Neuroendocrine biomarkers, subjective social status, and health in Taiwan

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Abstract

Objective: Both objective and, more recently, subjective measures of low social status have been linked to poor health outcomes. It is unclear, however, through which precise physiological mechanisms such standing may influence health, although it has been proposed that those of lower status may have biomarker profiles that are more dysregulated (and hence pose a greater risk for poorer health). The objective of this paper, then, is to investigate whether lower subjective social standing is associated with riskier neuroendocrine biomarker profiles.

Methods: This paper analyzes the SEBAS, a nationally representative survey of Taiwanese men and women (ages 54-91) conducted in Taiwan in 2000. We focus on five neuroendocrine markers (cortisol, dehydroepiandrosterone sulfate (DHEAS), epinephrine, norepinephrine, and dopamine) in relation to self-reported levels of social status in Taiwan and in the community. These biomarkers are analyzed both separately and collectively in an index termed neuroendocrine allostatic load (NAL).

Results: We find little connection between measures of status -- either measured through self-report or objective indicators of socio-economic status (SES) -- and riskier biomarker profiles.

Discussion: The negative finding found in this paper would be further supported with more and different measures of the neuroendocrine markers and rewording of one of the subjective social status ladders.

Introduction

Numerous studies in both humans and animals have revealed a compelling association between lower status and poorer health (Adler and Ostrove, 1999; Brunner, 2000; Marmot, 2006; Sapolsky, 2004). In humans, the relationship between socio-economic status (SES) and health not only exhibits a strong, gradient pattern, but has held in both Western and non-Western contexts such as in China and Taiwan (Liang et al., 2000; Liu, Hermalin, and Chuang, 1988; Zimmer et al., 2007; Zimmer et al., 2000). Since more conventional risk factors such as lack of health care access and personal health behaviors have failed to explain much of the gradient (Adler and Ostrove, 1999; Lantz et al., 1998; Sapolsky, 2005), researchers have more recently focused attention on other possible mechanisms, including those of a psychosocial nature, such as the role of stress, for explanatory power (Baum, Garofalo, and Yali, 1999; Cohen, Kaplan, and Salonen, 1999; Sapolsky, 2005).

There are good reasons to think that stress plays a role in the disproportionately negative health of those of low SES. For example, those with low SES may very well experience work characterized by high demands and low control, residential environments with higher levels of crime and general blight, and feelings of lowliness (Evans and English, 2002; Gallo et al., 2005; Taylor, Repetti, and Seeman, 1997; Wilkinson, 1999). Recognizing these conditions and more generally the importance of subjective evaluation in health (Idler and Benyamini, 1997; Krause, 2001), health researchers have recently introduced a subjective measure of social status in the form of a pictorial ladder to better understand how SES "gets under the skin" to cause health outcomes. Since the ladder measure is relatively new, results stemming from its use are not plentiful, but studies to date have shown that objective indicators of SES are significant predictors of subjective status assessments and so too are such phenomena as financial strain, low social support, low perceived personal opportunity, greater perceived victimization, and chronic stress (Adler et al., 2000; Franzini and Fernandez-Esquer, 2006; Goldman et al., 2006a; Singh-Manoux, Marmot, and Adler, 2003). Further, the subjective ladder assessments have predicted a wide variety of health outcomes, even with controls for objective SES indicators (Collins and Goldman, 2008; Ostrove et al., 2000; Singh-Manoux, Marmot, and Adler, 2003; Singh-Manoux et al., 2005).

Although these studies have certainly contributed to our understanding of the connection between status and health, they are not without their limitations. These investigations have often been characterized by relatively small sample sizes, non-representative samples, and study populations drawn from Western contexts. The paper here extends this literature by using a large, nationally representative survey conducted in a non-Western population. Further, we are the first researchers we are aware of to analyze two forms of the subjective social status ladder question -- one querying about participants' relative ranking in the entire society and the other querying about participants' relative ranking in the community -- in connection with neuroendocrine system function.

Investigations of the neuroendocrine system are important because recent large-scale studies, including neuroendocrine markers for the first time, have linked dysregulated neuroendocrine biomarker profiles to increased risk of a number of health problems, including greater physical and cognitive declines and mortality (Goldman et al., 2006b; Karlamangla et al., 2005; Seeman et al., 2001). Relatedly, it is thought that chronic stress plays an important role in contributing to such dysregulated profiles (McEwen, 1998; Timiras and Gersten, 2007). The paper here, then, investigates neuroendocrine system function as a potential physiological pathway that explains some of the association between SES and health, and we hypothesize that those reporting lower levels of subjective social status will have more dysregulated neuroendocrine biomarker profiles.

Data and Methods

Overview of the data set

We analyze the Social Environment and Biomarkers of Aging Study (SEBAS), a population survey conducted in Taiwan in 2000 (for a more detailed description of the study consult Goldman et al., 2003). The survey is nationally representative of those 54 and older and includes the institutionalized population. The SEBAS drew its sub-sample of respondents from a larger, ongoing longitudinal study called the Survey of Health and Living Status of the Elderly in Taiwan. The interview portion of the SEBAS included questions about cognitive and physical functioning, psychological well-being, living arrangements, and SES. With the respondents' additional consent, they were scheduled for lab work and a physical exam several weeks after the interview. Lab work included collection of blood and urine samples to produce a panel of physiological measurements, and the physical exam recorded information such as height and weight, blood pressure, and checked for a number of health problems.

Of those initially contacted for inclusion in the 2000 SEBAS, 92% gave interviews and 68% of these participants consented to the clinical examination, for a total of 1,023 respondents. Analysis reveals that partly because those most and least healthy declined to participate in the clinical exams, with controls for age, estimates derived from the clinical information are unlikely to be seriously biased (Goldman et al., 2003). Of those respondents who participated in the clinical examination, only 10 failed to fully comply (by not following the urine protocol, by not providing a sufficient volume of blood suitable for analysis, or by not completing the medical exam). In about 4% of all cases proxies helped answer some questions for the respondents. The survey over-sampled those 71 years and older and urban residents.

Dependent variables

In this paper we focus on cortisol, dehydroepiandrosterone sulfate (DHEAS), epinephrine, norepinephrine, and dopamine, a physiologically coherent class of neuroendocrine markers indicative of hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system (SNS) functioning (Bergquist et al., 2002; Sapolsky, 2004; Cohen, Kessler, and Gordon, 1995). Since these markers have been used as part of the allostatic load construct, when they are analyzed collectively in an index the index is referred to as neuroendocrine allostatic load (NAL) (for discussion of the allostatic framework and the NAL index please consult Gersten (2008)).

Twelve-hour overnight urinary samples were collected from respondents for measurement of all markers except DHEAS, for which blood was drawn. Subjects provided samples while under basal (resting) conditions and fasted in advance of the blood draw. In part because dissimilar body size leads to differential concentrations of the markers in urine, total urine was standardized using grams of creatinine. Blood and urine specimens were sent to Union Clinical Laboratories (UCL) in Taipei, Taiwan. In addition to routine standardization and calibration tests performed by the laboratory, blind duplicate samples were submitted to UCL periodically throughout the fieldwork and a further set of duplicates were sent to Quest

Diagnostics in the United States. Data from duplicate samples indicate intra-lab correlations (UCL and UCL) of 0.80 or higher and inter-lab correlations (UCL and Quest Diagnostics) of 0.76 or higher.

Independent variables

The first subjective status measure asks respondents to place themselves on a ladder (a picture of which is shown to them) that corresponds to their SES relative to all others in Taiwan. The ladder has a total of 10 rungs, with the 10^{th} rung corresponding to the highest level of status. Respondents are prompted to consider their educational level, income level, and the prestige of their job, in determining their SES. The second subjective status question is identical to the one shown to respondents moments before, but this time they are instructed to rate themselves as regards their community status. Community is not defined for the respondents, and they are not given any prompts as to what might be important criteria to consider in making their decision.

Other independent variables serve as controls. The three objective measures of SES are years of education for the respondent, years of education for the respondent's spouse, and an International Socio-Economic Index (ISEI) score for the primary lifetime occupation of male respondents and of female respondents' husbands. The ISEI is a widely used measure reflecting occupational status and has a theoretical range of 16-90 (Ganzeboom and Treiman, 2003). We use information from female respondents' husbands because nearly one third of the female participants in the survey were never employed. Since levels of the neuroendocrine biomarkers can be influenced by a wide variety of factors independent of stress (Gersten, 2006), all models control for variables pertaining to diet, exercise, smoking, alcohol consumption, betel nut chewing, medication use, age, and sex.

Methods

Regarding extreme values, five outliers for dopamine have been removed that were all at least six standard deviations above the mean. Concerning other data transformations, cortisol had a distribution that exhibited the most skewness in one direction or the other (in its case, a right tail) and has been logged, creating a more normalized distribution and more normalized residuals.

The most popular approach to operationalizing AL has been to create a score that gives one point for every biomarker for which the subject can be considered at higher risk (i.e., the elevated risk zone approach). The literature most often represents high risk by greater values for cortisol, epinephrine, norepinephrine, and lower values for DHEAS; this convention is followed here. Relative to the other markers under study in this paper, relatively little research has been conducted on dopamine, but the literature suggests that low levels are a risk factor for a number of health conditions and that it is reasonable to hypothesize (as we do in this paper) that those of lower social status have lower baseline levels (Backman and Farde, 2001; Isovich, et al., 2000; Wood, 2004; Sapolsky, 2004, p. 295). Since there is no agreed upon standard for what biomarker values represent different risk levels, it has been most common to define risk as above or below distribution percentiles (e.g., 10^{th}, 25^{th}, 75^{th}, and 90^{th}). Since subjects can be assigned 1 point on five biomarkers if they have high risk values, NAL scores can range from 0-5.

In addition to NAL scores based on cutpoints, a summed z-score is created for respondents which is the total number of standard deviations from the mean in the direction of high risk for each biomarker. Unlike the cut-off approach, an index using the z-score method allows for unequal weighting of the markers and the index can range from zero to no pre-determined upper limit. Like the biomarkers analyzed individually and the NAL score based on cutpoints, the combined z-score will be the dependent variable in an OLS regression. Lastly, the multivariate analysis makes use of weighted data. Descriptive statistics for the individual markers and for the different NAL constructs are presented in Table 1.

Results

Table 2 depicts descriptive statistics for independent variables used in this analysis. Notably, because of mainly male emigration to Taiwan shortly after World War II (sparked by conflict on mainland China), there are more men than women in the sample. Also noteworthy is that respondents, on average, tend to rate themselves more highly (by about half a rung on the ladder) in reference to community standing compared to standing in all of Taiwan. This difference is highly significant (p-value < 0.000), calculated using a paired t-test appropriate for weighted data.

Figure 1 presents the distributions of self-reported standing in Taiwan and in the community. Both distributions are right tailed, with comparatively few participants willing to rate themselves highly either relative to the Taiwanese population or relative to their communities. This type of skewed distribution, which may partially reflect Taiwanese modesty, contrasts with distributions stemming from surveys conducted in Western populations in which the data more resemble a normal curve (and sometimes even have a tilt toward high values) (Adler et al., 2000; Singh-Manoux, Marmot, and Adler, 2005; Goldman et al., 2006a). As mentioned before, participants in the SEBAS are more willing to rate themselves higher in reference to their communities. This can be observed from the figure, as nearly two times as many subjects are willing to give themselves a "7" rating in the community compared to that in Taiwan and such a proportional increase also applies to other ratings at the higher end (i.e., the 8th, 9th, and 10th rungs) of the ladder.

Table 3 presents results for OLS regressions in which different neuroendocrine biomarkers are the dependent variables and standing in the community, standing in Taiwan, and objective indicators of SES are the key independent variables. An important finding revealed in the table is that for the biomarker DHEAS, higher self-reported status is correlated with higher (and thus less risky) DHEAS levels when the status in Taiwan and the status in the community variables are entered singly in the models. Importantly, however, the associations between the subjective status assessments and DHEAS levels disappear with inclusion of objective indicators for SES.

Contrary to expectation, for norepinephrine, report of higher status in Taiwan is associated with higher (and thus more risky) levels of that biomarker and the relationship holds with the inclusion of controls for objective measures of SES. Although statistically significant, the observed relationships for DHEAS and norepinephrine are of minor substantive significance (e.g., an increase of three years of education is associated with an increase of about 1/9th of a standard deviation in DHEAS levels). Still in reference to Table 3, the Model C regressions simultaneously include both versions of the ladders in the models to test whether they are independently associated with biomarker levels. Tests of joint significance for these variations reveal essentially no improved association when compared to inclusion into regressions of either of the ladder measures singly.

Motivated by the literature, additional analyses were carried out in which the biomarkers remained dependent variables in the analysis (as presented in Table 3), but this time the dependent variables were dichotomized into "risky" and "non-risky" values using the biomarker-specific cutpoints in Table 1 (i.e., the 10th and 25th or 75th and 90th percentiles) and analyzed using logistic regression. By and large, this method of analysis produced results (not shown) that were similar, although somewhat weaker, than those presented.

Table 4 presents data similar to that in Table 3, but in this case the dependent variable is not individual neuroendocrine biomarkers, but NAL scores. As can be observed from the table, the coefficients for the different subjective social status variables are by and large in the hypothesized direction, with higher status yielding lower (and thus less risky) scores. However, none of the associations reach conventional levels of statistical significance.

Numerous variants of the analysis thus far presented have also been carried out. For instance, instead of entering the status measures as continuous variables, they were entered as variables grouped into low, medium, and high categories (pertaining to rungs 1-4, 5, and 6-10, respectively). Also, instead of analyzing men and women together and using cutpoints based on the entire sample, analyses were rerun separately by sex and based on sex-specific cutpoints. Further, since there is a fair amount of evidence to suggest that for cortisol, not only high, but low values as well, pose risk (Loucks, Juster, and Pruessner, 2008; Raison and Miller, 2003; Fries et al., 2005), analyses were rerun examining both tails of cortisol's distribution for the marker analyzed separately and as part of the NAL constructs. All of the additional analyses just described produced results (data not shown) consistent with the main findings that have already been discussed.

Discussion

The main goal of this paper was to investigate whether different measures of subjective social standing were linked to riskier neuroendocrine biomarker profiles. The results here have not supported such a link. That is, using a nationally representative study conducted in Taiwan (the 2000 SEBAS), most of the biomarkers when analyzed individually were not associated with status ratings and various indices of the biomarkers also were not associated with status ratings.

As far as we are aware, we are the first authors to investigate the connection between baseline levels of the neuroendocrine markers (as measured in overnight urine samples, except for DHEAS which was measured in blood samples) and two differently worded measures of subjective social status. Although a study by Seplaki and others (under review) using the SEBAS data set focused on objective measures of SES, some part of their study examined subjective social status and they found results that support the generally negative findings found in the paper here. The only other data set that appears to have collected baseline levels of the neuroendocrine biomarkers in a similar fashion to the SEBAS and to have collected at least one measure of subjective social status is the CARDIA study (Adler et al., 2008; Janicki-Deverts et al., 2007). As far as we know, however, researchers have yet to publish work using it analyzing neuroendocrine levels in reference to subjective social status.

Although limited, some work has investigated objective measures of SES with respect to levels of the neuroendocrine biomarkers as collected in the study analyzed here. The results of this work appears mixed, with investigations finding both positive relationships (Cohen, Doyle, and Baum, 2006; Evans and Kim, 2007; Janicki-Deverts et al., 2007) and negative relationships (Dowd and Goldman, 2006; Gersten and Dow, 2008) between SES and riskier neuroendocrine levels.

Like any study, the one here has limitations. Negative findings such as found in this paper could stem from a number of sources, one of the more important being how biomarkers are collected and measured. Ideally, instead of one overnight urine sample as collected in the SEBAS, there would be about three per week over the course of two or three weeks (Loucks, Juster, and Pruessner, 2008). The necessity for so many measures stems from the possibility that "state factors" unrelated to stressor exposure (such as sleep duration and quality, diet, and exercise) influence the levels of the markers (Loucks, Juster, and Pruessner, 2008; Gersten, 2005). Further, it would be more ideal if overnight urinary measures were complemented with those that provided information about how neuroendocrine levels change during the day. Salivary cortisol measures, for example, could provide such dynamic information with only a limited number of samples (about five or more). Having information on subjects' cortisol levels over the day is important since it appears that in older persons the diurnal rhythm tends to flatten, exhibiting less of a morning rise and less of a nighttime low, compared to their younger counterparts (Van Cauter et al., 1996; Magri et al., 2000; Ice et al., 2004). Such a flattening of the rhythm may be harmful and might be more likely to come about or hastened with greater exposure to low status. Lastly, some measure of respondent reactivity to one or more stressors and the time needed to return to baseline levels would be valuable since it appears that those with a compromised neuroendocrine system are "sluggish" in returning to a basal state (Sapolsky, 2004; Seeman and Robbins, 1994).

As mentioned before, this paper analyzed two versions of a subjective social status question. The first asked respondents to rate themselves relative to those in all of Taiwan and the second asked respondents to rate themselves only in reference to their community, however they chose to define it. Of the two versions, we thought that respondents would rate themselves more highly in the community, and this was indeed the case. Lives are lived in particular geographic locations and communities and it is likely that people positively value many of the social relations and roles they assume in these spheres, translating into higher ratings on this version of the status question. Nevertheless, using one or the other version of the status question in reference to biomarker vaules produced similar results. Further, we reasoned that the different status questions would each capture a different aspect of status that would independently influence biomarker values. Results with both ladders in the models revealed, however, that this was not the case.

The similarity in responses to both status questions might have something to do with the order in which they were presented to survey respondents and the fact that the question asked first (about status in all of Taiwan) was accompanied with a prompt (i.e., "At the top of the ladder are the people ... with the most money, the most education and the most respected jobs."). As we ourselves tried answering the two status questions the prompt remained salient in our thinking when trying to answer the second, even though it was worded differently and contained no prompt. Further, should the status question not contain a prompt, a positive consequence might be that respondents are more likely to consider a wider array of factors in assessing their level of status, factors such as feelings of discrimination, neighborhood traits (e.g., neighborhood safety and amenities), and characteristics of those that are close to them (e.g., educational levels and resources of their spouse and children). In other words, a promptless question might better capture general feelings of "lowliness" that authors such as Wilkinson (1999) have argued are detrimental to health. Indeed, it is interesting to note that one of the most predictive measures of a wide variety of future health outcomes is that of current, self-rated health, a question which typically has no prompts (Idler & Benyamini, 1997). It is our feeling that if the subjective SES question is mainly a shortcut way of obtaining information on objective SES, without having to query about education, income, wealth, employment, and so on separately, then a question with a prompt seems preferable to its opposite. Used in studies to date, however, the subjective status question seem less a substitute for objective measures than a way to gauge feelings of relative deprivation; that is, studies often include objective measures of status along with responses to the ladder question in an attempt to measure, or so it seems, the “extra material” costs of low SES (Hu et al., 2005; Collins and Goldman, 2008; Ostrove et al., 2000; Singh-Manoux, Marmot, and Adler, 2005).

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Table 1 Descriptive statistics and cut-points for the neuroendocrine biomarkers and descriptive statistics for the neuroendocrine allostatic load (NAL) indices – sample population, Taiwan (ages 54 to 91, both sexes combined, year 2000)[a]

	Mean	SD	Min	Max	N	Percentile cutoffs 10th	25th	75th	90th
Neuroendocrine markers									
Cortisol (logged)[b]	3.0	0.7	0.8	7.2	1019	--	--	3.4	3.9
DHEAS[c,d]	80.7	58.6	0	496.6	1021	20.9	40.8	--	--
Epinephrine[b,d]	2.6	2.6	0	19.9	1019	--	--	3.7	5.6
Norepinephrine[b]	21.9	9.9	1.6	74.7	1019	--	--	27.1	34.7
Dopamine[b]	152.0	61.7	6.0	796.5	1014	87.4	112.3	--	--
NAL indices									
10% cutoff points	0.5	0.7	0	4	1012	--	--	--	--
25% cutoff points	1.3	0.9	0	4	1012	--	--	--	--
Summed z-score	1.8	1.5	0	9.0	1012	--	--	--	--

Note: [a] The tabulations are based on unweighted survey data. The literature most often represents high risk by greater values for cortisol, epinephrine, and norepinephrine and lower values for DHEAS, a convention which is followed here. Also based on the literature, we hypothesize that low dopamine values pose risk.
[b] (µg/g creatinine).
[c] (µg/dl).
[d] Values below assay sensitivity were coded in the original, publicly available data set as zero.

Source: Authors' tabulations based on the 2000 SEBAS (Goldman et al., 2003).

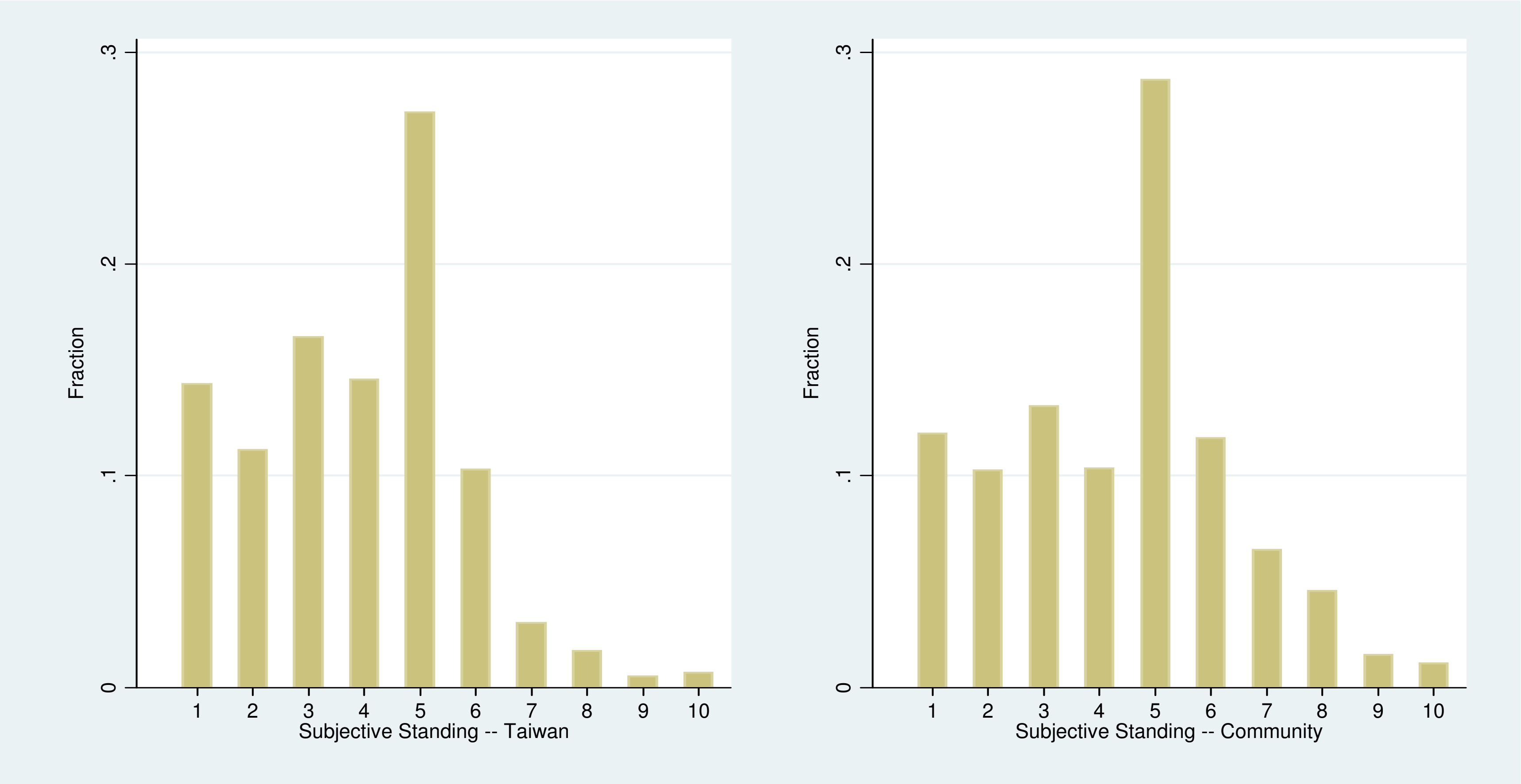
Table 2 Descriptive statistics for all of the independent variables used in the analysis – sample population, Taiwan (ages 54 to 91, both sexes combined, year 2000)[a]

	% or Mean (SD)	Range	N
Subjective social standing			
Taiwan ladder[b]	3.9 (1.9)	1-10	991
Community ladder[b]	4.3 (2.1)	1-10	986
Controls			
Demographic			
Age (years)	68.3 (8.5)	54-91	1023
Male sex	58%	--	1023
Objective SES indicators			
Education (years), respondent	5.2 (4.7)	0-17	1023
Education (years), spouse	4.9 (4.5)	0-17	992
Int'l Socioeconomic Index score[c]	38.0 (14.0)	16-87.5	998
Health/behavioral			
Takes medication	57%	--	1023
Chews betel nut daily	2%	--	1020
Smokes daily	22%	--	1022
Consumes alcohol daily	5%	--	1020
Exercises six times a week or daily	41%	--	1022
Diet of at least two fruits and three vegetables daily	53%	--	1021

Note: [a] The tabulations are based on unweighted survey data.
[b] Ten represents the highest status and one the lowest.
[c] Calculated for the respondent if male and for the respondent's spouse if female.

Source: Authors' tabulations based on the 2000 SEBAS (Goldman et al., 2003).

Figure 1 Distributions of self-reported standing in Taiwan and in the community -- sample population (ages 54 to 91, both sexes combined, year 2000)[a]



Note: [a] The tabulations are based on unweighted survey data. Ten represents the highest status and one the lowest.
Source: Authors' tabulations based on the 2000 SEBAS (Goldman et al., 2003).

Table 3 Estimated regression results with different neuroendocine biomarkers as the dependent variables and reports of subjective social status as the highlighted independent variables – Taiwan (ages 54 to 91, both sexes combined, year 2000)[a]

	Dependent variables									
Independent variables	DHEAS[b]		Cortisol[c]		Epinephrine[c]		Norepinephrine[c]		Dopamine[c]	
	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2
Model A:										
Status in Taiwan	**2.47 (0.006)**	0.40 (0.650)	-0.01 (0.488)	-0.02 (0.257)	0.05 (0.223)	-0.02 (0.659)	**0.38 (0.018)**	**0.41 (0.012)**	-0.41 (0.650)	-0.06 (0.952)
Education (years), resp.	--	**2.16 (0.002)**	--	-0.00 (0.906)	--	0.04 (0.182)	--	0.02 (0.836)	--	-0.54 (0.451)
Education (years), spouse	--	0.44 (0.511)	--	-0.00 (0.609)	--	0.04 (0.225)	--	-0.15 (0.184)	--	-0.40 (0.434)
Occupational score resp./husb.	--	0.10 (0.589)	--	0.00 (0.098)	--	0.01 (0.415)	--	**0.07 (0.002)**	--	0.17 (0.167)
Model B:										
Status in Community	**2.16 (0.028)**	0.62 (0.471)	-0.01 (0.702)	-0.01 (0.474)	0.08 (0.082)	0.04 (0.497)	0.16 (0.246)	0.21 (0.122)	-0.46 (0.606)	-0.18 (0.833)
Education (years), resp.	--	**2.14 (0.002)**	--	-0.00 (0.765)	--	0.04 (0.236)	--	0.03 (0.735)	--	-0.52 (0.473)
Education (years), spouse	--	0.43 (0.513)	--	-0.00 (0.691)	--	0.04 (0.225)	--	-0.13 (0.218)	--	-0.40 (0.431)
Occupational score resp./husb.	--	0.10 (0.587)	--	0.00 (0.104)	--	0.01 (0.419)	--	**0.07 (0.002)**	--	0.18 (0.145)
Model C:										
Status in Taiwan	1.44 (0.420)	-0.33 (0.863)	-0.01 (0.593)	-0.02 (0.411)	-0.04 (0.553)	-0.12 (0.102)	**0.60 (0.042)**	0.54 (0.096)	0.05 (0.974)	0.30 (0.840)
Status in Community	1.20 (0.512)	0.86 (0.629)	0.00 (0.938)	-0.00 (0.956)	0.11 (0.160)	0.11 (0.140)	-0.25 (0.330)	-0.15 (0.587)	-0.51 (0.723)	-0.40 (0.768)
Education (years), resp.	--	**2.14 (0.003)**	--	-0.00 (0.835)	--	0.04 (0.202)	--	0.02 (0.849)	--	-0.53 (0.460)
Education (years), spouse	--	0.44 (0.502)	--	-0.00 (0.679)	--	0.04 (0.201)	--	-0.14 (0.213)	--	-0.40 (0.434)
Occupational score resp./husb.	--	0.10 (0.566)	--	0.00 (0.085)	--	0.01 (0.380)	--	**0.07 (0.003)**	--	0.17 (0.170)
F-test (Taiwan + Community ladders)	**(0.022)**	(0.753)	(0.768)	(0.503)	(0.223)	(0.254)	(0.052)	**(0.042)**	(0.868)	(0.958)

Note: [a] Each column presents results from different OLS regressions in which a single neuroendocrine marker (measured continuously) is the dependent variable. The regression coefficients are unstandardized and precise levels of statistical significance are inside the parentheses. All of the analysis is based on weighted survey data and regressions include baseline controls (i.e., medication use, diet, exercise, alcohol consumption, betel quid chewing, and smoking) and those for age and sex.

[b] µg/dl.

[c] µg/g creatinine.

Source: Authors' calculations based on the 2000 SEBAS (Goldman et al., 2003).

Table 4 **Estimated regression results with neuroendocrine allostatic load (NAL), scored using different methods, as the dependent variable and reports of subjective social status as the highlighted independent variables -- Taiwan (ages 54 to 91, both sexes combined, year 2000)**[a]

	Dependent variables					
Independent variables	Cutpoint scoring (10%)		Cutpoint scoring (25%)		Summed z-score scoring	
	M1	M2	M1	M2	M1	M2
Model A:						
Status in Taiwan	-0.02 (0.102)	-0.02 (0.153)	-0.00 (0.712)	-0.01 (0.748)	-0.01 (0.679)	-0.01 (0.598)
Education (years), resp.	--	-0.01 (0.382)	--	0.01 (0.420)	--	0.00 (0.845)
Education (years), spouse	--	0.00 (0.898)	--	-0.02 (0.146)	--	-0.02 (0.263)
Occupational score resp./husb.	--	0.00 (0.543)	--	0.00 (0.185)	--	0.01 (0.169)
Model B:						
Status in Community	-0.02 (0.255)	-0.02 (0.343)	-0.01 (0.317)	-0.01 (0.495)	-0.01 (0.760)	-0.01 (0.810)
Education (years), resp.	--	-0.01 (0.329)	--	0.01 (0.427)	--	-0.00 (0.989)
Education (years), spouse	--	0.00 (0.786)	--	-0.01 (0.174)	--	-0.01 (0.320)
Occupational score resp./husb.	--	0.00 (0.565)	--	0.00 (0.165)	--	0.01 (0.152)
Model C:						
Status in Taiwan	-0.02 (0.478)	-0.02 (0.512)	0.01 (0.503)	0.01 (0.808)	-0.01 (0.870)	-0.02 (0.650)
Status in Community	-0.01 (0.478)	-0.01 (0.789)	-0.02 (0.257)	-0.01 (0.487)	-0.00 (0.913)	0.00 (0.928)
Education (years), resp.	--	-0.01 (0.341)	--	0.01 (0.462)	--	0.00 (0.972)
Education (years), spouse	--	0.00 (0.771)	--	-0.01 (0.183)	--	-0.01 (0.326)
Occupational score resp./husb.	--	0.00 (0.524)	--	0.00 (0.177)	--	0.01 (0.143)
F-test (Taiwan + Community ladders)	(0.274)	(0.365)	(0.476)	(0.713)	(0.927)	(0.851)

Note: [a] Each column presents results from different OLS regressions in which the NAL score is the dependent variable. The regression coefficients are unstandardized and precise levels of statistical significance are inside the parentheses. All of the analysis is based on weighted survey data and regressions include baseline controls (i.e., medication use, diet, exercise, alcohol consumption, betel quid chewing, and smoking) and those for age and sex.

Source: Authors' calculations based on the 2000 SEBAS (Goldman et al., 2003).

Appendix

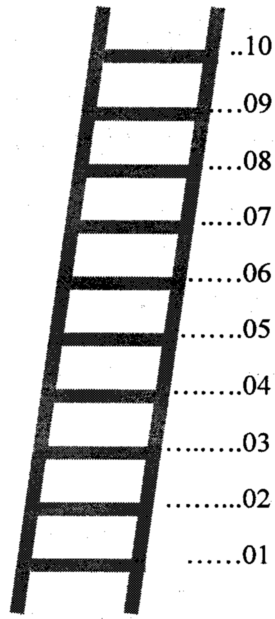
★D1 **[Show the figure on the right-hand side of this page to the respondent]**

Here is a ladder. There are also ten stairs in total from the bottom to the top.

Think of this ladder as representing where people stand in Taiwan. At the top of the ladder are the people who are the best off – those who have the most money, the most education and the most respected jobs. At the bottom are the people who are the worst-off – who have the least money, least education, and the least respected jobs or no jobs.

The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

If you consider your current situation and compare it with all other people in Taiwan, where would you place yourself on this ladder? Please indicate it to me.



[Please circle the rung that respondent indicates.]

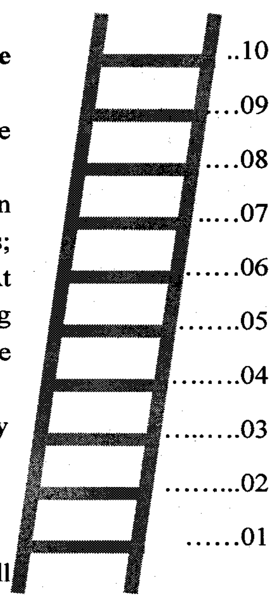
☐66 Other response (Please specify)

★D2 **[Show the figure on the right-hand side of this page to the respondent]**

Here is another ladder. In total, there are ten stairs from the bottom to the top.

Think of this ladder as representing where people stand in their communities. People define community in different ways; please define it in whatever way is most meaningful to you. At the top of the ladder are the people who have the highest standing in their community. At the bottom are the people who have the lowest standing in their community.

[Interview note: Please let respondents define community by themselves. If respondents really don't know or don't understand, please probe using the word neighborhood (where you live and the surrounding area).]



If you consider your current situation and compare it with all other people in your community, where would you place yourself on this ladder? Please indicate it to me.

[Please circle the rung that respondent indicates.]

☐66 Other response (Please specify)