries (1): frequency, distribution, and association with socio-economic indicators. *Crisis*, 26, 104–111.

Wasserman, D., Cheng, Q. and Jiang, G. X. (2005). Global suicide rates among young people aged 15–19. *World Psychiatry*, 4, 114–120.

Willis, L. A., Coombs, D. W., Drentea, P. and Cockerham, W. C. (2003). Uncovering the mystery: factors of African American suicide. *Suicide and Life Threatening Behaviour*, 33, 412–429.

Yip, P. S. F., Liu, K. Y., Hu, J. and Song, X. M. (2005). Suicide rates in China during a decade of rapid social change. *Social Psychiatry and Psychiatric Epidemiology*, 40, 792–798.

Zhang, J. (1998). Suicide in the world: toward a population increase theory of suicide. *Death Studies*, 22, 525–539.

https://doi.org/10.1017/S1041610210001110 Published online by Cambridge University Press