

「建立台灣永續發展的家庭、人口、健康、社區與勞動保障體系：公民權利契約觀點」國際學術研討會

Urban Variations in the Utilization of Pap-smear and Breast-cancer Screening under the National Health Insurance System in Taiwan

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ABSTRACT

The primary aim of this paper is to explore the association between the level of urbanization and cervical and breast cancer screening amongst women aged between 30 and 69 years under the National Health Insurance (NHI) system in Taiwan. This investigation is undertaken using a bivariate probit model and a nationwide survey dataset obtained from the 2001 National Health Interview Survey (NHIS).

The results indicate that urbanization levels have a significant influence on both Pap-smear testing and breast cancer examinations; nevertheless, as a result of concerted efforts by the government, considerable improvements have been made in the more remote areas since the implementation of the NHI system, particularly with regard to Pap-smear screening usage.

Keywords: Urbanization; Pap-smear testing; Breast cancer examinations; National Health Insurance.

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1. INTRODUCTION

Cervical and breast cancers are the most common forms of cancer and often the leading cause of death amongst women in many countries throughout the world. A number of studies have identified Papnicolaou (Pap) smear testing and breast cancer screening programs as the most effective methods of reducing the mortality rate from these particular forms of cancer (Koss, 1989; Segura et al., 2000; Adams et al., 2003).

Cervical cancer can be detected much earlier than other cancers and can be treated much more effectively through Pap smear screening; indeed, about 70-90 per cent of all cervical cancers can be cured if detected and treated early enough (Clarke and Anderson, 1979; Sigurdsson, 1993; Cheek et al., 1999). As regards breast cancer, self-examination and clinical examination of the breasts, as well as mammography, have been shown to be effective methods for early detection (Fung, 1998; Segura et al., 2000; Savage and Clarke, 2001).

The prior studies in this area suggest that a variety of factors are associated with cervical and breast cancer screening use rates, including socio-demographic characteristics, awareness of preventive care services, accessibility to medical care and geographical location. Factors contributing to the failure to attend screening services include lower education levels (Chen and Chou, 1995; Wu et al., 2001; Nguyen et al., 2002), lower income levels (Katz and Hofer, 1994; Adams et al., 2003; Wang et al., 2005) and poor accessibility to such services (Mandelblatt et al., 1999; Zambrana et al., 1999; Wu et al., 2001). Furthermore, elderly women (≥ 60 years) are less likely to have ever had a Pap smear test as compared to their younger counterparts (Chen and Chou, 1995; Mandelblatt et al., 1999).

It has been shown that different geographical areas result in different Pap-smear test utilization levels, with those women living in larger cities being generally more likely to present for cervical smear testing (Wang and Lin, 1996; Eaker et al., 2001; Hancock et al., 2001). Finally, health insurance also has an important role to play in

the usage of Pap smear testing and breast cancer examinations, since it has been found that a lack of health insurance coverage is a major predictor of low utilization rates for these two cancer screening methods (Sung et al., 2002; Carrasquillo and Pati, 2004; Rodriguez et al., 2005).

In 2001, the incidence rates in Taiwan for these two diseases (per 100,000 of the population) were 54.58 for cervical cancer and 46.22 for breast cancer, which represented the highest and second highest rates for all female malignant neoplasms at that time. In the same year, the mortality rate for breast cancer (per 100,000 of the population) was 10.94, whilst the rate for cervical cancer was 8.55; these were, respectively, the fourth and fifth highest of all female malignancies (*Taiwan Cancer Registry* [in Chinese]).

Despite the fact that the Pap smear program in Taiwan commenced in 1974, the initial utilization rates remained at extremely low levels between 1974 and 1978, at around 2.38 per cent. This was partly attributable to the failure amongst Taiwanese women to recognize the importance of the Pap smear test, but also due, in some part, to embarrassment and/or fear (Chou and Lai, 1993).

In an attempt to further raise the utilization rate of Pap smear testing, free cervical cancer screening was made available under the National Health Insurance (NHI) program in July 1995, just four months after the inauguration of the NHI; thereafter, all women aged 30 years or above became eligible for one test per year. As a result, the Pap smear testing utilization rate jumped from 10 per cent in 1995 to 30 per cent in 1998 (*Health Statistics* [in Chinese]). Nevertheless, whilst the Pap smear testing rate has risen significantly under the NHI system, it remains much lower than the average rate, of approximately 70-80 per cent, in most developed countries (Guzick, 1978).

Although free breast cancer screening services had not been available until the implementation of the NHI program in 1995, the Department of Health (DOH) in Taiwan was already promoting breast examination, a policy which subsequently took shape through three distinct stages. First of all, between 1992 and 1997, the DOH adopted a policy of encouraging breast self-examination; however, since such self-examination cannot efficiently reduce the number of breast cancer incidences, in its approach to the second stage, between 1999 and 2001, the DOH made provisions for palpation by doctors for all females above the age of 35 years. Finally, in order to more efficiently meet the need for breast examination, the DOH made mammography

screening available to high-risk groups of women; from July 2004, all women aged between 50-69 years became eligible for a mammography X-ray examination biennially under the NHI program.

Although a number of studies have found that the utilization rates for cancer screening tests are higher in cities than those for the country as a whole, such studies have tended to investigate only the urban-rural regional variations, and as such, they have not focused on the level of urbanization of the community in which the women were located. In addition, virtually all of the prior studies exploring these two female cancer screening factors have been heavily reliant upon state-wide samples or sub-populations; i.e., region-specific or group-specific data.

As opposed to adopting such potentially biased samples, nationwide survey data is adopted in this study in an effort to improve upon the shortcomings of the prior studies. The primary objective of this study is therefore to examine the association between the level of urbanization and Pap-smear and breast cancer screening, under the NHI in Taiwan, amongst women aged between 30 and 69 years.

2. METHODS

2.1 Database and Study Sample

The data adopted for this investigation were obtained from the 2001 National Health Interview Survey (NHIS), a survey carried out by the National Health Research Institutes and the Bureau of Health Promotion (BHP) at the Department of Health in Taiwan. The 2001 NHIS provides nationwide population estimates of health behavior, health conditions and medical resource usage within Taiwan's 23 administrative districts. The database also provides detailed information on a series of personal demographic and socioeconomic characteristics including age, gender, marital status, highest educational level attained and income, as well as detailed information on individual medical resource usage, health status and other types of health-related behavior. More-detailed information on the data collection process is provided by Shih and Chang (2001).

The survey target population comprised of 27,160 observations on individuals over the age of 12 years on 16 January 2001 by means of face-to-face interviews and a multi-stage stratified systematic sampling design methodology. Between late August 2001 and January 2002, the NHIS ultimately collected data on 20,855 people,

representing 76.8 per cent of the target population. The dataset does, however, lack details of Pap-smear screening and breast examinations on women under the age of 30; furthermore, given that the incidence rates of both cervical and breast cancer are very low amongst females ≥ 70 years, this group is rarely involved in Pap-smear or breast screening. This study therefore focuses on a sample between the ages of 30 and 69 years. In order to more accurately explore the factors influencing these two areas of female preventive care screening, we select from the sample those who had used Pap-smear and breast cancer screening after the implementation of the NHI program, for comparison with those who had not used the available screening.

After excluding all male observations ($n=10,371$), females below the age of 30 ($n=3,561$), females age 70 years or above ($n=767$) and those females on whom there was missing data ($n=241$), we were ultimately left with a total sample of 5,915 individuals for inclusion in our analysis.

2.2 Statistical Analysis

Numerous international studies have explored the factors influencing the utilization of female cancer screening, generally using an individual single equation probit model for their analysis of these two preventive care methods (Zamrana et al., 1999; Hiatt et al., 2001; Rodriguez et al., 1005). However, to the best of our knowledge, there have thus far been no studies within the literature which have modeled the bivariate outcomes and simultaneously discussed whether women have received Pap-smear testing and breast examinations.

Given that cervical and breast cancer tests are the most important preventive care services available to women, if such women do undertake breast cancer examinations, this would imply that they would also hope to avoid female malignant neoplasm; thus, there is a higher probability of this particular group of women undergoing Pap-smear testing. From our study sample, we found that of the total of 1,649 women who reported having undergone breast cancer examinations, 1,474 of these women (89.39 per cent) had also had cervical cancer screening.

In order to avoid any impact from correlation disturbances between these two preventive services, and to ensure more accurate estimation results, this study adopts a bivariate probit (two-equation) model with correlated disturbances to simultaneously examine the usage rates for the two types of medical check-ups. Following Green (2003), the basic multivariate specification is:

$$\text{Pap-smear test}^* = \beta'_{pap} X_{pap} + \varepsilon_{pap},$$

Pap-smear test = 1 if Pap-smear test* > 1, otherwise 0.

$$\text{Breast cancer examination}^* = \beta'_{bre} X_{bre} + \varepsilon_{bre},$$

Breast cancer examination = 1 if breast cancer examination* > 1, otherwise 0.

$$[\varepsilon_{pap}, \varepsilon_{bre}] \sim \text{bivariate normal (BVN)} [0,0,1,1,\rho]$$

where Pap-smear test and breast cancer examination are the two binary variables, and the two regressor vectors, X_{pap} and X_{bre} , are as shown in Table 1.

Prior to proceeding with the estimation, we carried out the likelihood ratio test of $\rho = 0$, with the statistical result showing that $\tilde{X}^2 = 743.28$, thereby rejecting the null hypothesis of $\rho = 0$ and indicating the validity of the bivariate probit model for our analysis. In addition to multivariate analyses, we also performed descriptive analyses for the measurement of the two cancer check-up utilizations rates, including both frequency and percentage, as well as the two-dimension characteristics of the Pap-smear test and breast cancer examination samples.

The SAS System for Windows (Version 8.2) and Stata (Version 9.0, STATA Corporation) statistical packages were used to undertake the analyses. We also adopt 95 per cent confidence interval (CIs) to determine the statistical significance, with the differences being considered statistically significant where the two-sided p -value was less than, or equal to, 0.05.

2.3 Key Variables of Interest

The dependent variables, defined in this study as the Pap-smear test and breast cancer examination, are dichotomous, with a score of 1 if the woman had received a cervical smear test or breast cancer examination after the launch of the NHI, otherwise 0. The types of breast cancer examination used in this study included palpation by doctors, mammography screening and ultrasound breast examination. The breast cancer examination variable was defined as 1 if women had undergone at least one of the three types of examination.

Table 1 Definitions of dependent and independent variables

Variable	Definition
Dependent variables	
Pap smear test	Dummy variable=1 if woman accept Pap smear test, other=0
Breast cancer exam	Dummy variable=1 if woman accept Breast cancer exam, other=0
Independent variables	
Urbanization level	
1 (highest)	(Woman lives in highest level of urbanized areas is the reference category)
2	Dummy variable=1 if woman lived in 2nd level, other=0
3	Dummy variable=1 if woman lived in 3rd level, other=0
4	Dummy variable=1 if woman lived in 4th level, other=0
5	Dummy variable=1 if woman lived in 5th level, other=0
6	Dummy variable=1 if woman lived in 6th level, other=0
7	Dummy variable=1 if woman lived in 7th level, other=0
8 (lowest)	Dummy variable=1 if woman lived in 8th level, other=0
Age	
30-39	Dummy variable=1 if woman's age in this range, other=0
40-49	Dummy variable=1 if woman's age in this range, other=0
50-59	Dummy variable=1 if woman's age in this range, other=0
60-69	(Woman's age in this range is the reference category)
Education	
Primary school and below	(Primary school and below is the reference category)
Junior high	Dummy variable=1 if woman finished Junior high school, other=0
Senior high	Dummy variable=1 if woman finished Senior high school, other=0
College and above	Dummy variable=1 if woman finished College and above, other=0
Marital status	Dummy variable=1 if woman have married, other=0
Birth experience	Dummy variable=1 if woman have birth experience, other=0
Gynecologic disease	Dummy variable=1 if woman have gynecologic disease, other=0

The independent variables were split into three categories as follows: (i) urbanization level; (ii) socio-demographic characteristics, including age, education attainment, marital status and birth experience; and (iii) gynecological disease. The definitions of the variables used in this empirical analysis are provided in Table 1. The key independent variable of interest to this study was the level of urbanization of the community in which the women were located.

The urbanization of all 316 cities/counties was classified into eight levels according to the standards published by the Institute of Occupational Safety and Health (IOSH) in Taiwan (1=highest urbanization level, 8=lowest urbanization level). These standards include population density, age structure, employment rate, the density of manufacture industry, average male immigration rate, average female immigration rate, economic activities, average annual income per person, average annual expenditure per person, the average daily amount of garbage per thousand population, the average number of telephone per family, educational level, physician number per thousand population and availability of healthcare facilities in each city/county. (Tseng and Wu, 1986; Lin et al., 2005).

Those areas with the highest urbanization levels comprise of the Taipei municipality and Yonghe city. The regions with the second highest urbanization level include Kaohsiung, Taichung and Tainan municipalities and the cities of Banchiao, Sanchong, Jhonghe, Sinjhung, Taoyuan, Fongshan and Hualien. The municipalities of Keelung, Hsinchu and Chiayi and cities such as Sindian, Jhongli, Ilan and Miaoli come under the third highest level of urbanization, whilst the fourth to seventh levels of urbanization contain most of the rural areas, including villages and small towns. Finally, the lowest level of urbanization, level 8, comprises of virtually all of the mountainous regions, the most isolated and inaccessible areas in Taiwan.

According to many of the prior studies, there are a number of other factors that are significantly correlated with the utilization of Pap-smear testing and breast cancer examinations. Our analyses of the two types of female cancer tests in this study concentrate on the impact of socio-demographic characteristics and gynecological diseases. The control variables explored in this study also included age, education, material status, birth experience and any prior history of gynecological disease.

Our age observations were classified into one of four age groups, 30-39, 40-49, 50-59 and 60-69 years of age, whilst educational attainment was divided into four categories, primary school and below (0-6 years of full-time education), junior high

school (7-9 years), senior high school (10-12 years) and college or above (≥ 13 years). Marital status comprised of married or single/unmarried categories, with the unmarried category also including those who had been divorced, separated or widowed. Finally, this study categorized any prior history of gynecological disease as any instances where women had undertaken medical treatment as a result of diseases of the womb or ovaries.

3. RESULTS

The descriptive statistics of the variables are presented in Table 2, which reveals that 3,684 (62.28 per cent) of the total sample of 5,915 women had received Pap-smear screening under the NHI system. In contrast, only 1,649 (27.88 per cent) of the total sample had ever undergone a breast cancer examination. The distribution, by level of urbanization, indicated that the majority of the women (22.75 per cent) were located in communities situated at the second highest urbanization level. The average age of the study sample was approximately 46.6 years, with a standard deviation of 10.7 years. About two-thirds of the women in the sample were aged between 30-49 years, and around 44 per cent had graduated from primary school or below, representing the largest constituent group of the sample. Most of the women (80 per cent) were married and a very high proportion (92 per cent) had birth experience. Finally, only 6.3 per cent of the study sample reported ever having had any experience of gynecological disease.

Table 2 also provides the bivariate statistics on the two types of female cancer examinations. Women living in regions at the lower levels of urbanization were less likely to receive screening services than those living in regions with the highest level of urbanization. Elderly women (≥ 60 years) were less likely to undergo a Pap-smear test, whilst women aged 30 to 39 years had a slightly lower probability of undergoing a breast cancer examination than those in other age groups. The uptake of breast cancer examinations also increased with higher educational attainment. The specific groups of women who were more likely to undergo Pap-smear screening and breast examinations were those who were married, who had given birth and who had reported prior experience of gynecological diseases. Details on the associations between the female cancer tests and all of the independent variables examined in this study are provided in Table 3.

Table 2 Descriptive statistics of the variables (n=5,915)

Variables	Characteristics of sample		Pap-smear test acceptance	Breast cancer exam acceptance
	Total NO.	(%)	Total NO. (%)	Total NO. (%)
Dependent variables				
Pap-smear test	3,684	62.28	--	1,474 (40.01)
Breast cancer exam	1,649	27.88	1,474 (89.39)	--
Independent variables				
Urbanization level				
1 (highest)	710	12.00	486 (68.45)	258 (36.34)
2	1,346	22.75	779 (57.88)	367 (27.27)
3	863	14.59	555 (64.31)	248 (28.74)
4	634	10.72	384 (60.57)	169 (26.66)
5	779	13.17	467 (59.95)	219 (28.11)
6	444	7.51	273 (61.49)	101 (22.75)
7	550	9.30	354 (64.36)	149 (27.09)
8 (lowest)	589	9.96	386 (65.53)	138 (23.43)
Age (year)				
30-39	1,814	30.67	1,175 (64.77)	421 (23.21)
40-49	1,918	32.43	1,318 (68.72)	609 (31.75)
50-59	1,246	21.06	743 (59.63)	386 (30.98)
60-69	937	15.84	448 (47.81)	233 (24.87)
Education level				
Primary school and below	2,593	43.84	1,428 (55.07)	622 (23.99)
Junior high	943	15.94	626 (66.38)	271 (28.74)
Senior high	1,512	25.56	1,054 (69.71)	439 (29.03)
College and above	867	14.66	576 (66.44)	317 (36.56)
Marital status				
Married	4,744	80.20	3,188 (67.20)	1,400 (29.51)
Unmarried	1,171	19.80	496 (42.36)	249 (21.26)
Birth experience				
Yes	5,443	92.02	3,556 (65.33)	1,555 (28.57)
No	472	7.98	128 (27.12)	94 (19.92)
Gynecologic disease				
Yes	371	6.27	289 (77.90)	130 (35.04)
No	5,544	93.73	3,395 (61.24)	1,519 (27.40)

Table 3 Bivariate probit regression analyses of Pap-smear test and breast cancer exam

Variables	Pap-smear test		Breast cancer exam	
	Coef.	P -value	Coef.	P -value
Urbanization level				
1	--	--	--	--
2	-0.3339	<0.0001	-0.1823	0.003
3	-0.1722	0.013	-0.1545	0.022
4	-0.2517	0.001	-0.1945	0.008
5	-0.2345	0.001	-0.1167	0.097
6	-0.1699	0.039	-0.2590	0.002
7	0.0117	0.884	-0.1020	0.195
8 (lowest)	0.0507	0.516	-0.1876	0.017
Age (year)				
30-39	0.2936	<0.0001	-0.3309	<0.0001
40-49	0.3785	<0.0001	-0.0038	0.949
50-59	0.2137	<0.0001	0.0880	0.142
60-69	--	--	--	--
Education level				
Primary school and below	--	--	--	--
Junior high	0.2216	<0.0001	0.2706	<0.0001
Senior high	0.4010	<0.0001	0.3288	<0.0001
College and above	0.4774	<0.0001	0.5543	<0.0001
Marital status				
Married	0.3248	<0.0001	0.1816	<0.0001
Unmarried	--	--	--	--
Birth experience				
Yes	1.0747	<0.0001	0.2567	0.001
No	--	--	--	--
Gynecologic disease				
Yes	0.4103	<0.0001	0.1879	0.007
No	--	--	--	--
Constant	-1.2451	<0.0001	-0.9761	<0.0001
Number of observations			5,915	
Wald X^2 (36)			744.83	
Prob> X^2			0.00001	
Likelihood ratio test of $\rho=0$				
\tilde{X}^2 (1)			743.28	
Prob> \tilde{X}^2			0.00001	

The bivariate probit analysis results show that after controlling for other factors, living in any of the urbanization areas between the second and sixth levels had a negative and significant association with Pap-smear screening utilization, as compared to living in the highest urbanization level. It is worth noting that urbanization levels 7 and 8 had positive relationships with Pap-smear testing, although this was not statistically significant. Table 3 also demonstrates that urbanization levels were, for the most part, found to have a highly significant and negative impact on the utilization of breast cancer screening services.

These empirical results imply that the level of urbanization is a crucial factor in the utilization of female cancer check-up services; however, the urbanization level variable is seen to have distinct impacts for the two different types of preventive care services. The results also show that women aged ≥ 60 years are significantly less likely to undergo a Pap-smear test ($p < 0.001$), essentially because women between the ages of 60 and 69 years are usually found to be at much lower risk of cervical cancer, so there is a lower probability of the need for a cervical smear test. This finding is similar to those reported in the prior literature (Mandelblatt et al., 1999).

More surprisingly, women aged between 30 and 39 years are significantly less likely to undergo a breast cancer examination than those aged ≥ 60 years. The likely explanation for this is that in Taiwan, incidences of breast cancer are less common amongst younger women (< 40 years) but much higher amongst females aged between 40 and 55 years; the probability of the need for such examinations is therefore reduced for the younger of these two groups.

We also find that educational level is another important factor explaining the variations in the utilization of female cancer screening, a finding which is consistent with the earlier studies of Wu et al. (2001) and Nguyen et al. (2002), each of which found a positive and significant correlation between educational levels and utilization of the two types of tests. Women with experience of giving birth and those with any prior history of gynecological disease both had significantly higher probabilities of undergoing either, or both, of the cancer screening methods, specifically as a result of their pregnancy and gynecological concerns. Finally, this study finds that married women tended to have a greater likelihood of undergoing both cervical and breast cancer screening.

4. DISCUSSION

Although there has been increasing emphasis amongst many researchers on the need for exploration of the factors affecting female cancer screening usage, to the best of our knowledge, there has been no documented evidence thus far on the effects of the level of urbanization on the utilization of cervical and breast cancer screening. More importantly, the prior studies have tended to carry out individual single probit model equations as the means of investigating the issue of cancer screening and the correlation disturbances between Pap-smear testing and breast cancer examination. We therefore use bivariate probit estimation procedures in this study to take into consideration the potential correlation disturbances between the use of the two cancer prevention services.

There have been some recent studies in which emphasis has been placed on the need for exploration of the associations between urbanization and incidences of certain diseases, such as diabetes, asthma, allergic diseases and breast cancer. The results of these studies have indicated that urbanization does have a significant impact on disease morbidity, with urban areas generally being observed to have excess incidence rates as compared to rural areas (Hall et al., 2005; Nicolaou et al., 2005; Viinanen et al., 2005). However, the degree of urbanization of each community was not examined in these studies, since the measurement of urbanization was merely divided into urban-rural areas or city/rural towns/villages.

Our study takes advantage of the NHIS database which covers all of the administrative areas of Taiwan. Urbanization was divided into eight different levels according to age structure, population density, immigration rate, economic activity, educational level, average family income and healthcare facilities. We therefore provide a more unequivocal representation of the differences in urbanization levels between each region, which should result in more accurate estimations. Our empirical results show that the level of urbanization is an important factor which does contribute to the utilization rates of Pap-smear screening and breast cancer examinations in Taiwan. After adjusting for other factors, we find that women living in any of the urbanization areas between the second and sixth levels were still less likely to partake in cervical cancer screening.

Interestingly, the lowest and second-lowest levels of urbanization were found to have no significant association with the utilization of Pap-smear testing; although there was still greater acceptance of Pap-smear screening in those areas at the highest urbanization level than in other areas, we nevertheless find that there was significant improvement in the use of such testing in the more remote regions. Conversely, the

degree of urbanization had a significant and negative relationship with breast cancer screening as compared to those areas at the highest level of urbanization. In other words, the higher the level of urbanization, the greater the probability of female residents undergoing breast examinations, which clearly implies that there are urban differences with regard to the utilization of breast cancer screening.

Starting in July 1995, all obstetric and gynecological hospitals and clinics in Taiwan were encouraged to contract with the government to enable the NHI program to provide free annual pap-smear screening for all women aged ≥ 30 years. By 1997, around 1,500 medical care institutions were under contract, accounting for more than 90 per cent of all eligible medical care institutions (*Public Health in Taiwan* [in Chinese]). Furthermore, in order to provide balanced access to the utilization of Pap-smear testing between different regions, the health authorities introduced mobile testing stations to provide specimen collection services in the more remote areas. This substantially improved the previously poor accessibility to these services for those women at the lower urbanization levels, thereby raising the usage rate of Pap-smear preventive care considerably; this explains why the coefficients for urbanization levels 7 and 8 were insignificant.

Although the DOH in Taiwan also put in place various breast examination policies, women remained ineligible for such examinations under the NHI program until 2001. Mammography screening and ultrasound examination machines are very expensive, and given the lack of preventive care resources outside of the metropolitan areas, both the availability of, and accessibility to, breast cancer examination in the lower urbanization levels was very low. Thus, as compared to those areas at the highest urbanization level, those living in less-developed regions were less likely to receive breast check-ups.

5. CONCLUSIONS

Breast cancer is the most common form of cancer and the leading cause of death amongst women in Taiwan, with the respective morbidity and mortality rates being the second and fourth highest of all female malignant neoplasms. Since, annual Pap-smear screening is available to all woman aged ≥ 30 years, free of charge, under the NHI program, this has significantly enhanced the accessibility to female cancer preventive care services by taking pap-smear testing deep into the more remote areas. Coverage could also be extended to breast examinations to raise the overall utilization rate of breast cancer screening. As of July 2004, mammography screening was

available under the NHI program for 50-69 year-old women only, on a biennial basis.

We should, at this stage, point out two inherent limitations of this study. Firstly, some of the prior literature has shown that health insurance coverage plays an important role in raising the utilization rates for female cancer screening (Sung et al., 2002; Carrasquillo and Pati, 2004; Rodriguez et al., 2005); however, since the dataset adopted used in this study only began in 2001, it does not contain sufficiently detailed information to enable us to compare the differences in the utilization of the two types of cancer preventive tests between the pre-NHI and post-NHI periods.

Secondly, the degree of urbanization for each region was calculated by a composite score from several variables published by the Institute of Occupational Safety and Health in Taiwan, including population density, age structure, immigration rate, economic activity, average family income, educational level and healthcare facilities (Tseng and Wu, 1986; Lin et al., 2005). It may well be that different variables have diverse impacts on female cancer prevention. Unfortunately, the database lacks information on important variables, with the exceptions of age structure and educational level. Thus, future research should focus on exploring the relationship between the two types of cancer check-ups and other dimensions, such as population density, economic activity and average family income.

Despite these limitations, this is the first nationwide-based study to use a bivariate probit model to examine variations in female cancer preventive care service utilization based upon urbanization levels. We have demonstrated that under the NHI program, there are variations in cervical and breast cancer utilization rates amongst those living in different urbanization levels in Taiwan. In addition, age, education level, marital status, birth experience and history of gynecological disease are other factors affecting female cancer preventive care utilization. This finding suggests that although the Bureau of National Health Insurance and the Department of Health have made significant advances with regard to cervical and breast cancer examinations, the health authorities still need to design effective policies aimed at enhancing accessibility to female cancer preventive care outside of the metropolitan areas.

The results of the bivariate probit model applied in this study, along with nationwide survey data, to explore the role of urbanization on Pap-smear screening and breast cancer examination utilization, show that urbanization levels do have a significant influence on such usage. As a result of protracted efforts by the government, following the implementation of the NHI program there has been

significant improvement, particularly in Pap-smear screening usage, in the more remote areas. In addition to such services being made available free of charge under the NHI, the health authorities have launched various programs aimed at increasing the knowledge and accessibility to cervical cancer preventive test services in less-developed areas.

These plans include home visits by public health nurses, mobile Pap-smear testing stations and frequent national TV and newspaper advertisements on the importance of Pap-smear testing. However, with regard to breast cancer preventive screening, women living in those areas at the lower levels of urbanization are significantly less likely to receive breast examinations as compared to those living in areas at the highest levels of urbanization. The utilization rate for breast cancer screening will undoubtedly rise as the NHI begins to provide free mammography testing; nevertheless, more effort is needed to reduce the disparities in the current utilization rates of breast cancer check-ups in Taiwan.

Acknowledgements

The authors would like to appreciate the National Health Research Institutes of the Republic of China, Taiwan for providing the data used in this study.

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