

## *Crossover Effects of Education on Health and Health Behavior Among Married Couples*

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### **Abstract**

This study presents an empirical analysis of not only the effect of education on the health behaviors and health status of married couples but also the crossover effect of education between married couples. First, basic statistics show that wives perform better vis-à-vis dietary health behaviors, whereas husbands perform better with regard to exercise and medical checkups. Furthermore, the crossover effect between educational levels is more pronounced for the effect from wives to husbands than vice versa. Among various health behaviors, medical checkups showed the clearest effect of educational background, and crossover effect was confirmed for both husbands and wives.

Keywords: Health Behavior, Health Status, Crossover Effect, Married Couples

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## 1. Introduction

According to the Simplified Life Tables of the Ministry of Health, Labor and Welfare (MHLW; 2021), the average life expectancy for men and women is 81.47 years and 87.57 years, respectively, typifying a decrease of 0.09 years for men and 0.14 years for women compared to the previous year. This is believed to be due to the manner in which the new coronavirus infection shortens life expectancy, while mortality from malignant neoplasms and pneumonia has decreased. The difference in life expectancy between men and women is 6.10 years, representing a decrease of 0.05 years from the previous year. However, a comparison of life expectancy with that of other countries is considered difficult, primarily because the basic period and methods of creating life expectancy data differ among countries. However, according to the Simplified Life Tables of the MHLW (2021), Japanese women's life expectancy has maintained the first position since 1985, except for 2011, the year of the Great East Japan Earthquake, and the gap between Japan and other countries has been widening. The length of life expectancy for men is also in the top position, along with Switzerland and Iceland.

This study confirms the effect of an individual's education and the crossover effect of the spouse's education on various health behaviors and health statuses in this social context.

Studies on the impact of the education of married individuals on spousal health have been mainly conducted abroad. On the one hand, Jaffe et al. (2006) analyze the impact of an individual's and their spouse's education on cardiovascular disease in married couples. The analysis reveals that the husband's education does not affect the wife's morbidity, but the wife's education does affect the husband's morbidity after controlling for his own education. The study also finds that the husband's (wife's) education is associated with the wife's (husband's) morbidity. Furthermore, the study examined the effect of the education gap between couples and found that the risk of morbidity increases when a highly educated woman partners with a less educated man. On the other hand, Guo et al. (2020), using twin data between two time points in their analysis, find that the years of education of the wife reduce the husband's consumption of tobacco and alcohol, increase the frequency of exercise, reduce the probability of being overweight, and reduce the number of chronic diseases. Using China's educational reforms as an instrumental variable, Fu et al. (2022) find that more years of education increased subjective health conditions and decreased the probability of being overweight, smoking, and alcohol consumption.

In a domestic study, Sato (2017) uses a matching method to examine the effect of education on health and finds that college graduates have not only better subjective health and lower rates of obesity, alcohol consumption, and smoking but also higher rates of sports activity. However, few studies in Japan have examined the crossover effect (the effect of the spouse's education on the partner's health behaviors and health status) of education on health.

This study uses a basic model to examine how the education of married men or women and their spouses affects the dependent variables for various health behaviors and health statuses.

## 2. Data and Analysis Methods

### 2.1. Data and Analysis Model

Our analysis employs anonymous data from the Comprehensive Survey of Living Conditions. The survey has been conducted every three years since 1986, covering households and household members nationwide, and consists of five questionnaires focusing on household, health, care, income, and savings. Each survey covers households and household members in stratified randomly sampled districts from the census tracts. As of June 2022, data from 1995 to 2016 of this survey are available as anonymous data. In this study, we use the data from the 2010 survey, which include information on the education of married couples, to examine the crossover educational effects on health behavior and health status among married couples. Data from 2010, 2013, and 2016 were pooled.

The estimated models examine the impact of education and age on each married individual's health behavior and health status, and that of a partner's education in addition to the individual's education on health behavior and health status. Thus, the analytical models (Models 1 and 2) are presented as follows:

$$Y_i = \alpha + \sum_{edu} \beta_{edu} Edu_i + \beta_{age} age_i + \varepsilon_i \quad (1)$$

$$Y_i = \alpha + \sum_{edu} \beta_{edu} Edu_i + \sum_{edu\_p} \beta_{edu\_p} Edu_{pi} + \beta_{age} age_i + \varepsilon_i \quad (2)$$

The dependent variable  $Y_i$  refers to the health behavior or health status of individual  $i$ . The explanatory variables  $Edu_i$  are education dummies for the individual and  $Edu_{pi}$  are education dummies for the spouse (partner), and the individual's age  $age_i$  is added. Model 1 uses only the individual's education as an explanatory variable, whereas Model 2 adds the spouse's education; thus, we can expect the effect of the individual's education dummies in Model 1 to be reduced in Model 2, with the couple's education matching absorbing some of that effect. It is possible that the crossover effect of spousal education may be higher than that of the individual's education.

For education, high school, vocational school, junior college/technical college, university, and graduate school dummies are used based on junior high school. For age, as the answers to the questions are given in age group intervals of 5 years, we create a continuous variable that takes the median value of the relevant option (e.g., 42 for the 40–44 age group). Participants were excluded if their or their spouse's age or educational level was unspecified. The sample size for both age and education was 137,832 (with 68,916 couples).

We conduct an empirical analysis using samples between 22 and 62 years of age, whose ages correspond to the working-age population (15–64 years old) and their spouses.

### 2.2 Variables and Methods of Analysis

The dependent variables, health behavior, and health status utilize 13 items from 1) to 13), as listed thus: first, regarding health behavior, 1) Frequency of drinking is selected from the following options: “daily,” “5–6 days a week,” “3–4 days a week,” “1–2 days a week,” “1–3

days a month,” “rarely drink,” “quit drinking,” and “do not drink (cannot drink).” 2) Amount of alcohol consumed (for those who drink alcohol, in terms of daily portions): “900 ml or more,” “720 ml or more but less than 900 ml,” “540 ml or more but less than 720 ml,” “360 ml or more but less than 540 ml,” “180 ml or more but less than 360 ml,” and “less than 180 ml.” 3) Frequency of smoking: “I smoke every day,” “I smoke sometimes,” “I used to smoke but haven't for over a month,” and “I don't smoke.” 4) Number of cigarettes: “10 or less,” “11–20,” “21–30,” and “31 or more.” 5) The level of rest and satisfaction with sleep is selected from the following options: “I get enough,” “Fairly well,” “Not very well,” and “Not at all well.”

Next, with regard to health status, 6) Health awareness is evaluated based on a 5-point scale of “good,” “fairly good,” “normal,” “not so good,” and “not so good.” As the choices for the abovementioned items are sequential, Ordered Probit analysis is used to analyze the explained variables.

In addition, regarding 7) Mental health, for the following six questions, each answer is given a score of 4 points for a total of 24 points (the higher the score, the worse the state of mind): (1) “Do you feel irritable?” (2) “Do you feel hopeless?” (3) “Do you feel fidgety and restless?” (4) “Do you feel depressed, as if nothing will happen to make you feel better?” (5) “Do you feel like doing anything is exhausting?” and (6) “Do you feel like everything you do is a struggle?” For this question, most respondents who lived a normal life rated each item as 0, and many scored a total of 0. Therefore, the analysis is conducted using the Tobit model, which analyzes the distributions in which the explained variable is truncated at 0.

Item 8) comprises 10 questions: 1) “I eat breakfast, lunch, and dinner regularly;” 2) “I eat a well-balanced diet;” 3) “I eat lightly seasoned foods;” 4) “I try not to overeat;” 5) “I exercise moderately or get physical activity;” 6) “I get enough sleep;” 7) “I don't smoke;” 8) “I try not to drink too much alcohol;” 9) “I try not to stress out;” and 10) “others.” For each of these, 1 is selected if the case is being executed; otherwise, 0 is selected. We use Logistic regression analysis for these variables, and the coefficients indicate the odds ratios.

Similarly, Logistic analysis using 1 or 0 as the dependent variable is also used for the following items: 9) Medical checkups and 10) Cancer screenings for the following five items: (1) “Stomach cancer screening,” (2) “Lung cancer screening,” (3) “Colorectal cancer screening,” (4) “Uterine cancer screening,” and (5) “Breast cancer screening.”

We also use the Logistic regression for 11) Having worry or stress; 12) The prevalence of three major diseases, namely, (1) “Stroke,” (2) “Angina pectoris/myocardial infarction,” and (3) “Malignant neoplasm;” and 13) Whether the respondent has been hospitalized or not.

In some cases, some of the couples did not respond to the questions regarding health behavior or health status, which was used as the dependent variable. Additionally, participants who have been hospitalized or in residential care are excluded because of missing data. The sample sizes for 1), 2), 5), and 8) are significantly reduced because these questions are not included in the 2010 survey. Notably, 10) “Screening for uterine and breast cancers is applicable only to women and is not responded to by men. Therefore, the sample sizes for each gender-specific estimate differed.

### 3. Considerations Using Basic Statistics

#### 3.1. Educational Background Matching of Married Men and Women

This section discusses the background of the analysis, using the basic statistics of the variables adopted.

First, there are 44,943 couples in which the man (husband) falls within the working-age range (15–64 years) and 49,777 couples in which the woman (wife) falls within the working-age range. Their educational background combinations are presented in Table 1, which shows that the most common educational background combination for couples where the husband is of working age is a high school graduate and the wife is also a high school graduate (26.18%), followed by 11.11% where both the husband and wife are university students.

		Wives						Total
		Junior high school	High school	Vocational school	Junior college/technical college	University	Graduate university	
H u s b a n d s	Junior high school	2.29	3.29	0.81	0.37	0.14	0	6.90
	High school	1.78	26.18	5.39	5.61	1.82	0.06	40.85
	Vocational school	0.26	3.49	3.00	2.01	0.93	0.04	9.74
	Junior college/technical college	0.05	1.31	0.50	1.04	0.34	0.01	3.26
	University	0.25	8.53	4.38	10.62	11.11	0.36	35.26
	Graduate university	0.01	0.32	0.37	0.87	1.97	0.45	3.99
	Total	4.64	43.14	14.45	20.53	16.32	0.92	100
		Husbands						Total
		Junior high school	High school	Vocational school	Junior college/technical college	University	Graduate university	
W i v e s	Junior high school	3.17	1.96	0.26	0.06	0.26	0.01	5.70
	High school	3.89	27.09	3.29	1.31	8.68	0.31	44.57
	Vocational school	0.85	5.15	2.79	0.48	4.13	0.34	13.74
	Junior college/technical college	0.37	5.38	1.86	1.00	10.3	0.84	19.75
	University	0.13	1.70	0.85	0.31	10.53	1.88	15.39
	Graduate university	0	0.06	0.04	0.01	0.34	0.41	0.85
	Total	8.4	41.33	9.08	3.16	34.23	3.79	100

**Table 1: Combination of educational attainment for couples in which either the husband or wife falls into the productive age group**

Similarly, the lower side of Table 1 shows that the most common combination of educational backgrounds where the wife is of working age is where the husband and wife are high school graduates (27.09%), followed by college graduates for both the husband and wife (10.53%).

#### 3.2. Health Behaviors and Health Status of Married Men and Women

Tables 2 present the results of using t-tests to confirm the differences in the means of health behaviors and health status between men and women who fall into the working-age group and those who are over the working-age group, respectively. Generally, the differences

between men and women for most variables are significant at the 1% level. For example, for the frequency of alcohol consumption, the difference is 2.030 points for men (5.238) and women (3.208) in the working-age group, but the difference in the frequency of alcohol consumption decreases to 2.494 points for those older than the working--age group. In Tables 2, the numerical values for the frequency of drinking, amount of drinking, smoking status, and number of cigarettes smoked are all higher for men, and the numerical values decrease when they are older than working age. As a higher value indicates worse mental health, it can be confirmed that women have, on average, worse mental health than men.

For the 10 health behaviors (1) to (10), a numerical value close to 1 indicates that the health behavior is being implemented, and the numerical values for the diet-related items (1) to (4) are all higher for women than for men in terms of both working age and older.

In the working-age group, only item (5), related to exercise, is performed better by men; however, other behaviors related to sleep and stress are undertaken better by women.

Item	Husband	Wife	Item	Husband	Wife	Item	Husband	Wife
Drinking status	5.238	3.208	Eat regularly	0.447	0.546	Medical checkup	0.821	0.618
Amount of alcohol consumed	2.425	1.821	Well-balanced diet	0.316	0.412	Cancer screening①	0.437	0.285
Smoking status	2.234	1.351	Lightly seasoned food	0.169	0.293	Cancer screening②	0.430	0.305
Number of cigarettes smoked	2.024	1.679	Not to overeat	0.312	0.409	Cancer screening③	0.379	0.281
Rest satisfaction through sleep	2.842	2.826	Exercise	0.334	0.281	Cancer screening④	—	0.497
Health conscious	3.489	3.418	Enough sleep	0.276	0.295	Cancer screening⑤	—	0.421
Mental health	2.917	3.496	Do not smoke	0.381	0.446	Worries and Stress	0.495	0.581
			Not to drink too much	0.250	0.250	Three major diseases	0.025	0.016
			Not to get stressed	0.235	0.267	Hospitalization	0.008	0.009
			Other	0.017	0.027			

Note: Health behavior (8) “Not to drink too much” in Table 2 is not significant, and hospitalization is significant at the 5% level.

**Table 2: Health status of men and women of working age**

Although women get enough sleep, their degree of fulfillment is lower than that of men. In addition, once they exceed the working age, men perform better on items (5) to (8). Although men outperform women in terms of cigarette smoking and alcohol consumption, the results suggest that men are more conscious of these health behaviors.

Men perform better in terms of health-screening-related behaviors. This may reflect the availability of medical checkups in the workplace. It can also be confirmed that women are relatively more likely to experience worries and stress, regardless of age. The probability of the two major illnesses and hospitalization tends to be higher for men when they are older (over working age).

## 4. Empirical Analysis Results

### 4.1. Health Behaviors and Health Status of Married Men and Women of Working Age

#### 4.1.1. Men’s Health and Crossover Effects

Tables 3 and 4 present the results of Models 1 and 2 for men who are of working age, whereas Tables 5 and 6 present the results of the analysis for working-age women.

Variables	Drinking	Alcohol	Smoking	Number of cigarettes	Sleep	Health conscious	Mental health
High school	-0.025	-0.112 ***	-0.264 ***	-0.197 ***	-0.019	0.155 ***	-0.155
Vocational school	-0.117 ***	-0.231 ***	-0.380 ***	-0.327 ***	-0.110 ***	0.154 ***	0.140
Junior college/technical college	-0.011	-0.263 ***	-0.430 ***	-0.189 ***	-0.026	0.229 ***	-0.165
University	-0.084 ***	-0.291 ***	-0.638 ***	-0.402 ***	-0.056 *	0.281 ***	-0.108
Graduate university	-0.174 ***	-0.556 ***	-1.150 ***	-0.678 ***	-0.002	0.352 ***	-0.360 *
age	0.012 ***	-0.011 ***	-0.012 ***	0.013 ***	0.010 ***	-0.015 ***	-0.017 ***
Sample size	28,105	19,127	42,556	16,443	28,038	42,491	42,028

  

Variables	Eat regularly	Well-balanced diet	Lightly seasoned food	Not to overeat	Exercise	Enough sleep	Do not smoke
High school	1.086	1.309 ***	0.938	1.076	1.359 ***	0.853 ***	1.177 ***
Vocational school	1.154 **	1.609 ***	1.085	1.152 **	1.353 ***	0.822 ***	1.427 ***
Junior college/technical college	1.334 ***	1.640 ***	1.366 ***	1.195 **	1.722 ***	0.920	1.668 ***
University	1.439 ***	2.277 ***	1.299 ***	1.319 ***	1.889 ***	0.935	1.840 ***
Graduate university	2.235 ***	3.376 ***	2.342 ***	1.688 ***	2.336 ***	0.947	2.787 ***
age	1.045 ***	1.027 ***	1.050 ***	1.032 ***	1.014 ***	1.023 ***	1.013 ***
Sample size	28,307	28,307	28,307	28,307	28,307	28,307	28,307

  

Variables	Not to drink too much	Not to get stressed	Other	Medical checkup	Cancer screening①	Cancer screening②	Cancer screening③
High school	1.145 **	1.096	1.030	1.915 ***	2.350 ***	2.153 ***	2.179 ***
Vocational school	1.325 ***	1.094	1.270	1.744 ***	2.546 ***	2.335 ***	2.454 ***
Junior college/technical college	1.352 ***	1.269 **	1.096	2.762 ***	3.716 ***	3.056 ***	3.305 ***
University	1.587 ***	1.286 ***	0.951	3.527 ***	4.247 ***	3.340 ***	3.620 ***
Graduate university	2.237 ***	1.295 ***	0.781	5.245 ***	4.702 ***	4.141 ***	4.345 ***
age	1.013 ***	1.024 ***	0.998 ***	0.996 ***	1.053 ***	1.042 ***	1.055 ***
Sample size	28,307	28,307	28,307	43,667	43,133	42,989	42,866

  

Variables	Worries and Stress	Three major diseases	Hospitalization
High school	0.988	0.940	0.621 ***
Vocational school	1.170 ***	0.804	0.820
Junior college/technical college	0.993	0.663 *	0.407 **
University	1.093 **	0.891	0.386 ***
Graduate university	1.102	0.882	0.328 ***
age	0.991 ***	1.127 ***	1.038 ***
Sample size	42817	43687	44391

Note: \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10% levels, respectively. All tables in this paper use the same notations.

**Table 3: Effects of education on men who fall into the working-age group**

The results in Table 3 confirm that most of the estimates are significant. The top row shows the coefficients of the Ordered Probit model analysis based on the frequency of alcohol consumption and mental health. Regarding the two variables of alcohol consumption and smoking, we can confirm that the higher the level of education, the more people tend to abstain. In particular, the differences between not only high school graduates and those with higher levels of education but also college graduates and beyond are clear. Although there is no clear relationship between education and sleep, there is a distinct hierarchy in terms of health consciousness. The results of the analysis in the second column and below are presented as odds ratios, with values above (below) 1 indicating a positive (negative) effect.

The 10 items on health behaviors also generally show disparities among educational backgrounds. The pecking order of educational background is more clearly indicated for health and cancer screening, with significant results at the 1% level for all items. Those with a final postgraduate degree are approximately four to five times more likely to have undergone medical examinations than the base group of junior school graduates. In particular, the probabilities of undergoing regular medical checkups are 3.527 and 5.245 times higher among college graduates and postgraduates, respectively. Worries and stress have little correlation with educational background, and the three major diseases are also not significantly related to educational background. The probability of hospitalization tends to decrease with higher education, with some educational variables being statistically insignificant.

Next, we confirm the results of the analysis of the crossover effects for men in the working-age category in Table 4. The results of this analysis are shown in Model 2, with the wife's education dummy inserted as an explanatory variable for the man's education. The wife's educational level has a significant effect on smoking status, although no correlation with the wife's educational level is confirmed for alcohol consumption. In other words, the higher the wife's education level, the lower the smoking rate, even if the man's education level is the same. The wives' educational levels are also significantly correlated with health consciousness.

A wife's educational background also has a significant positive impact on diet-related health behaviors (1) through (4). A similar trend is observed for item (5), that is, exercise-related health behaviors. The influence of wives' educational background on medical checkups is also significant, especially the difference between high school and vocational school graduates, while that of those with higher educational backgrounds is significantly evident. However, the effect of wives' educational background on worries, stress, three major illnesses, and hospitalization is hardly observed.

Variables	Drinking	Alcohol	Smoking	Number of cigarettes	Sleep	Health conscious	Mental health
High school	0.039	-0.001	-0.088 ***	-0.025	-0.019	0.101 ***	-0.395 **
Vocational school	0.053	-0.007	-0.174 ***	-0.083 *	-0.062	0.110 ***	-0.228
Junior college/technical college	0.035	-0.040	-0.212 ***	-0.095 **	-0.030	0.133 ***	-0.311 *
University	0.037	-0.069	-0.363 ***	-0.273 ***	-0.037	0.147 ***	-0.403 **
Graduate university	0.040	-0.102	-0.459 ***	-0.172	-0.004	0.184 ***	0.205
age	0.012 ***	-0.011 ***	-0.013 ***	0.012 ***	0.010 ***	-0.014 ***	-0.016 ***
Sample size	28,105	19,127	42,556	16,443	28,038	42,491	42,028

  

Variables	Eat regularly	Well-balanced diet	Lightly seasoned food	Not to overeat	Exercise	Enough sleep	Do not smoke
High school	1.145 **	1.190 **	1.134	1.126	1.355 ***	1.097	1.112
Vocational school	1.173 **	1.394 ***	1.194 *	1.201 **	1.476 ***	1.128	1.203 **
Junior college/technical college	1.261 ***	1.486 ***	1.369 ***	1.261 ***	1.536 ***	1.042	1.307 ***
University	1.288 ***	1.657 ***	1.512 ***	1.304 ***	1.617 ***	1.172 *	1.477 ***
Graduate university	1.289 *	1.845 ***	1.676 ***	1.490 ***	1.875 ***	1.149	1.758 ***
age	1.046 ***	1.029 ***	1.052 ***	1.033 ***	1.016 ***	1.023 ***	1.015 ***
Sample size	28,307	28,307	28,307	28,307	28,307	28,307	28,307

  

Variables	Not to drink too much	Not to get stressed	Other	Medical checkup	Cancer screening①	Cancer screening②	Cancer screening③
High school	0.880	0.958	1.604	1.312 ***	1.460 ***	1.413 ***	1.491 ***
Vocational school	0.923	0.933	1.957 **	1.329 ***	1.573 ***	1.592 ***	1.664 ***
Junior college/technical college	1.006	1.024	1.725 *	1.557 ***	1.981 ***	1.814 ***	1.963 ***
University	1.094	1.055	1.793 *	1.543 ***	1.869 ***	1.760 ***	1.929 ***
Graduate university	1.397 **	1.101	1.610	1.380 **	1.793 ***	1.911 ***	1.666 ***
age	1.014 ***	1.025 ***	1.000	0.997 **	1.055 ***	1.044 ***	1.057 ***
Sample size	28,307	28,307	28,307	43,667	43,133	42,989	42,866

Note: The bottom row of the explanatory variables represents the spouse's educational level. The results for worries and stress, three major illnesses, and hospitalization are omitted.

**Table 4: Crossover effects on health for men who fall into the working-age group**

#### 4.1.2. Women's Health and Crossover Effects

Table 6 confirms the effect of education when the wife falls into the working-age category. This result also shows that most of the effects are significant. In the top row of the variables, the ordinal order of education is clear for the two variables of alcohol consumption and smoking, as well as for the variable on health consciousness. However, there is no clear correlation between the frequency of alcohol consumption and sleep. This finding is similar to that observed in men. However, the frequency of alcohol consumption is positively significant for women, unlike men. In addition, while almost no significant results are observed for the mental health of men, a significant pecking order is confirmed for women, with the more highly educated group having better mental health. Based on the effects of health behaviors (1) through (4) regarding diets, the differences between educational backgrounds are particularly evident for item (2), "eating a well-balanced diet," with postgraduates being 4.738 times more likely than junior high school graduates. In addition, a correlation with educational background can be generally confirmed for items (5) exercise, (7) behaviors to abstain from smoking, and (8) alcohol consumption. Furthermore, similar to men, the correlation with educational background is strong for medical checkups, all of which, including uterine and breast cancer checkups, are significant at the 1% level. As in the case of men, the disparity between educational backgrounds for the probability of receiving a regular medical checkup is the largest, at 3.245 times for college graduates and 5.245 times for postgraduates.

Variables	Drinking	Alcohol	Smoking	Number of cigarettes	Sleep	Health conscious	Mental health
High school	0.082 **	-0.323 ***	-0.467 ***	-0.212 ***	-0.117 ***	0.142 ***	-0.423 ***
Vocational school	0.153 ***	-0.410 ***	-0.590 ***	-0.371 ***	-0.131 ***	0.203 ***	-0.376 ***
Junior college/technical college	0.108 ***	-0.534 ***	-0.975 ***	-0.464 ***	-0.105 ***	0.245 ***	-0.551 ***
University	0.157 ***	-0.651 ***	-1.153 ***	-0.657 ***	-0.077 **	0.325 ***	-0.711 ***
Graduate university	0.156 **	-1.078 ***	-1.416 ***	-1.336 **	-0.113	0.322 ***	0.109
age	0.002 ***	-0.023 ***	-0.022 ***	0.004 ***	0.003 ***	-0.011 ***	-0.026 ***
Sample size	31,264	10,746	47,300	5,189	31,108	46,987	46,317

  

Variables	Eat regularly	Well-balanced diet	Lightly seasoned food	Not to overeat	Exercise	Enough sleep	Do not smoke
High school	1.167 ***	1.545 ***	1.121 *	1.024	1.295 ***	0.865 **	1.427 ***
Vocational school	1.285 ***	2.104 ***	1.369 ***	1.159 **	1.445 ***	0.973	1.699 ***
Junior college/technical college	1.730 ***	2.646 ***	1.485 ***	1.166 ***	1.667 ***	1.030	1.905 ***
University	1.920 ***	3.691 ***	1.939 ***	1.270 ***	2.009 ***	1.235 ***	2.303 ***
Graduate university	2.047 ***	4.738 ***	2.473 ***	1.439 ***	1.843 ***	1.165	2.262 ***
age	1.029 ***	1.027 ***	1.046 ***	1.024 ***	1.045 ***	1.002 *	1.005 ***
Sample size	31,432	31,432	31,432	31,432	31,432	31,432	31,432

  

Variables	Not to drink too much	Not to get stressed	Other	Medical checkup	Cancer screening①	Cancer screening②	Cancer screening③
High school	1.331 ***	1.095	1.104	1.708 ***	1.840 ***	1.810 ***	1.870 ***
Vocational school	1.690 ***	1.242 ***	1.403 *	2.167 ***	2.142 ***	2.477 ***	2.234 ***
Junior college/technical college	1.933 ***	1.219 ***	1.165	2.252 ***	2.709 ***	2.514 ***	2.843 ***
University	2.326 ***	1.329 ***	0.933	2.665 ***	3.199 ***	2.885 ***	3.212 ***
Graduate university	2.720 ***	1.299 *	1.548	4.544 ***	3.874 ***	4.049 ***	3.426 ***
age	1.002 *	1.026 ***	1.011 ***	1.035 ***	1.059 ***	1.055 ***	1.063 ***
Sample size	31,432	31,432	31,432	48,344	47,242	47,211	47,273

  

Variables	Cancer screening④	Cancer screening⑤	Worries and Stress	Three major diseases	Hospitalization
High school	1.450 ***	1.909 ***	1.042	0.902	0.754
Vocational school	1.738 ***	2.169 ***	1.240 ***	0.901	0.752
Junior college/technical college	2.263 ***	3.051 ***	1.105 **	0.805	0.535 ***
University	2.593 ***	3.449 ***	1.002	0.876	0.577 **
Graduate university	3.003 ***	3.394 ***	1.405 ***	0.911	0.216
age	0.981 ***	1.037 ***	0.986 ***	1.078 ***	1.022 ***
Sample size	48,444	48,457	47,407	48,292	49,174

Note: \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10% levels, respectively.

**Table 5: Effects of education on women who fall into the working-age group**

However, similar to men, no clear correlation with educational background can be confirmed for worries, stress, or the three major illnesses. No clear correlation with educational background is observed for hospitalization as well.

Table 6 confirms the crossover effect of husbands' education on the health of working-age women. Although there is no clear educational effect on the frequency of alcohol consumption, it is positive and significant, indicating that the husband's education somewhat affects the wife's frequency of alcohol consumption. Regarding smoking status, a crossover effect is found among married couples, which is similar to the results presented in Table 4. Unlike the crossover effect for husbands, there is no clear correlation between education and

health consciousness, although it is significant; however, the difference between those with a college degree or higher and those with less than a college degree is clear. In other words, there is a positive effect on subjective health consciousness if the husband has a college degree or higher. Some educational attainment is also significant for mental health, but there is no clear pecking order.

Variables	Drinking	Alcohol	Smoking	Number of cigarettes	Sleep	Health conscious	Mental health
High school	0.086 ***	-0.044	-0.161 ***	-0.113 **	0.022	0.091 ***	-0.349 ***
Vocational school	0.107 ***	-0.081	-0.239 ***	-0.071	0.013	0.120 ***	-0.400 ***
Junior college/technical college	0.143 ***	-0.085	-0.267 ***	-0.226 **	0.081 *	0.087 **	-0.165
University	0.115 ***	-0.134 ***	-0.396 ***	-0.102 *	0.068 **	0.172 ***	-0.398 **
Graduate university	0.060	-0.325 ***	-0.677 ***	-0.171	0.127 ***	0.238 ***	-0.456 **
age	0.002 ***	-0.023 ***	-0.022 ***	0.004 ***	0.003 ***	-0.010 ***	-0.027 ***
Sample size	31,264	10,746	47,300	5,189	31,108	46,987	46,317

  

Variables	Eat regularly	Well-balanced diet	Lightly seasoned food	Not to overeat	Exercise	Enough sleep	Do not smoke
High school	0.963	1.140 **	1.033	1.014	1.072	0.960	1.119 **
Vocational school	1.020	1.367 ***	1.079	1.000	0.990	0.949	1.175 ***
Junior college/technical college	1.015	1.249 ***	1.173 *	1.083	1.143	0.949	1.223 **
University	1.129 **	1.658 ***	1.258 ***	1.067	1.343 ***	1.060	1.368 ***
Graduate university	1.484 ***	2.089 ***	1.695 ***	1.143 *	1.510 ***	1.193 **	1.724 ***
age	1.029 ***	1.028 ***	1.046 ***	1.024 ***	1.045 ***	1.002 *	1.005 ***
Sample size	31,432	31,432	31,432	31,432	31,432	31,432	31,432

  

Variables	Not to drink too much	Not to get stressed	Other	Medical checkup	Cancer screening①	Cancer screening②	Cancer screening③
High school	1.076	1.003	1.002	1.233 ***	1.422 ***	1.386 ***	1.384 ***
Vocational school	1.169 **	1.005	1.159	1.178 ***	1.387 ***	1.341 ***	1.396 ***
Junior college/technical college	1.122	1.086	0.669	1.320 ***	1.621 ***	1.537 ***	1.653 ***
University	1.331 ***	1.084	0.830	1.254 ***	1.668 ***	1.566 ***	1.698 ***
Graduate university	1.727 ***	1.205 **	1.014	1.265 ***	1.667 ***	1.455 ***	1.779 ***
age	1.003 **	1.026 ***	1.012 ***	1.035 ***	1.059 ***	1.056 ***	1.063 ***
Sample size	31,432	31,432	31,432	48,344	47,242	47,211	47,273

Note: Results for cancer screening items (4) and (5), worries and stress, three major diseases, and hospitalization are omitted.

**Table 6: Crossover effects on health for women of working age**

For the health behavior items (1) through (4) related to diet, unlike in the case of the husbands in Table 4, it can be confirmed that some crossover effects of the husbands' educational backgrounds are not significant. However, for health behavior item (2), "I eat a balanced diet," the crossover effect of the husband's educational background, as well as the wife's educational background in Table 4, is clearly significant.

For exercise as a health behavior (5), having a husband with a college degree or higher indicates a significantly positive effect. As in the case of men, the crossover effect for couples can be clearly confirmed by refraining from smoking (7) rather than alcohol consumption (8). The effect of husbands' educational backgrounds on health screening is also generally significant. Although the coefficient varies slightly depending on the level of education, we can confirm that husbands with higher educational levels generally have an increased probability of their wives receiving medical checkups.

## **5. Conclusion**

This study empirically analyzes not only the effect of education on the health behaviors and health status of married couples but also the crossover effect of education among them. First, basic statistics show that women perform better in terms of dietary health behaviors, whereas men perform better in terms of exercise and medical checkups. Furthermore, the crossover effect is more pronounced regarding the wife-to-husband scenario than vice versa. Among the various health behaviors, the clearest effect of one's educational background is medical checkups, and the crossover effect is also clearly confirmed for both husbands and wives.

The remaining issues include the possibility of reverse causality and intervention via a covariate factor. The verification of these points will be the subject of future studies.

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