Obesity, Schooling and Health Knowledge: An Empirical Study of Taiwanese Women

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ABSTRACT

This paper sets out to examine the impacts of schooling and health knowledge on the level of obesity in Taiwan. The results obtained from a sample of Taiwanese females support the hypothesis of Grossman (1972, 1975), that schooling has a direct positive effect on health by reducing the likelihood of a person being obese. The awareness of obesity-disease and the intake of fiber are negatively associated with obesity; however, the observed schooling-obesity correlation cannot be attributed solely to any differences existing between the health knowledge and awareness of different individuals. Furthermore, in common with the developed nations, the stigma attached to the obesity of women is also found to be widespread within Taiwanese society.

Key Words: schooling, health knowledge, obesity, body weight perceptions

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1. INTRODUCTION

Over the past three decades, economists and health commentators alike have gained an increasing awareness of the importance of schooling on health behavior, with the positive correlation between health and schooling having been explained in a number of ways. Some have argued that schooling enhances health production, a causal relationship that runs from increases in schooling provision to general increases in health (Grossman, 1972, 1975; Taubman and Rosen, 1982; Berger and Leigh, 1989).

Grossman (1972) hypothesized that schooling increases the efficiency of household health production, an efficiency effect which can take either of two forms. Production efficiency pertains to a situation in which the better educated obtain a greater health output from a given set of healthy inputs. Allocative efficiency pertains to a situation in which schooling increases information about the true effects of healthy inputs. For example, the better educated may have more detailed knowledge about the harmful effects of cigarette smoking, heavy drinking or obesity (Grossman, 2000).

Others have asserted that one or more ‘third variables’, such as unobserved genetic characteristics, or rate of time discount, can affect both health and schooling in the same direction. Fuchs (1982) argued that individuals with a higher rate of time preference are more likely to attend school for longer periods and make greater investments in their personal health. The Fuchs (1982) study on time preference, along with studies by Farrell and Fuchs (1982) and Sander (1998) on smoking, provide support for this viewpoint.

Ability and health endowments can be regarded as a further source of self-selection since those individuals with higher abilities, or those with a greater health endowment, may receive more schooling, and thereby improve their personal health behavior. In Berger and Leigh (1989), Sander (1995a, 1995b) and Leigh and Dhir (1997), schooling was treated as an endogenous variable in the health equation and a two-stage model was used to identify the effects of schooling on health behavior. Behrman and Wolfe (1989) also used childhood background factors to control for unobserved components. The results of each of these studies are, nevertheless, consistent with the hypothesis that schooling is a causal factor of health, as opposed to the third variable explanation.

Other studies point to reverse causality, arguing that better health results in more schooling (Edwards and Grossman, 1979; Perri, 1984; Wolfe, 1985); the suggestion is that healthier people may be more efficient in terms of enhancing their stock of knowledge. In this case, in the absence of controls for past health, the positive relationship between health and schooling may indeed reflect reverse causality.

Nevertheless, a number of other studies have hypothesized that by improving an individual's health knowledge, schooling improves allocative efficiency (Kenkel, 1990, 1991; Variyam, et al., 1996). These studies explored the effects of schooling and health knowledge on a variety of health behaviors and outcomes. Examples include the consumption of cigarettes and alcohol and the propensity for exercise (Kenkel, 1991), smoking (Hsieh, et al., 1996; Jones and Kirigia, 1999) and dietary fiber or other nutritional intake (Ramezani and Roeder, 1995; Variyam, et al., 1996). Kenkel (1991) found that both schooling and health knowledge reduced the uptake of smoking and heavy drinking, whilst also increasing the amount of exercise that a person would tend to engage in.

After taking into consideration the differences in health knowledge amongst individuals, the effects of schooling on health behavior nevertheless remain. Hsieh et al. (1996) suggested that health knowledge has a negative effect on the likelihood of a person participating in smoking and, as such, education should be considered as an effective channel for expanding health knowledge. Ramezani and Roeder (1995) concluded that nutritional intake was predicated by the important prerequisites of nutritional knowledge and education. Similarly, Variyam, et al. (1996) suggested that information on nutrition has a positive effect on the amount of fiber consumed, thus confirming that by enhancing the level of available information, education exerts a sizable effect on nutritional intake.

Focusing on the relatively neglected, but nevertheless important, health issue of obesity, Nayga (2000a, 2001) revisited the issue of the effects of schooling on health, by examining the relationship between obesity, schooling and health knowledge. In contrast to Kenkel's (1991) findings, Nayga (2000a) concluded that the association between schooling and obesity was mainly attributed to differences in health knowledge amongst individuals. However, using different methodologies, Nayga (2000b, 2001) also provided support for the Grossman hypothesis, that schooling does have a direct positive effect on health by reducing the prospects of a person becoming obese.[1]

To our knowledge, no research has yet been undertaken on the relationship between schooling and obesity outside of the United States. Therefore, using a sample of Taiwanese females, this empirical work sets out to separate the estimated effects on obesity from schooling, and from health knowledge. In addition to the two measures of obesity constructed by the clinical records of body weight, the body mass index (BMI), and an obesity dummy, our respondents' own perceptions of obesity are also included in our analysis. The specific hypothesis to be tested is that schooling improves allocative efficiency, that is, the choice of health inputs, by improving the health knowledge of individuals.

The empirical results suggest that schooling and health knowledge do have strong

[1] One of the most striking facts about obesity in the medical literature is the inverse relationship existing between obesity and socioeconomic status amongst women in developed countries (Sobal and Stunkard, 1989; Jeffery, 1996); furthermore, related studies have assessed socioeconomic status using a variety of indicators, most frequently income or education (Gutiérrez-Fisac, *et. al.*, 1996; Young, 1996; Molarius, *et. al.*, 2000).

negative effects on obesity. They show that in a comparison between those educated to either senior high school or college graduate level, and those of lower levels of education, those with the higher education levels were less likely to be obese. This study supports the Grossman (1972, 1975) hypothesis that schooling leads to a reduction in obesity by increasing the production of health, or the pursuit of a healthy lifestyle. Therefore, any policies which set out with the aim of enhancing investment in education and the promotion of health knowledge are likely to reduce the incidence of obesity.

The remainder of this paper is organized as follows. The next section describes the data and measures used in this study, whilst the presentation of the BMI distribution amongst Taiwanese women, along with their weight perceptions, are provided in the subsequent section. The penultimate section describes the empirical model and results, followed in the final section, by the conclusions drawn from this study.

2. DATA AND MEASURES

The data used in this study are taken from a survey of health behavior in Taiwan, carried out at the Mackay Memorial Hospital in Taipei. The target sample comprised of all females aged 40 or older participating in the adult physical examination provided by the Bureau of National Health Insurance, Taiwan, from July 2001 to December 2001.

The questionnaire for completion by the respondents covered socio-demographic characteristics and parental characteristics, as well as perceptions of body weight and health knowledge. In order to avoid the possibility of reporting bias resulting from respondents' self-reported height and weight, these measures were obtained from clinical records. The original data comprised of 968 observations, but after excluding all individuals with incomplete information on key variables, we were left with a total of 918 valid observations for analysis.

We examine the representative nature of our data by measuring the percentages of females across different age groups. According to the 2001 Taiwan Demography Quarterly, for the total female population aged 40 years or older, the proportion of females in the 40-49 age group was 44 per cent, whilst the 50-59 age group accounted for 24 per cent, the 60-69 age group 18 per cent, and those aged 69 years or above accounted for 15 per cent. The corresponding figures for the same age groups in our sample were 46 per cent, 32 per cent, 16 per cent and 6 per cent, which indicates that with regard to age distribution, our sample is largely representative of the Taiwanese female population.

Body Mass Index (BMI) and Obesity

Two measures of obesity are used in this study, the body mass index (BMI) and an obesity dummy. The BMI is the standard measure of obesity invariably adopted within the literature, and is calculated as a person's weight in kilograms divided by the person's height squared, in meters (kg/m^2). According to the guidelines provided by the Department of Health in Taiwan, the standard BMI is 22, indicating that the medically-determined 'ideal weight' is calculated by height squared in meters, multiplied by 22 (m^2 x 22). Obesity is represented in this study by a binary variable which takes the value of 1 if the respondent is obese, otherwise 0.

A person is defined as being overweight if body weight is more than 10 per cent above the prescribed 'ideal weight', whilst an obese person is one whose body weight is more than 20 per cent above their 'ideal weight'. More specifically, a BMI ranging from 24.2 to 26.4 is defined as 'overweight', whilst the determinant of 'obesity' is a personal BMI which is greater than 26.4.[2] Since our measures of height and weight are

[2] See Department of Health , Taiwan (2002): http://www.bhp.doh.gov.tw

taken from clinical records, errors arising from respondents' subjective evaluations are eliminated.[3] One of the advantages of our survey is the inclusion of both weight perceptions and the BMI indicator, which enables us to simultaneously examine individual characteristics, in terms of the perception of obesity, alongside clinically-defined obesity.

Perception of Obesity

The perception of personal body weight was assessed by asking participants to assess their own body size in relation to their personally-determined ideal weight. The following responses were provided for this personal weight assessment: (1) 'very underweight'; (2) 'underweight'; (3) 'about the ideal weight'; (4) 'slightly overweight'; and (5) 'very overweight'. The *perception of obesity* variable was measured as 1 if the respondent perceived herself as being 'very overweight', otherwise 0.

In order to explore to what extent individuals have inaccurate perceptions of their body size, we constructed two measures of inaccurate perception: (i) *obese but not perceived as obese*; and (ii) *not obese but perceived as obese*. The former was measured as 1 if the respondent was obese, but did not perceive herself as being very overweight, otherwise 0; the latter was measured as 1 if the respondent was not obese, but perceived herself as being very overweight, otherwise 0.

Health Knowledge

The measure of health knowledge is constructed in a manner similar to Kenkel (1991) and Nayga (2000a, 2001).[4] The health knowledge measure, which assesses obesity-disease relationships, was constructed from the following question: "Have you heard

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3 Cawley (2001) discussed the extent of reporting errors in weight and height in the National Longitudinal Survey of Youth (NLSY).

4 Kenkel (1991) used the number of illnesses the respondent correctly believes are related to cigarette smoking and heavy drinking as measures of health knowledge. Following a similar approach, Nayga (2000a, 2001) used diet-disease knowledge as a determinant of obesity.

about any health problems that might be related to obesity?” The ten health problems included cardiovascular disease, stroke, osteoporosis, gall bladder stones, hyperlipidemia, diabetes mellitus, nephritis, osteoarthritis, gastric ulcers and migraine. For each question, the respondent was simply required to answer ‘yes’, ‘no’ or ‘don’t know’; each correct answer was given a value of 1, each incorrect or uncertain answer was given a value of 0. The *health knowledge* variable was subsequently calculated based on correct responses, ranging from 0 to 10; the more points that a respondent accumulated, the higher the respondent’s awareness of obesity-disease relationships.

Socio-demographic Variables

Socio-demographic variables collected in the survey include age, gender, marital status, education level, employment status, occupation level and personal disposable income. With the exception of income, all of the socio-demographic variables are categorically constructed. We use three age dummies, 50-59, 60-69 and 70 or over, and a reference group, which is those people below the age of 50.

Marital status was defined as 1 if the respondent was married, otherwise 0. We created dummy variables for three different education levels according to individual years of schooling completed: *junior high school*, *senior high school* and *college (or above)*. The reference group is those people with only elementary education. The variable *Housewives* was defined as 1 if the respondent was a housewife or unemployed, otherwise 0.

At the occupation level, *white-collar* workers were defined as 1, and *blue-collar* workers as 0. The measure of the *log personal income* variable is the logarithm of personal monthly income (or retirement payment and income from family members) in NT$ thousands.[5]

[5] For respondents who are retired workers, housewives or unemployed, we use monthly retirement payment or income from family members as a proxy for personal income.

Parental Mortality and Diseases

Parental mortality was measured as 1 if the respondent's father or mother had died; otherwise 0. The *father died* variable identified those respondents whose father had died, whilst the *mother died* variable identified those respondents whose mother had died.

Survey participants were also asked if their parents had suffered from any of the following eight diseases: asthma, diabetes mellitus, gastric or duodenal ulcer, heart disease, hepatitis, hyperlipidemia, hypertension or thyroid disease. The respondents were simply required to answer 'yes' or 'no' to these sub-questions. The variables, *father's diseases* and *mother's diseases* were measured as the sum of these eight diseases which, from the respondents' own judgment, their parents suffered from.

Health Behavior

Six types of health behavior were examined in this study. The measure for exercise was assessed from the respondents' own indication of how often they take exercise. *Exercise* was measured as 1 if a respondent had exercised more than once in the past week, otherwise 0. *Smoke* was measured as 1 if the respondent was a current smoker, otherwise 0. *Drink* was measured as 1 if the respondent was an occasional or regular drinker, otherwise 0. *Breakfast* was measured as 1 if the respondent was in the habit of eating breakfast on a daily basis, otherwise 0. *Fiber intake* was assessed by asking participants if they regularly ate at least three portions of vegetables and two fruits each day, and was measured as 1 if the respondent had a normal fiber intake, otherwise 0. Sleep duration was assessed by asking participants what time they arose each morning, and what time they would normally go to bed. *Sleep* was measured as the number of hours sleep per day.

BMI and Body Weight Perceptions

In order to describe the sample, BMI values were grouped into the following three classifications using the reliable heights and weights of responding participants: <24.2 (normal or below), 24.2-26.4 (overweight) and >26.4 (obese). As Table 1 shows, more than one third of the responding females had a BMI of >24.2. Of all the survey respondents, 19.3 per cent were considered to be overweight (a BMI of 24.2-26.4), and 15.4 per cent were considered to be obese (a BMI of >26.4).

As the table clearly shows, those respondents with BMI scores of less than 24.2 had the highest number of years of schooling (10.5 years); those respondents who were considered to be overweight had an average of 9.2 years of schooling, whilst those considered to be obese had an average of 7.5 years of schooling. Only 7.6 per cent of those females who were classified as obese, were college graduates, as compared to the 24.6 per cent of respondents at, or below, the normal BMI range, with a college education (or above). This suggests an inverse relationship between education and body weight. Amongst the three BMI classifications, subjects with a BMI of less than 24.2 also had the highest scores in terms of obesity-disease knowledge.

With regard to personal perceptions of body weight, almost half of the women in our study were concerned about being overweight. Although 39.3 per cent of all survey respondents described themselves as being ‘slightly overweight’, a further 9.6 per cent of the total sample saw themselves as being ‘very overweight’.

A somewhat surprising finding was that alongside an increase in the number of years of schooling, there was a corresponding increase in the perception of excess body weight. Those respondents who assessed their own body size as being either at, or below, their ideal body weight, had the lowest number of years of schooling. Compared with the 17.9 per cent of the sample with a college education (or above), about a quarter of all respondents who perceived themselves as being ‘slightly overweight’ or ‘very overweight' were college graduates. Since obesity amongst women is socially stigmatized in the developed nations, this indicates that Taiwanese women appear far more ready to accept such a social stigma.[6]

A comparison between the BMI and weight perceptions reveals some interesting findings. As Table 2 shows, 45.8 per cent of all respondents have inaccurate weight perceptions; whilst 8.5 per cent of those respondents with a BMI greater than 26.4 did not perceive themselves as being obese, a further 5.2 per cent of respondents did perceive themselves as obese, even though they were not. Moreover, 6.3 per cent of all respondents with a BMI of 24.2-26.4, described themselves as being neither overweight nor obese, whilst around 25.8 per cent of respondents perceived themselves as being overweight, and a further 1.9 per cent perceived themselves as obese, even though, by the strict definition, they were not. In other words, around 28 per cent of all females who were dissatisfied with their current weight believed that they were too heavy. These results are generally consistent with the evidence found in the developed countries (Falon and Rozin, 1985; Sobal and Stunkard, 1989).

3. THE EMPIRICAL MODEL AND RESULTS

The household production model introduced by Becker (1965) and Grossman (1972) provided the conceptual framework for the economic analysis of health inputs and outcomes (Pitt and Rosenzweig, 1985; Behrman and Deolalikar, 1988; Variyam, et al., 1996). The reduced-form demand function for health outcomes can be written as:

$$Y = f(S, K, X, e) \qquad (1)$$

[6] A number of studies highlight the concerns amongst women about being overweight. For example, Falon and Rozin (1985) found that college women in the United States judged their appearance as being far heavier than their ideal appearance. Jeffery and French (1996) also showed that women of lower socioeconomic status expressed less concern about their weight. Jeffery, et al. (1984) and Biener and Heaton (1995) also suggested that a substantial proportion of normal-weight women had been on weight loss diets.

where Y is the health outcome measured as obesity, S is the level of education, K is the level of obesity-disease knowledge, X is a vector of observable characteristics and e represents the unobservable determinants of obesity. The vector of X includes the incidence of exercise, smoking and drinking, the habit of eating breakfast, fiber intake, sleep duration, employment status and occupation level.

Variable definitions and summary statistics are reported in Table 3. For the model with BMI (the continuous variable) as the dependent variable, the ordinary least squares (OLS) estimation method was adopted. The White (1980) heteroskedastic-consistent covariance matrix is used, since heteroskedasticity arises primarily in the analysis of cross-section data (Greene, 1993). In the model with obesity, the probit estimation method was adopted for the perception of obesity – or the inaccurate perception (the binary variable) as the dependent variable.

Table 4 presents the results of the BMI and obesity regressions. The first three columns report the OLS estimates of the BMI regressions, whilst the last three columns report the probit estimates of obesity regressions. The first and fourth columns provide the results of the regression with only the socio-demographic variables and parental characteristics as regressors. The second and fifth columns provide the results of the regressions with the health knowledge variable included. In the third and sixth columns, both health knowledge and health behavior variables are included as regressors. As column 1 (or column 4) shows, schooling has a statistically significant negative effect on obesity. As compared to those with lower levels of education, senior high school and college graduates were less likely to be obese.[7] This result is consistent with the findings in the related literature, indicating that those with higher levels of education are more efficient producers of health, i.e., that they pursue a healthier lifestyle.

[7] It is possible that schooling may be an endogenous variable; however, due to lack of high quality instruments, we are unable to control for this issue of endogeneity.

Column 2 (or column 5) shows that although there is a fall in the magnitude of the senior high and college graduate dummies when the health knowledge variable is included, it nevertheless remains statistically significant. This result indicates that the effect of schooling, i.e., a reduction in the probability of being obese, is not caused by individual differences in health knowledge. Indeed, since information on the negative impacts of obesity is ubiquitous, it is not clear whether there is a major information advantage to better educated women. However, a negative schooling effect could still exist through other mechanisms such as culture or social norms.

The significant negative correlation between health knowledge and obesity suggests that the awareness of obesity-disease relationship does reduce the likelihood of obesity. These results are similar to the findings of Nayga (2000a, 2001) and provide support for the theory that the provision of diet-disease knowledge is a useful tool with regard to reducing the incidence of obesity. The BMI regressions indicate that older, married women appear to carry more excess weight than young, single women, although the relationship between the two variables and obesity is weakened in the obesity regressions. There is also evidence of a negative income effect on obesity, but the variable is not statistically significant.[8] These results suggest, therefore, that in terms of the correlation with health, schooling is more important than income.

Our results also support the inverse relationship between socioeconomic status and obesity among Taiwanese women, which is consistent with the evidence found in the developed countries (Sobal and Stunkard, 1989; Stunkard and Sørensen, 1993; Gutiérrez-Fisac, et al., 1996; Young, 1996; Goodman, 1999). With the exception of fiber

[8] In order to avoid the potential correlation between personal income and schooling, family income during childhood is a better control in the BMI and obesity regressions; however, this variable is not available in the survey. Since about 46 per cent of the respondents were retired workers, housewives or unemployed women, we used monthly retirement payment or income from family members as a proxy for personal income. In this case, we can therefore say that personal income is measured as family income.

intake, all the health behavior variables are insignificantly correlated with obesity; lower fiber intake is associated with both a higher BMI level and obesity.[9]

Since the *health knowledge* variable is a potentially endogenous variable, an instrumental variable (IV) method is also used to estimate the BMI and obesity regressions. The socio-demographic variables, subjective health status, health behavior, personal health history and the health history of the respondent's father and mother, are all treated as instruments for health knowledge. As predicted, those females with higher levels of education were more likely to be aware of the association between obesity and disease, which is consistent with the findings of most of the related studies (Kenkel, 1991; Hsieh, et al., 1996; Variyam, 1996).

After treating the *health knowledge* variable as endogenous in the BMI and obesity regressions, the effects of schooling on obesity nevertheless remain, which suggests that the observed schooling-obesity correlation is due primarily to the direct effects of schooling, rather than any specific effects of health knowledge. The differences between these two specifications, based on the Hausman test, are not statistically significant; therefore, health knowledge is not treated as an endogenous variable. We do not report the IV estimation results here, purely for the purpose of saving space.

Table 5 presents the results of the respondents' perceptions of personal body weight. The first two columns report the regressions on the perception of obesity, the second two columns report the regressions on those who are obese but have a personal perception of not being obese, and the last two columns present the regressions on those who are not obese, but have a personal perception of being obese. Columns 1 and 2 show that health knowledge has an insignificantly positive effect on the perception of

[9] The respective proportions of current smokers and occasional or regular drinkers in our sample were only 4 per cent and 10 per cent, which may lead to a weaker association between the two health behavior variables and obesity.

obesity. Female white-collar workers, and those with junior high school education, are more likely to describe themselves as being very overweight; however, there appears to be no substantial age difference involved in people's perception of obesity. The income effect is also quite small. Similarly, fiber intake is negatively associated with the perception of obesity.

In the last four columns of Table 5, we further examine the individual characteristics of inaccurate weight perceptions. The third and fourth columns show that older women tend not to perceive themselves as obese, even in cases where they clearly are. In contrast, those females educated to higher levels, and those who are more aware of the health hazards of obesity, are less likely to make such an incorrect judgment. In the last two columns of Table 5, the positive effect of health knowledge and schooling on the binary dependent variable confirms our previous findings that females with better schooling and higher knowledge are more likely to perceive themselves as being obese even when they are not. It appears that schooling may be related to obesity partly for reasons unrelated to health concerns. One possible explanation is that the stigma attached to obesity varies across socioeconomic groups. Since the desire for an unrealistically slim appearance has been promoted widely by the media and fashion industries, the powerful societal pressure for slimness and the pervasive stigmatization are somewhat stronger for educated women. Body weight may also be highly correlated with self-esteem amongst educated women.[10] This finding is consistent with the evidence found in developed societies, which suggests a stronger relationship between pressure for slimness and socioeconomic status amongst women (Fallon and Rozin, 1985; Sobal and Stunkard, 1989). These results continue to hold

[10] Harper (2000) suggested that social norms, with regard to whether one was considered as being overweight, are based on relative weight criteria. If better-educated women compare themselves to other women with similar education levels, it is of little surprise that the highly-educated are more likely to perceive themselves as being obese, even though they are not.

when health knowledge is treated as an endogenous factor.

Table 6 reports the marginal effects of the key variables in Tables 4 and 5. The marginal value for health knowledge in the obesity regression was about –2.4 per cent. Respondents with college education had a lower probability of being obese, by around 10.2 per cent, whilst those individuals who had a normal fiber intake reduced the likelihood of being obese by around 5.4 per cent. The marginal value of health knowledge within the model with ‘not obese but perceived as obese’ as the dependent variable was -0.7 per cent, whilst college graduation raised the probability of a woman perceiving herself as being obese, even if she was not, by around 4.3 per cent.

To summarize, the results presented here are generally consistent with the evidence found in the United States by Nayga (2000a, 2001). This study suggests that highly-educated and highly-knowledgeable females are less likely to be obese but more likely to perceive themselves as being obese even though they may not be. In contrast, older women, with lower levels of education and lower awareness of obesity-disease, are more likely to perceive themselves as not being obese, even though they are. Amongst all of the health behavior variables, fiber intake is found to be the most important determinant of obesity.

4. CONCLUSIONS

This paper examines the individual characteristics of obesity, and the general perception of obesity in Taiwan. Consistent with the findings in the developed countries, in this study of Taiwanese women, we find an inverse relationship between socioeconomic status and obesity. The probability of obesity is higher amongst those who are married, amongst those with lower levels of education and obesity-disease knowledge, and amongst those whose fiber intake levels are lower.

These findings have important public health implications. According to a nationally representative Nutrition Survey in Taiwan, the proportion of obese Taiwanese women in 1996 was about 18 per cent, whilst the prevalence of obesity among Taiwanese women aged 40 years or older was about 21 per cent. Since excess body weight is closely associated with the incidence of many chronic diseases, such as hypertension, cardiovascular diseases and diabetes mellitus, the incidence of socioeconomic differences in cases of obesity is likely to contribute to subsequent inequalities in health. There is, therefore, a strong need for greater intervention, in terms of education about ideal weight levels and obesity, which should be targeted at females with a lower socioeconomic status.

It is noteworthy that around 46 per cent of women have inaccurate weight perceptions; of these, around 9 per cent of respondents with a BMI greater than 26.4 do not perceive themselves as being obese. There are also around 5 per cent of the respondents who perceived themselves as being obese, even though they are not. Amongst all respondents with inaccurate perceptions of their personal body weight, more than half of the group with a BMI which was either at, or below, the normal range, described themselves as being either overweight or obese. This indicates that the pervasive stigma attached to obesity, which is common in the developed nations, is also prevalent in Taiwanese society, where the general perception of the ideal female figure is one of a woman who is significantly slimmer than the theoretically-constructed female, based on the clinical definition of the BMI.

From a policy standpoint, this means that public health information needs to send out a clear message, that weight loss is not recommended for people of normal weight, and that weight loss practices amongst normal-weight individuals may expose them to unnecessary health risks. Furthermore, it is of considerable interest to note that better-educated and highly-knowledgeable individuals are more likely to perceive themselves as being obese, even when they are not. This implies that the powerful societal pressure for slimness, as well as the pervasive stigmatization, is relatively stronger for educated women, which is consistent with the evidence found in the developed societies.

Our study indicates that both schooling and health knowledge have strong negative effects on obesity, with the results supporting the Grossman hypothesis, that schooling has a direct positive effect on health through a reduction in the prevalence of obesity. This implies that the effects of schooling on obesity cannot be attributed solely to the differences in health knowledge amongst individuals.

The results also suggest that an increase in expenditure on general education and the provision of diet-disease health knowledge could be regarded as an appropriate policy for the effective reduction of obesity levels within society as a whole. Although our findings are generated from a sample of females in Taiwan, the results should serve as a useful benchmark for future studies aimed at assessing obesity levels and general weight perceptions in other countries.

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Table 1 Schooling and Knowledge Scores by Body Mass Index (BMI) and Weight Perceptions

Actual BMI categories	N	%	Years of schooling	% who are college graduates	Knowledge scores
< 24.2 (normal or below)	622	67.8	10.5	24.6	5.47
24.2 – 26.4 (overweight)	177	19.3	9.2	20.9	5.42
>26.4 (obesity)	119	15.4	7.5	7.6	4.56
Weight perceptions	**N**	**%**	**Years of schooling**	**% who are college graduates**	**Knowledge scores**
Below or equal ideal weight (perceptions of normal weight or underweight)	469	51.1	9.1	17.9	5.01
Slightly overweight (perceptions of overweight)	361	39.3	10.6	25.8	5.64
Very overweight (perceptions of obesity)	88	9.6	10.6	25.0	5.69

Table 2 BMI and Weight Perceptions

	Weight perceptions		
	Below or equal ideal weight (perceptions of normal weight or underweight)	Slight overweight (perceptions of overweight)	Very overweight (perceptions of obesity)
Actual BMI categories			
<24.2 (normal or below)	368 (40.1)	237 (25.8)	17 (1.9)
24.2-26.4 (overweight)	58 (6.3)	89 (9.7)	30 (3.3)
>26.4 (obesity)	43 (4.7)	35 (3.8)	41 (4.5)

Table 3 Variable Definitions and Summary Statistics

Variable	Definition	Mean (std. dev.)
BMI and weight perceptions		
Body mass index	Weight divided by height squared (kg/m^2).	23.18 (3.06)
Obesity	1 if respondent is obese; 0 otherwise.	0.13 (0.34)
Perception of obesity	1 if respondent perceives herself as very overweight; 0 otherwise.	0.19 (0.39)
Obese but not perceives obese	1 if respondent is obese but not perceives herself as very overweight.	0.09 (0.28)
Health knowledge	The sum of correctly answered obesity-disease questions (range 0-10).	5.34 (1.74)
Sociodemographic variables		
Age 50-59	1 if respondent age 50-59; 0 otherwise.	0.32 (0.47)
Age 60-69	1 if respondent age 60-69; 0 otherwise.	0.16 (0.36)
Age above 69	1 if respondent age above 69; 0 otherwise.	0.06 (0.24)
Junior high	1 if respondent's education level is junior high school; 0 otherwise.	0.15 (0.36)
Senior high	1 if respondent's education level is senior high school; 0 otherwise.	0.27 (0.44)
College	1 if respondent's education level is junior college, university or graduate school; 0 otherwise.	0.22 (0.41)
Marital status	1 if respondent is married; 0 otherwise.	0.73 (0.44)
Log personal income	Log (personal monthly income) (NT$1000s).	2.46 (1.43)
Housewives	1 if respondent is a housewife or unemployed; 0 otherwise.	0.46 (0.50)
White-collared	1 if respondent is a white-collared worker; 0 otherwise.	0.19 (0.39)
Parental mortality and diseases		
Father died	1 if respondent's father has died; 0 otherwise.	0.66 (0.47)
Mother died	1 if respondent's mother has died; 0 otherwise.	0.46 (0.50)
Father's diseases	Sum of eight diseases the respondent's father has (range 0-8).	0.78 (1.09)
Mother's diseases	Sum of eight diseases the respondent's mother has (range 0-8).	0.86 (1.17)
Health behaviors		
Exercise	1 if respondent exercises more than once in the past week; 0 otherwise.	0.28 (0.45)
Smoke	1 if respondent is a current smokers; 0 otherwise.	0.04 (0.20)
Drink	1 if respondent is an occasional or regular drinkers; 0 otherwise.	0.10 (0.30)
Breakfast	1 if respondent eats breakfast every day; 0 otherwise.	0.57 (0.50)
Fiber intake	1 if respondent eats at least three plates of vegetables and two fruits every day; 0 otherwise.	0.35 (0.48)
Sleep	Hours of sleep per day.	7.60 (1.13)

Table 4 Actual BMI and Obesity (OLS or Probit Model)

	BMI			Obesity		
	w/o health knowledge and health behaviors	w/ health knowledge	w/ health knowledge and health behaviors	w/o health knowledge and health behaviors	w/ health knowledge	w/ health knowledge and health behaviors
Constant	23.071	23.727	24.072	-1.0302	-0.4082	0.0505
	(54.64)***	(47.54)***	(28.89)***	(-4.30)***	(-1.37)	(0.10)
Health Knowledge		-0.1479	-0.1308		-0.1422	-0.1361
		(-2.45)**	(-2.16)**		(-3.60)***	(-3.38)***
Junior high	-0.3076	-0.2600	-0.2634	-0.0983	-0.0664	-0.0745
	(-1.01)	(-0.86)	(-0.87)	(-0.63)	(-0.42)	(-0.47)
Senior high	-1.2435	-1.1431	-1.1461	-0.5302	-0.4602	-0.4753
	(-4.55)***	(-4.15)***	(-4.16)***	(-3.33)***	(-2.83)***	(-2.86)***
College	-1.1774	-1.0256	-1.0151	-0.7032	-0.5850	-0.5877
	(-3.88)***	(-3.32)***	(-3.30)***	(-3.62)***	(-2.94)***	(-2.94)***
Age 50-59	0.4830	0.4589	0.6017	0.0792	0.0465	0.1250
	(2.04)**	(1.94)**	(2.50)***	(0.56)	(0.33)	(0.85)
Age 60-69	1.3282	1.3200	1.5080	0.2012	0.1840	0.2743
	(3.93)***	(3.91)***	(4.42)***	(1.12)	(1.01)	(1.46)
Age above 69	0.3965	0.3647	0.5762	0.3648	0.3291	0.4472
	(0.84)	(0.77)	(1.22)	(1.58)	(1.40)	(1.86)*
Marital status	0.5412	0.5601	0.6619	0.1483	0.1602	0.2132
	(2.42)**	(2.51)**	(2.93)***	(1.13)	(1.21)	(1.55)
White-collared	-0.0199	0.0260	0.0835	-0.0856	-0.0668	-0.0272
	(-0.07)	(0.09)	(0.28)	(-0.43)	(-0.33)	(-0.13)
Housewives	-0.1694	-0.1631	-0.1252	0.0204	0.0356	0.0874
	(-0.69)	(-0.67)	(-0.51)	(0.15)	(0.26)	(0.62)
Log personal income	-0.0957	-0.0907	-0.0826	-0.0798	-0.0736	-0.0704
	(-1.15)	(-1.09)	(-1.00)	(-1.76)*	(-1.60)	(-1.51)
Father died	0.1373	0.1241	0.1339	0.0077	-0.0028	0.0145
	(0.60)	(0.55)	(0.59)	(0.06)	(-0.02)	(0.10)
Mother died	0.2925	0.3067	0.3471	0.1500	0.1551	0.1636
	(1.30)	(1.36)	(1.54)	(1.16)	(1.18)	(1.22)
Father's diseases	-0.0306	-0.0140	0.1174	-0.0039	0.0127	-0.0043
	(-0.30)	(-0.13)	(1.23)	(-0.06)	(0.19)	(-0.06)
Mother's diseases	0.0899	0.1247	-0.0396	0.0595	0.0934	0.0917
	(0.95)	(1.30)	(-0.39)	(1.02)	(1.57)	(1.50)
Exercise			-0.0685			-0.2138
			(-0.30)			(-1.52)
Smoke			0.1160			0.0103
			(0.23)			(0.03)
Drink			0.4336			0.0306
			(1.26)			(0.15)
Breakfast			-0.2921			-0.1101
			(-1.41)			(-0.91)
Fiber intake			-0.6187			-0.3116
			(-2.98)***			(-2.43)***
Sleep			-0.0384			-0.0538
			(-0.45)			(-1.07)
R^2	0.10	0.11	0.12			
Log-likelihood				-324.30	-317.39	-311.68
Estimation	OLS	OLS	OLS	Probit	Probit	Probit

Note: Figures in parentheses are t-statistics. ***, **, and * represent statistically significance at 1%, 5% and 10% levels respectively.

Table 5 Perception of Obesity and Inaccurate Weight Perceptions (Probit Method)

	Perception of obesity		Obese but not perceived as obese		Not obese but perceived as obese	
	w/o health behaviors	w/ heath behaviors	w/o health behaviors	w/ heath behaviors	w/o health behaviors	w/ heath behaviors
Constant	-1.6640	-1.5289	-0.6359	-0.3515	-2.7801	-2.8526
	(-5.46)***	(-3.02)***	(-1.81)*	(-0.61)	(-6.74)***	(-4.41)***
Health knowledge	0.0308	0.0378	-0.1727	-0.1652	0.0944	0.0975
	(0.86)	(1.04)	(-3.51)***	(-3.31)***	(2.17)**	(2.20)**
Junior high	0.3867	0.408	-0.1519	-0.1732	0.6976	0.7094
	(2.18)**	(2.28)**	(-0.84)	(-0.94)	(2.69)***	(2.73)***
Senior high	0.0821	0.0869	-0.5612	-0.5781	0.4570	0.4538
	(0.48)	(0.50)	(-2.78)***	(-2.82)***	(1.84)*	(1.82)*
College	0.1015	0.0813	-0.6131	-0.5985	0.5910	0.5741
	(0.54)	(0.43)	(-2.43)**	(-2.37)**	(2.28)**	(2.21)**
Age 50-59	0.0029	0.0668	0.1104	0.1570	0.0029	0.0235
	(0.02)	(0.46)	(0.64)	(0.89)	(0.02)	(0.13)
Age 60-69	0.1056	0.1819	0.3066	0.3675	0.2615	0.2956
	(0.51)	(0.85)	(1.49)	(1.74)*	(0.92)	(1.03)
Age above 69	-0.3272	-0.2447	0.5822	0.6677	-0.0299	-0.0034
	(-0.91)	(-0.67)	(2.30)**	(2.59)***	(-0.06)	(-0.01)
Marital status	0.0347	0.0512	0.1140	0.1701	-0.1320	-0.1229
	(0.25)	(0.36)	(0.75)	(1.08)	(-0.77)	(-0.70)
White-collared	0.2953	0.3493	-0.3633	-0.3393	0.3953	0.4404
	(1.71)*	(1.97)**	(-1.20)	(-1.10)	(1.84)*	(2.01)**
Housewives	0.1263	0.1709	0.1481	0.1914	0.3897	0.4217
	(0.83)	(1.09)	(0.96)	(1.19)	(1.89)*	(1.99)**
Log personal income	-0.0402	-0.0395	-0.0300	-0.0256	0.0301	0.0307
	(-0.82)	(-0.79)	(-0.58)	(-0.49)	(0.48)	(0.48)
Father died	0.0076	0.0136	-0.0530	-0.0265	-0.0158	-0.0202
	(0.06)	(-0.10)	(-0.30)	(-0.15)	(-0.10)	(-0.12)
Mother died	-0.1283	-0.1068	0.1695	0.1753	-0.3694	-0.3497
	(-0.93)	(-0.76)	(1.09)	(1.11)	(-2.01)**	(-1.88)*
Father's diseases	0.0472	0.0396	-0.0174	-0.0301	0.0554	0.0509
	(0.82)	(0.68)	(-0.20)	(-0.35)	(0.83)	(0.75)
Mother's diseases	0.0336	0.0492	0.0804	0.0707	-0.0289	-0.0165
	(0.63)	(0.91)	(1.07)	(0.92)	(-0.45)	(-0.25)
Exercise		-0.2285		-0.0936		-0.0934
		(-1.52)		(-0.59)		(-0.50)
Smoke		-0.5036		0.2974		-0.4411
		(-1.34)		(0.89)		(-0.91)
Drink		-0.0204		0.0243		-0.0457
		(-0.10)		(0.10)		(-0.18)
Breakfast		-0.1313		-0.1182		-0.1688
		(-1.06)		(-0.82)		(-1.10)
Fiber intake		-0.2239		-0.2115		-0.0954
		(-1.67)*		(-1.45)		(-0.57)
Sleep		-0.0081		-0.0385		0.0219
		(-0.16)		(-0.66)		(0.33)
Log-likelihood	-281.02	-276.19	-226.74	-224.32	-167.87	-166.27

Note: See Table 4.

Table 6 Marginal Probabilities for Key Variables in Probit Models

Probit Model	Variable		
	Health knowledge	College	Food intake
Obesity	-0.024	-0.102	-0.054
Perception of obesity	0.006	0.013	-0.035
Obese but not perceived as obese	-0.017	-0.061	-0.021
Not obese but perceived as obese	0.007	0.043	-0.007

Note: The marginal effects are calculated from probit regressions with health knowledge and health behavior variables in Table 4 and Table 5.