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Gender-specific responses to social determinants associated with self-perceived health in Taiwan: A multilevel approach

Duan-Rung Chen [a,*], Ly-Yun Chang [b], Meng-Li Yang [c]

[a] National Taiwan University, Graduate Institute of Health Care Organization Administration, No. 636, #17, Hsu-Chu Road, Taipei, Taiwan
[b] Academia Sinica, Institute of Sociology, Taiwan
[c] Academia Sinica, Center for Survey Research, RCHSS, Taiwan

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ABSTRACT

There are well-documented gender differences in health. However, few studies have considered that the associations of personal and household characteristics with perceived health may vary between men and women because of their different socialized gender roles. This study investigates gender differences in health and addresses gender-specific responses to individual- and household-level determinants of health. We analyze the data of the 2001 Social Development Survey on Health and Safety, which consists of a representative sample of all registered households in Taiwan. Our findings give limited support to the hypothesis that women and men are differently associated with social determinants of health. We observe a significant gender gap in self-perceived health even after controlling for various health determinants. Notwithstanding, men and women are similar in many important aspects in relation to social determinants of health. Gender-specific responses are found only in the impacts of employment status, stressful life events, own disability, and number of family members with a disability. Men report having poorer health than women when being disabled and facing stressful events. Women's perceived health is at a higher risk when family members require short-term, intensive care. Further consideration of the observed, gender-specific responses to health determinants shed insight on the possible social and cultural relevance behind gender differences in self-perceived health.

Background

Gender differences in health have been well-documented in the literature (Arber & Cooper, 1999; Bird & Rieker, 1999; Macintyre, Hunt, & Sweeting, 1996; McDonough & Walters, 2001). Although women live longer than men on average, they generally report poorer health. For example, women report higher levels of depression and distress, a greater variety of psychiatric disorders and chronic illnesses (Annandale & Field, 2007; Baum & Grunberg, 1991; McDonough & Walters, 2001), and more functional limitations over the life course than men (Gorman & Read, 2006). The gender gap in perceived health observed in Western countries is also found in Asian countries, such as Japan (Shibuya, Hashimoto, & Yano, 2002), Korea (Park, 2005), and Taiwan (Department of Health [DOH], 2005). For instance, while women in Taiwan have a higher life expectancy at birth (79.42 years) than men (73.59 years), more women (21.6%) than men (8.2%) between 21 and 90 years old report poor health (DOH, 2005); women also have a higher adjusted mortality rate from suicide than men (DOH, 2005).

Denton, Prus, and Walters (2004) provided a useful framework for studying the gender gap in health outcomes (Denton's model, hereafter). According to them, health is affected by (a) social-economic determinants, including such personal socio-economic resources as education, income, and employment; (b) behavioral determinants,

* Corresponding author. Tel.: +886 2 3322 8066; fax: +886 2 2343 4200.
E-mail address: duan@ntu.edu.tw (D.-R. Chen).

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including such health behaviors as smoking, obesity, and physical inactivity; and (c) psychosocial determinants, including critical life events, chronic stressors, and psychological resources (Denton et al., 2004). Notwithstanding the importance of the aforementioned factors, Denton's model is insufficient for understanding the gender gap in health because social contexts are not included in the model. Contextualizing risk factors is especially critical because we speculate that men and women occupy different positions in the various social contexts in our society. Accordingly, men and women can present different responses toward their respective social conditions, and thus generate different perceptions of health assessment.

This study examines the disparity in perceived health between men and women by taking both individual and household characteristics into consideration. We argue that an individual's social and economic resources, responses to psychological strain, and health behaviors are embedded within the household contexts where gender differences in health may be patterned. For instance, the domestic roles of men and women vary significantly in terms of the division of the labor in rendering care to family members. The amount of care giving depends upon the number of children, the health condition of family members, as well as the number of the elderly in the family. Therefore, it can be expected that household conditions may interact with a person's sex and thus generate different impacts on men's and women's perceived health.

Taiwan is a particularly interesting case for studying the relative importance of personal and household factors on the health disparity between the sexes. Men and women have enjoyed equal educational opportunities in Taiwan since 1950. According to 2006 educational statistics, the female-to-male ratio of those with a college education is 0.97:1 (Ministry of Education [MOE], 2007). While the gender gap has narrowed significantly in educational attainment, the male-female difference in the percent of labor market participation persists (45% for women and 70% for men, Directorate-General of Budget, Accounting and Statistics [DGBAS], 2005). Compared to their counterparts in Western countries, women in Taiwan are less likely to participate in the formal labor market and more likely to stay home. Taiwanese women report spending much more time doing housework than men do (Lu, 1999).

Moreover, while in the West, where most studies found in the literature have been conducted, nuclear families are the typical form of family structure, extended families are more prevalent in Taiwan. In extended families, women are not only wives and mothers, but also daughters-in-law. While the decision about who the major caregivers are is not necessarily gender-specific, Taiwanese women are more likely to shoulder the care-giving responsibilities because they are less likely to participate in the labor market (Chang, 2001). In Taiwan, wives, daughters, and daughters-in-law make up 63% of the caretakers of handicapped/ill household members (Lin et al., 1995; Lu, 1999; Wu & Lin, 1999). The fact of low labor market participation among Taiwanese women combined with the equal education attainment between men and women may provide a hint to the reason for the persistent male-female difference in perceived health.

Literature review

Denton's model of the multi-determinants of health offers a good starting point to understand the gender gap in perceived health in Taiwan. First of all, people with a higher socioeconomic status tend to have lower mortality and morbidity and to perceive being in better health than those with a low socioeconomic status (Beckfield, 2004; Farmer, 1999; Wilkinson & Marmot, 2003). The availability of resources is thought to explain the positive association between socioeconomic status and good health, suggesting that people with more socioeconomic resources, including higher education and higher incomes, are more likely to be in good health. Women are less likely to be employed and are more likely to have lower incomes and do more domestic labor than men (Denton et al., 2004; Denton & Walters, 1999; Lu, 2001, 2006; Ross & Bird, 1994). Access to goods and resources generates different health outcomes for men and women (Bird & Rieker, 1999). Arber and Cooper (1999) also indicated that women's health is put at a disadvantage because women have less access to material and social resources that foster health. In other words, gender differences in health can be a consequence of social stratification.

Second, however, men and women are reported to adopt different, but similarly unhealthy lifestyles. Men are more likely than women to smoke and consume alcohol, while women are more likely to become physically inactive (Denton & Walters, 1999; Ross & Bird, 1994). Although smoking and drinking hurt lungs and livers, inactivity, too, is an important contributing factor to such diseases as diabetes, heart disease, and bone disease (Blair & Brodney, 1999). Moreover, such health behaviors and lifestyles also can be responses to life's stresses and strains. Women are reported to be more sensitive to ongoing strains than men are, and tend to be more anxious and depressed, while men are more likely to turn to risky behaviors (Busfield, 2000; Wheaton, 1990). Thus, it seems that women's coping strategies consume their attention and immune systems, resulting in perceptions of ill health and slowly deteriorating health conditions, whereas men's coping strategies set them in immediate danger or slowly damage their organs.

Third, the socially and culturally accepted division of labor for men and women may be more demanding and stressful for women. Women often take on more domestic responsibilities than men in addition to holding a full-time job (Walters, McDonough, & Strohschein, 2002). In fulfilling these responsibilities, they are more involved in the caretaking of children and the elderly, especially in times of illness, while such duties have been linked to stress and anxiety and thus cause health problems (McDonough, Walters, & Strohschein, 2002). Nevertheless, responsibilities of caring do not entail only stress and energy-consumption; such responsibilities, when generated in a web of social networks, also offer opportunities for emotional attachment, a sense of belongingness, and a sense of achievement, as suggested in the social support

and social capital literature (Kawachi & Berkman, 2001). Therefore, while women may perceive having ill-health because they are consumed by such caring responsibilities, they also might benefit from embedded social ties.

At this juncture, this study extends Denton's model of multi-determinants of health in two important aspects. First, we include household-level variables to contextualize the health risk factors known in the literature. Second, the study focuses on more than the gender gap in perceived health and the correlates of the gender gap; we also address gender-specific responses to individual and household-level determinants of perceived health. Hence, although we use a data set from Taiwan, the research question is not area-specific. We believe that findings generated from this study shall contribute to understanding the mechanisms underlying social disparities in health, and, in turn, help the development of general theory in health inequality.

Following Denton et al.'s (2004) framework of multi-determinants of health, we analyzed the dependent variable, self-perceived health, by considering individual social-economic resources, health behaviors, psycho-social variables, and household caretaking needs. We used multilevel, ordinal regression models to evaluate how much variance in self-perceived health can be attributed to the variances of individual and household characteristics, respectively. In light of the works of Turner and Avison (1987), McDonough and Walters (2001), and Prus and Gee (2003), we further examined whether women and men differ in terms of their vulnerability to some, but not all, of the social determinants of health. We did this by examining the interaction terms of women with individual characteristics (e.g., women by education, income, employment, health behaviors, and psychosocial variables). Finally, to investigate whether men and women were differently associated with household caretaking needs, we examined several cross-level interaction terms of women with household caretaking needs (e.g., women by household caretaking needs) to determine how male-female differences in self-perceived health are embedded in household contexts.

Methods and measurement

Study population

Data used to explore the aforementioned research questions were derived from the 2001 Social Development Survey on Health and Safety (SDSHS). The SDSHS was conducted by the Directorate General of Budget, Accounting and Statistics (DGBAS), an institute of Taiwan's central government. It consists of 50,354 respondents in 13,000 households in 867 villages. This representative sample of the population in Taiwan in 2001 is derived from a two-stage, stratified, random-sampling design. The sampling procedures are summarized as follows: First, all the townships in Taiwan were assigned to one of 81 strata based on the size of the population; the number of households; urbanization levels; percentages of people aged 15 and above; ratios of agriculture, industry, and service employment; and percentages of high school graduates. Several towns then were sampled from each stratum. Second, two villages (*chun-li's*) were drawn from each town. A number of households were randomly drawn from each village. All members aged 15 years and older in each household were interviewed. In addition, information on family members younger than 15 years old also was collected.

To control for sampling error within a certain level, the sampling ratio of SDSHS was kept at a level of 2/1000. Each respondent in the sample was assigned a sampling weight, which was the product of the inverse of the sampling probabilities in the sampling stages, divided by the final total sample size (which is called "normalized" in statistics), such that the total of the weights equaled the sample size. This resulted in weighted samples that approximated the distribution of the demographic composition of Taiwan's adult population with respect to gender, age, and education. (Details can be accessed at the DGBAS website http://www129.tpg.gov.tw/mbas/society/index.html).

For the purpose of this study, respondents aged 20 years old and below, 65 years old and above, and students were excluded from the analysis. In addition, because single-person households do not have household resources or responsibilities for family members, we excluded them as well. This resulted in 29,312 respondents from 11,017 households. All the hierarchical, ordinal regression analyses were weighted using weights provided in the data set.

Dependent variable: self-perceived health

Self-perceived health has been studied intensively. Several studies have reported strong associations between self-perceived health and objective measures of morbidity (Kaplan et al., 1996; Miilunpalo, Vuori, Oja, Pasanen, & Urponen, 1997; Moller, Kristensen, & Hollnagel, 1996). Self-perceived health also has been found to be a significant predictor of mortality (Miilunpalo et al., 1997; McGee, Liao, Cao, & Cooper, 1999). Respondents in this study reported their health status over the last 3 months on a four-point Likert scale, with good coded as "1," fair coded as "2," poor but capable of self-care coded as "3," and poor and not capable of self-care coded as "4." Due to the limited number of respondents reporting poor and not capable of self-care, we combined categories "3" and "4" into one category "3" as "poor" perceived health.

Independent variables: individual characteristics

Socioeconomic variables

Individual characteristics, such as social-economic status, are represented in this study by education, personal income, and employment status. Education is coded into four levels: 1 = less than 6 years of education; 2 = more than 6 and less than 9 years of education; 3 = more than 10 and less than 12 years of education; and 4 = 13 or more years of education. Respondents with less than 6 years of education were used as the reference group. Personal income was categorized into six levels: "1" (less than NT$20,000 per month), "2" (more than NT$20,000 and less than NT$30,000), "3" (more than NT$30,000 and less than NT$40,000), "4" (more than NT$40,000 and less than

NT$60,000), "5" (more than NT$60,000 and less than NT$80,000), and "6" (NT$80,000 or more per month). People with less than NT$20,000 per month were used as the reference group. Employment status refers to whether the individual was currently a business owner or self-employed, employed full-time, employed in a family business more than 15 h per week, a housewife/househusband, or unemployed. Being unemployed is the reference group.

Health behaviors

Health behavior is indicated by two variables: smoking and physical inactivity. Smoking is further differentiated into two dummy variables: current regular smokers (i.e., at least a few cigarettes a day) and previous smokers. Never smokers are the reference group. Physical inactivity indicates whether the respondent had been exercising regularly during the 3 months prior to the interview. The answer format is either yes coded as "1," or no coded as "0."

Psycho-social variables

A number of studies have found the disabled to be significantly more depressed or to have more psychological distress generally (e.g., Turner & Noh, 1988; Hansen, Fink, Frydenberg, & Oxhøj, 2002), although some failed to find a difference between the disabled and the nondisabled (Albrecht & Devlieger, 1999). A variable "disability" was constructed to indicate whether the respondent is disabled physically and mentally. The variable "disability" represents the potential for a long-term, stressful situation.

Continuing anxiety, insecurity, and lack of control over work and home life have powerful effects on health (Wilkinson & Marmot, 2003). A variable "perceived level of personal insecurity" was constructed and measured by three items: worry about having an accident when going out, worry about safety when taking a taxi, and worry about safety around one's own residential vicinity. The variable represents the extent of psychological insecurity in daily life. The responses ranged from "1" to "4," respectively, indicating "not worried at all" to "very worried." The composite variable "perceived level of personal insecurity" is a sum of these three responses, with values ranging from "3" to "12" and larger values indicating higher levels of worry. Using a principle component factor analysis, we found that these items have good internal reliability (Cronbach's α 0.85).

The third variable is stressful events. The respondents were asked whether they had been physically attacked, robbed, or threatened or blackmailed for money or property during the last year. Respondents who reported having experienced any one of these events were coded as "1," and "0" otherwise. People with stressful experiences are thought to be more likely to have psychological strain and thus are more likely to report poor health (Dohrenwend, 2006; Hatch & Dohrenwend, 2007; Turner & Lloyd, 1995).

Independent variables: household characteristics

We constructed three variables to indicate levels of caretaking loads in the family. Household caretaking can consist of long-term or short-term responsibilities. The numbers of family members who were 15 years of age or younger, 65 years of age or older, or disabled were used as proxies for the levels of demands for long-term, daily care. The number of household members who had been injured or had accidents and required intensive care during the 3 months prior to the interview as used to indicate the level of demand for short-term care. The larger the number, the higher the level of demand entailed.

In addition, household income was used to represent levels of resources possessed by individuals. The variable "household income" was coded in the same way as personal income. Households with an income of less than NT$20,000 per month were used as the reference group.

Control variables

Although the focus of this study was not the effects of age, marital status, and personal injury on perceived health, those variables were included in the models as controls. Marital status is represented by three dummy variables: single, divorced/separated, or widowed. Being currently married is the reference group. Personal injury refers to whether the respondents had injuries or accidents that required intensive medical care during the 3 months prior to the interview.

Statistical analysis: multilevel ordinal regression models

The focus of this study was to investigate gender differences in health and to address gender-specific responses to individual- and household-level determinants of health. The dependent variable, self-perceived health, is an ordinal variable coded on a three-point Likert scale (good, fair and poor perceived health). The self-perceived health measure possesses an intrinsic ordering. Thus, we used a two-level, ordinal logistic regression to analyze the data. Based on Long (1997), we used an informal test to examine the adequacy of the proportional odds' assumption by estimating two individual-level binary regressions (good vs. fair and poor; good and fair vs. poor) (data is in the Appendix). The results indicated that the 95% confidence interval of odds ratios of gender effects and individual variables in ordered logistic model approximately overlapped with those found in these two binary logistic models. It suggests that the proportional odds assumption may be supported.

Hedeker and Gibbons (1994) had extended the logic of ordinal regression to a multilevel setting. Multilevel, ordinal logistic regression uses ordinal logistic regression in the first (e.g., individual) level to model the ordinal response. An ordinal model uses a cumulative probability model, which assumes that, with K possible actual responses, an unobservable latent variable, y, is related to the responses through a series of threshold values, γ_1, $\gamma_2,\ldots,\gamma_{k-1}$, with $\gamma_0 = -\infty$, and $\gamma_k = \infty$. A response occurs in category k ($Y = k$) if y exceeds the value of γ_{k-1} and does not exceed γ_k. Ordinal logistic regression uses the logit link, the log of the odds ratio of the probability of $Y \leq k$ against $Y > k$ in HLM6 (Raudenbush & Bryk, 2002; Raudenbush, Bryk, Cheong, & Congdon, 2004).

For two-level ordinal regression models, an ordinal regression is run for each "group" (each household in our

case), and then the resultant intercepts and coefficients are used as dependent variables in the second (e.g., household) level and predicted by group characteristics (such as household caretaking needs in our case).

In equation form, for level 1 we have

$$f(y_{ij} = k|\beta) = \beta_{0j} + \sum_p x_{ijp}\beta_{jp} + e_{ij},$$

where y_{ij} is an ordinal variable with three levels ($K = 3$). Given $\text{prob}(y_{ij} = k|\beta) = \phi_{ij(k)}$, and $\phi'_{ij(k)} = \phi_{ij(1)} + \phi_{ij(2)} + \cdots + \phi_{ij(k)}$, the logit is $f(y_{ij} = k|\beta) = \eta_{ij} = \log(\phi'_{ij(k)}/1 - \phi'_{ij(k)})$. β_{0j} is the intercept for household j, and x_{ijp} is the value of pth variable of person i in household j.

In level 2, β_{0j} is modeled by household characteristics. The β_j for "woman" also is modeled by all the household characteristics to examine the significance of the cross-level interactions (gender and household characteristics).

Following Goldstein (1995) and others (e.g., Snijders & Bosker, 1999), the intra-class correlation coefficient (ICC) is computed by using the linear threshold model method. Based on the linear threshold model method, the ICC is calculated as $V_B/(V_B + 3.29)$, while V_B is the between-group variance. In our logit models, ICC is 0.227 $(0.968/(0.968 + 3.29))$, indicating that 22.7% of the total variance in individual-level health is caused by variations between households, suggesting that a multilevel approach is appropriate for the data (Raudenbush & Bryk, 2002).

Taking this analytical approach, we first examined the baseline difference between men and women after adjusting for the control variables: age, age-squared, marital status, and personal injury (Model 1). We then conducted a series of multilevel, ordinal regressions to examine how the gender gap in health changed as we sequentially added individual socio-economic variables (Model 2), health behaviors (Model 3), psychosocial variables (Model 4), and finally household characteristics (Model 5). We also employed post hoc procedures (Wald tests) in HLM 6 to test the hypothesis that the gender gap is significantly different from 0, while the variables were subsequently added to the models (Raudenbush & Bryk, 2002).

To avoid multicollinearity, interaction terms were examined individually, and only statistically significant interaction terms were included in the final model. For the final model, we also employed a post hoc procedure (Wald-tests) to examine whether the final model with interactions was significantly better than the previous model without the interaction terms (i.e., Model 5) (Raudenbush & Bryk, 2002).

Results

Descriptive differences between men and women

About half of the subjects reported having good health (50.2%), about 42% (41.6%) fair health, 7.4% poor health but capable of caring for themselves, and 0.8% poor health and not capable of caring for themselves. Men and women did not differ in terms of age, stressful experiences in the previous year, and numbers of injuries and accidents (see Table 1). However, men and women differed significantly with regard to socio-economic variables. More women than men had less than 6 years of education (31.8% vs. 20.1%). Women were less likely than men to be employers (9.1% vs. 26.5%), and less likely than men to be employed full-time (40.9% vs. 56.3%). Women had lower personal income than men did, with 76.7% of women and 42.2% of the men earning less than NT$30,000 per month. Women were slightly less physically active than men. Women reported experiencing significantly greater psychological insecurity about their own personal safety than men, with the total scores for this variable being 6.4 and 5.8, respectively ($p < 0.001$). In contrast, far fewer women (3.5%) than men (51.2%) were smokers.

On average, there were about four members per household, with the size ranging from 2–20. Nearly half of the households (45.8%) had a monthly income in the range of NT$30,000–NT$60,000. About 24.5% of the households had a monthly income over NT$60,000. Almost 49% of the households did not have any members below 15 years of age, and 73.2% of them were not living with anyone over 65 years old. Only 9.4% of the households had persons who were disabled, and 7.7% had members who had recently incurred injuries requiring intensive medical care.

The gender gap in perceived health: size and correlates of the gap

To assess the extent to which men and women differ in terms of perceived health and sources of such gap, Table 2 presents five sets of models, with Model 1 as the baseline model. Variables of socioeconomic indicators, health behaviors, psycho-social variables, and household characteristics were subsequently included in the models to empirically observe the size of the gender gap in health and the change of the gender gap in health across the different model specifications. Note again, the first three sets contain only individual-level variables, while the last also includes household-level variables.

A gender gap in perceived health is evident, net of age, marital status, and personal injury (Model 1 in Table 2). The expected log-odds for women (i.e., the gender gap in perceived health) is -0.47, so that $\exp(-0.47) = 0.63$ (odds ratio) in Model 1. This can be interpreted as indicating that, compared with their male counterparts in age, marital status, and personal injury, the odds of perceiving "good" health vs. the combined outcomes of the remaining two categories was about 37% less likely for women. Approximately, the odds of perceiving "good" and "fair" health combined vs. of "poor" was similarly 37% less likely for women than for men (Long, 1997).

Second, the gender gap in perceived health remains sizable and statistically significant even when different types of social determinants (Models 2–4) and levels of household characteristics (Model 5) are included in the model estimations. As the estimates for the coefficients from ordinal regression are not comparable across models (Tam, 2002; Winship & Mare, 1983), we cannot directly compare the size of the estimates for the gender coefficients in different model specifications. Notwithstanding, further post hoc Wald statistics indicated that the gender

Table 1
Socio-demographic characteristics of study sample ($n = 29{,}273$)

	Men ($n = 14778$, 50.5%)		Women ($n = 14495$, 49.5%)		T-test/χ^2
	N	%/SD	*N*	%/SD	
Age	40.78	(11.65)	40.92	(11.99)	ns
Marital status					
Married	10173	68.8	10484	72.3	**
Single	3899	26.4	2640	18.2	
Divorced/separated	530	3.6	543	3.7	
Widows	176	1.2	828	5.7	
Education					
<6 Years	2966	20.1	4603	31.8	***
7–9 Years	3076	20.8	2358	16.3	
10–12 Years	4947	33.5	4436	30.6	
>13 Years	3789	25.6	3098	21.4	
Employment					
Business Owners/ self-employment	3921	26.5	1326	9.1	***
Full-time employment	8154	56.3	5927	40.9	
Family employment	233	1.6	1119	7.7	
Housework	39	0.3	5024	34.7	
Unemployed	2431	16.5	1099	7.6	
Personal income					
<20K	3700	25.0	8495	58.6	***
21–30K	2548	17.2	2475	17.1	
31–40K	2923	19.8	1552	10.7	
41–60K	2986	20.2	1229	8.5	
61–80K	1557	10.5	470	3.2	
>81K	1064	7.2	274	1.9	
Smoking					
Current smoker	7570	51.2	508	3.5	***
Former smoker	1514	10.2	273	1.9	
No-smoker	5694	38.5	13714	94.6	
Perceived personal insecurity	5.58	(1.52)	6.40	(1.56)	**
Stressful events last year					
Yes	313	2.12	304	2.09	ns
No	14465	97.88	14192	91.91	
Physical inactivity					
Yes	9720	65.8	9302	64.2	***
No	5058	34.2	5198	35.8	
Being disabled					
No	14080	95.35	14021	96.7	***
Yes/no welfare	226	1.5	151	1.0	
Yes/welfare	472	3.2	323	2.2	
Times of being injured during the last 3 months					
None	14248	96.4	14003	96.6	ns
One	476	3.2	444	3.1	
More than two	54	0.4	48	0.3	

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

effect was significantly different from 0 in different model specifications (all p-value < 0.001), and the expected log-odds for women remained significant throughout all the models. We thus are able to conclude that the gender gap in perceived health cannot be fully explained by social economic resources, health behavior, psycho-social variables, or household caretaking needs. Gender appears to be an independent factor associated with the level of perceived health in this study.

Third, most of the coefficient estimates of the independent variables are sizable in the expected directions and statistically significant, except for the number of household members under 15 years old and the number of household members older than 65. Contrary to our expectation, the presence of children was not associated with perceived health. In addition, the presence of older people was positively associated with perceived health for both sexes. In other words, the potential detrimental factor of household characteristics does not seem to have been caused by the demand of caring for the young. Rather, the detrimental factor of household characteristics associated with perceived health had more to do with caring for the disabled and the injured.

In summary, there was a significant gender gap in self-perceived health, even after adjusting for the various health determinants. The gender gap in health did not disappear after considering the two sexes' access to socioeconomic resources, health behaviors, psycho-social variables, and household caretaking needs.

Gender-specific responses to individual and household determinants of perceived health

To take advantage of the multilevel model approach, we further explored the gender-specific effects of individual and household characteristics on perceived health. Conceptually speaking, we examined whether the magnitude and direction of the relation between individual- and household-level characteristics and perceived health vary by gender. Interaction terms between women and individual characteristics, including socioeconomic status, health behaviors, and psycho-social variables, were constructed. The cross-level interaction between women and household caretaking needs also was constructed and included into the model. Again, age, marital status, and personal injury were the controls. Thus, no gender interaction terms were constructed. To simplify the presentation, only the estimates for the coefficients of gender interaction terms are presented in Table 3.

First of all, men and women were not different in terms of the associations between personal income, education, smoking, physical inactivity, psychological insecurity, and perceived health. In contrast, being employed yielded advantage in perceived health for men, but not for women (see Table 3). Men enjoyed better health if they were business owners, self-employed, or holding a full-time job. To the contrary, women seemed to benefit more from working for the family than men. More importantly, staying at home for the family entailed a health benefit for women, but not men.

Moreover, women did not appear to be as vulnerable as suggested in the literature when facing stressful events or being disabled. Both men and women with personal difficulties, such as stressful events and disabilities, tended to report poorer health, but women reported a significantly better condition than men in the same situation. In other words, both men and women who experienced stressful events or being disabled reported poorer health than otherwise (log-odds $= -0.57$, -1.66, and -2.38, respectively), women who experienced similar misfortunes perceived themselves as healthier than men of similar circumstances; the estimates of the coefficients for the gender interaction terms are 0.47, 0.75, and 0.74, respectively.

Third, perceived health was not significantly different between the two sexes under the circumstances of having

Table 2
Multi-level ordinal regressions on self-perceived health (log-odds and SD)

Fixed effect		Model 1	Model 2	Model 3	Model 4	Model 5
Individual variables						
Intercepts (G00)		0.72(0.26)***	−0.06(0.28)	0.43(0.27)	0.36(0.28)	0.11 (0.30)
Gender[Men]	Women	−0.47(0.03)***	−0.38(0.04)***	−0.53(0.05)***	−0.43(0.05)***	−0.46(0.05)***
Age		0.03(0.01)***	−0.02(0.01)	−0.08(0.01)	−0.001(0.01)	0.003(0.01)
Age^2		−0.09(0.01)***	−0.02(0.01)***	−0.02(0.01)***	−0.04(0.01)**	−0.05(0.01)**
Marital status[Married]	Single	−0.03(0.06)	0.05(0.06)	0.02(0.06)	0.06(0.06)	0.06(0.06)
	Divorced/separated	−0.27(0.10)**	−0.17(0.10)	−0.15(0.10)	−0.16(0.09)	−0.11(0.10)
	Windows	−0.33(0.09)**	−0.21(0.09)*	−0.21(0.09)*	−0.21(0.09)	−0.17(0.10)
	Once	−1.01(0.09)***	−0.97(0.09)***	−0.97(0.09)***	−0.91(0.09)***	−0.73(0.10)***
Being injured in latest 3 months[No]	More than once	−1.47(0.32)***	−1.41(0.32)***	−1.41(0.31)***	−1.12(0.32)***	−0.92(0.32)***
Socio-economy status						
Employment status[No]	Business Owners/self-employed		0.80(0.07)***	0.82(0.08)***	0.61(0.01)***	0.66(0.08)***
	Full-time employed		0.82(0.07)***	0.82(0.07)***	0.62(0.07)***	0.76(0.07)***
	Family employment		1.09(010)***	1.10(0.10)***	0.83(0.10)***	0.76(0.10)***
	Housework		0.93(0.08)***	0.90(0.07)***	0.66(0.08)***	0.60(0.08)***
Personal income[Below 20K]	21–30 K		0.18(0.06)***	0.18(0.06)***	0.15(0.06)***	0.10(0.07)
	31–40 K		0.46(0.07)***	0.47(0.07)***	0.41(0.07)***	0.26(0.07)***
	41–60 K		0.50(0.07)***	0.49(0.07)***	0.44(0.07)***	0.25(0.08)***
	61–80 K		0.55(0.09)***	0.53(0.09)***	0.48(0.09)***	0.27(0.11)*
	81K+		0.48(0.10)***	0.46(0.10)***	0.40(0.10)***	0.26(0.12)*
Year of education[Below 6 years]	7–9 Years		0.29(0.06)***	0.26(0.06)***	0.27(0.06)***	0.25(0.06)***
	10–12 Years		0.39(0.06)***	0.34(0.06)***	0.33(0.06)***	0.29(0.06)***
	13 Years+		0.49(0.07)***	0.40(0.07)***	0.37(0.07)***	0.32(0.07)***
Health-related behaviors						
Smoking[never-smoker]	Current smokers			−0.19(0.05)**	−0.24(0.05)**	−0.22(0.05)***
	Former smokers			−0.46(0.07)**	−0.46(0.07)***	−0.43(0.07)***
Physical inactivity[No]	Yes			−0.36(0.04)***	−0.34(0.08)***	−0.34(0.04)***
Psycho-social variables						
Disability[No]	Yes/not on welfare				−1.11(0.17)***	−1.25(0.17)***
	Yes/welfare				−2.11(0.13)***	−2.04(0.10)***
Perceived personal insecurity					−0.24(0.02)***	−0.24(0.02)***
Stressful events [No]	Yes				−0.35(0.12)***	−0.33(0.12)***
Household characteristics						
Household income[Below 20K]	21–30K					0.16(0.09)*
	31–40K					0.47(0.08)***
	41–60K					0.48(0.08)***
	61–80K					0.51(0.10)***
	81K+					0.40(0.11)***
Number of household members under age of 15[None]	One people					−0.11(0.06)
	Two people					−0.05(0.05)
	More than and equal three people					0.08(0.08)
Number of household member older than 65[None]	One people					0.15(0.06)*
	More than and equal two people					0.18(0.08)*
Number of household member disabled[None]	One people					−0.19(0.07)*
	More than and equal two people					−0.08(0.16)
Number of household member injured[None]	One people					−0.39(0.08)***
	More than and equal two people					−0.55(0.25)*
Random effect (Var(τ))		1.040	1.024	1.018	0.997	0.996

All THOLD2 are statistically significant at $p < 0.0001$ level (values not shown).
Reference groups are in parentheses. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

elderly or disabled family members in the household. Both men and women tended to report poorer health when family members had experienced injuries and accidents. However, intensive household caretaking needs resulting from family members' injuries and accidents were negatively associated with women's perceived health, especially when more than two family members had suffered injuries and accidents (−1.32).

Further post hoc Wald tests indicated that the model with interaction terms was significantly better than the previous model without interaction terms (Model 5) (Wald-statistics = 37.13, df = 9, $p < 0.0001$), and the interaction terms were also significantly different from 0 (all with p-values < 0.001).

Discussion

Although there have been many studies on the gender gap in health, the results have been inconsistent (Elo & Preston, 1996; Koskinen & Martelin, 1994; Marmot, Ryff, Bumpass, Shipley, & Marks, 1997; Stronks, van de Mheen, & van den Bos, 1995; Valkonen, 1989). Taking a multilevel

Table 3
Multi-level ordinal regressions on self-perceived health (log-odds and SD)

		Final model	Interaction effect for Women
Individual variables (level 1)			
Intercepts (G00)		0.21(0.30)	
Gender[Men]	Women	−0.68(0.12)*	
Age		−0.02(0.02)	
Age^2		−0.05(0.02)***	
Marital status[Married]	Single	0.07(0.06)	
	Divorced/separated	−0.11(0.10)	
	Windows	−0.18(0.10)	
Being injured in latest 3 months[no]	Once	−0.74(0.10)***	
	More than once	−0.96(0.31)	
Socio-economy status			
Employment status[No]	Business Owners/self-employed	0.67(0.09)***	0.22(0.14)
	Full-time employed	0.59(0.08)***	0.20(0.12)
	Family employment	0.19(0.21)	0.81(0.24)***
	Housework	−0.11(0.42)	1.16(0.43)**
Monthly income[Below 20K]	21–30K	0.10(0.06)	
	31–40K	0.25(0.07)***	
	41–60K	0.25(0.08)***	
	61–80K	0.27(0.11)***	
	81K+	0.25(0.12)*	
Year of education[Below 6 years]	7–9 Years	0.25(0.06)***	
	10–12 Years	0.30(0.06)***	
	13 Years+	0.33(0.07)***	
Health-related behaviors			
Smoking[never-smoker]	Current smokers	−0.23(0.05)**	
	Former smokers	−0.43(0.07)***	
Physical inactivity[No]	Yes	−0.34(0.04)***	
Psycho-social variables			
Perceived personal insecurity		−0.24(0.02)***	
Stressful events[No]	Yes	−0.57(0.16)***	0.47(0.22)*
Being disabled[No]	Yes/not on welfare	−1.66(0.22)**v	0.75(0.28)*
	Yes/welfare	−2.38(0.16)***	0.74(0.24)*
Household characteristics (level 2)			
Household income[Below 20K]	21–30K	0.16(0.09)*	
	31–40K	0.41(0.08)***	
	41–60K	0.46(0.08)***	
	61–80K	0.51(0.10)***	
	81K+	0.40(0.11)***	
Number of household members under age of 15[None]	One people	−0.11(0.06)	
	Two people	−0.04(0.06)	
	More than and equal three people	0.03(0.08)	
Number of household member older than 65[None]	One people	0.15(0.06)*	
	More than and equal two people	0.19(0.08)*	
Number of household member disabled[None]	One people	−0.20(0.07)*	
	More than and equal two people	−0.14(0.16)	
Number of household member injured[None]	One people	−0.34(0.10)***	−0.09(0.12)
	More than and equal two people	−0.11(0.41)	−1.32(0.55)*
Random effect (Var(τ))		1.00	

THOLD2 is statistically significant at $p < 0.0001$ level (value not shown).
Reference groups are in parentheses. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

approach, this study contributes to the existing literature in three important ways: (a) it extends Denton's model by assessing the association of both individual- and household-level characteristics with perceived health; (b) it explores gender-specific responses to individual- and household-level factors associated with perceived health; and (c) it offers a case report based on the gender gap in health by employing a data set of a representative sample of the population in Taiwan, a major economic entity in Asia. Without exception, in the case of Taiwan, women generally are more likely to perceive themselves in poor health than men do. The observed gender gap in perceived health remains relatively unchanged when individual and household characteristics are taken into consideration. This finding is similar to that of Denton et al. (2004), who reported a significant gender gap in self-perceived health among Canadians, even after controlling for various health determinants.

Notwithstanding the gender gap in perceived health, men and women are similar in many important aspects in relation to the social determinants of health. For instance, Denton et al. (2004) reported that social structural and psychosocial determinants of health are generally more important for women, and such behavioral determinants as

smoking, alcohol consumption, and physical activity are associated with self-perceived health only for men. In contrast, we observed significant differences between men and women only in the association of perceived health with psycho-social variables, such as stressful events and disabilities. The importance of health behaviors to health is not different for men and women.

One strength of the multilevel design used in this study is that it enabled us to assess the contextual effect of the gender gap in the perceptions of health status, while controlling for health risk-related, individual characteristics. In this study, most of the household-level characteristics measured are found to be associated with perceived health in the same way between men and women. This finding is contrary to that of Walters et al. (2002), who found that household resources were more important for women than they were for men.

Gender-specific responses are found in only four factors examined in this study. Further consideration of the observed, gender-specific responses to health determinants shed insight into the possible social and cultural influences behind gender differences in self-perceived health. First of all, working for the family or being housewives are associated with better health for women, but poorer health for men. Taiwanese women perceived better health in retreating to the domestic domain, yet men only perceived better health when they were employed in the formal labor market. Cheng, Chen, Chen, and Chiang's (2005) study found that stress from perceived job insecurity is stronger in Taiwanese men than women. We speculate that the male-to-female difference in responses to employment status on perceived health may be caused by men's socially expected gender role of having a career outside the family. Staying in the domestic domain brings health protection only for women, but not for men.

Second, stressful events such as violence, robbery, and threats to property are slightly more prevalent in men than in women. This result is consistent with most of the epidemiological studies of traumatic events in which men have reported greater exposure to lifetime traumas, including injuries, traffic accidents, serious accidents, physical assaults, and being threatened with a weapon (Hatch & Dohrenwend, 2007; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). However, both men and women who had experienced stressful events reported poorer health, but Taiwanese women reported a significantly better condition than men who had experienced the same situation. Annandale & Field, 2007 concluded that men and women are likely to experience psychological problems in different ways. Our finding confirms this notion. While women under stress tend to become anxious and depressed, men under stress are more likely to drink heavily, take drugs, or become physically abusive (Busfield, 2000; Jakupcak, Tull, & Roemer, 2005; Orth & Wieland, 2006). The social practices that undermine men's health are likely to be signifiers of masculinity and the tools that men use in the negotiation of social power and status (Courtenay, 2000). From this standpoint, we may speculate that Taiwanese men who have been threatened and robbed may suffer from psychological strain stemming from being deprived of control and self-esteem. The elevated likelihood of being involved in unhealthy activities after being deprived of social status eventually may erode their actual health.

However, many studies on posttraumatic stress have found that women are at higher risk for worse functioning and early psychological morbidity after a major trauma (Holbrook & Hoyt, 2004; Holbrook, Hoyt, & Anderson, 2001; Stein, Walker, & Forde, 2000). This inconsistency may be associated with the different types of traumas in these studies. Nevertheless, men and women differ in the types of traumatic and other stressful events they experience (Hatch & Dohrenwend, 2007). Women are more likely to report sexual traumas, such as molestation, rape, and abuse; or stressful events related to significant others (Hatch & Dohrenwend, 2007; Kessler et al., 1995). A better understanding of the impact of major stressful events in men and women will be an important component of efforts to improve gender differences in perceived health.

Third, although women in general reported poorer health than men, disabled men reported poorer health than did disabled women. Again, this difference may be because disability poses a barrier to men's socially expected gender role of having a career outside the family. Being disabled or unemployed may threaten a man's self-image as the man of the household. Men may feel that their disabilities deprive them of the chance to develop a good career, or they may feel that they are not as competitive as men without these disabilities. Women did not respond to disabilities as strongly as men did, possibly because their gender role orients them to the household and the family (Gilligan, 1993; Taylor, Gilligan, & Sullivan, 1995). Albrecht and Devlieger (1999) had reported that many people with serious and persistent disabilities report a good quality of life because they can maintain a harmonious set of relationships with their social contexts and external environments. Taiwanese women with serious or persistent disabilities may stay home, which does not conflict with their social role as a housewife. It may be easier for women to strike a balance among the body, mind, and spirit.

Fourth, although women were not found to be more influenced than men when providing long-term care of the disabled, women did perceive themselves as less healthy than men when intensive caretaking demands occurred. This reveals that women bear more responsibility for taking care of injured family members. In Taiwan, wives, daughters, and daughters-in-law make up 63% of the caretakers of handicapped/ill household members (Lin et al., 1995; Lu, 1999; Wu & Lin, 1999). This finding supports that Taiwanese women are more likely to shoulder the care-giving responsibilities in the family. The detrimental factor of household characteristics associated with women's perceived health had more to do with caring for the disabled and the injured. This finding confirms the finding of McDonough et al. (2002) that family demands are linked to health problems in women, but not in men.

We realize several limitations of this study, to name a few: (a) The findings based on cross-sectional data may raise the question of causation of individual and household characteristics on perceived health; (b) the measure of self-perceived health might involve other unknown

factors unrelated to health; (c) most of the respondents perceived their health to be good and fair, which may raise the issue of a "healthy sample" problem; (d) other measures of psychological strains that may be relevant to self-perceived health, such as work stress and family abuse, are not included. Finally, ordinal logistic regression assumes that all odds ratios are constant across all possible cut points of the outcome variable, which is also known as the parallel regression assumption (Long, 1997). Although the formal score test is available to test for the assumption, the adequacy of the test may be subject to the sample size (Scott, Goldberg, & May, 1997; Long, 1997). Moreover, it is also unclear if the formal score test is suitable for multilevel data. Based on Long (1997), we perform an informal test to informally assess the adequacy of parallel regression assumption at individual level. Caution is warranted.

Self-perceived health status makes up an important part of one's overall subjective perception of the quality of life. We hope to see future studies that include different measures of health, psychological strains, as well as contextual variables, such as neighborhoods characteristics (Stafford, Bartley, Mitchell, & Marmot, 2005), to ascertain the magnitude and pattern of the gender gap in health and to substantiate the findings of this study.

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Appendix

Logistic regressions on self-perceived health (95% CI of odds ratios)

Individual variables		Ordered OR	Interaction for women	OR (1 vs. 2 + 3)	Interaction for women	OR (1 + 2 vs. 3)	Interaction for women
Gender[Men]	Women	(0.402, 0.633)		(0.426, 0.694)		(0.423, 0.738)	
Employment status[No]	Business Owners/ self-employed	(1.437, 2.017)	(0.978, 1.694)	(1.129, 1.596)	(0.882, 1.598)	(2.133, 3.582)	(0.783, 1.784)
	Full-time employed	(1.484, 2.052)	(0.974, 1.569)	(1.182, 1.638)	(0.899, 1.501)	(2.257, 3.857)	(0.806, 1.642)
	Family employment	(0.841, 1.938)	(1.426, 3.670)	(0.648, 1.657)	(1.234, 3.563)	(1.093, 4.384)	(0.880, 3.998)
	Housework	(0.312, 1.558)	(1.426, 7.482)	(0.067, 1.128)	(1.601, 28.048)	(0.799,8.541)	(0.300, 3.365)
Personal income[Below 20K]	21–30K	(1.030, 1.308)		(1.011, 1.298)		(0.986, 1.532)	
	31–40K	(1.324, 1.720)		(1.355, 1.775)		(1.086, 1.832)	
	41–60K	(1.347, 1.785)		(1.385, 1.851)		(1.154, 2.182)	
	61–80K	(1.351, 1.925)		(1.365, 1.963)		(1.119, 3.029)	
	81K+	(1.213, 1.796)		(1.268, 1.897)		(0.845, 2.020)	
Year of education[Below 6 years]	7–9 Years	(1.172, 1.494)		(1.134, 1.442)		(1.045, 1.551)	
	10–12 Years	(1.252, 1.589)		(1.196, 1.518)		(1.205, 1.806)	
	13 Years+	(1.274, 1.674)		(1.184, 1.566)		(1.432, 2.401)	
Smoking[never-smoker]	Current smokers	(0.715, 0.872)		(0.716, 0.875)		(0.683, 1.0011)	
	Former smokers	(0.559, 0.747)		(0.541, 0.736)		(0.565, 0.977)	
Physical inactivity[No]	Yes	(0.657, 0.769)		(0.644, 0.755)		(0.666, 0.886)	
Disability[No]	Yes/not on welfare	(0.118, 0.274)	(1.199, 3.493)	(0.206, 0.489)	(0.714, 2.352)	(0.088, 0.192)	(1.409, 4.408)
	Yes/welfare	(0.064, 0.120)	(1.283, 3.346)	(0.127, 0.273)	(0.953, 2.943)	(0.069, 0.125)	(1.276, 3.261)
Perceived personal insecurity		(0.757, 0.818)		(0.750, 0.814)		(0.787, 0.897)	
Stressful events[No]	Yes	(0.405, 0.767)	(1.008, 2.341)	(0.477, 0.907)	(0.814, 1.995)	(0.247, 0.618)	(1.077, 3.841)

All models have been adjusted for control variables.

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