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Comparison of Two Adult Health Check-up Regimes: An experience from an Urban-Rural-Aboriginal Mixed Type Area, Nantou County, Taiwan

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ABSTRACT

Background Despite a number of studies addressing uptake of health check-up, very few studies were conducted to assess two screening regimes with one served on institution basis and the other on out-reaching basis from aspect of geographical and socio-demographic inequality in accessing to health check-up.

Aims The current study aimed to assess whether two screening regimes complement each other in terms of coverage rate and explore whether geographical or socio-demographic inequality exists and how socio-demographic features affect uptake of two screening regimes.

Methods Study population was based on 198,834 residents from an urban-rural-aboriginal mixed type area, Nantou County, located in central Taiwan. Data on uptake of two health check-up programmes, one featured by reach-in service and one featured by out-reaching service, and socio-demographic variables were collected. Coverage rate for the combination of two screening regimes was calculated by two age cohorts and the overlapping rate between the two regimes was also calculated. The association between socio-demographic variables and uptake of each screening regime or both was assessed by logistic regression model with adjustment for health status and severity of health. The independence of two screening regimes given socio-demographic variables was also evaluated.

Results For the young cohort, the overall coverage rate was 8.65% for AHPS only with 10.5% for female and 6.8% for male. The NCIS gives an incremental 6.1% of coverage rate to AHPS. Attendant involved in both programme was only 1.4%. For the elderly cohort, the overall coverage rate was 21.9% for AHPS only with 22% for female and 21.8% for male. The NCIS adds an incremental 6.2% of coverage rate to AHPS. Attendant involved in both programme was only 3.8%. The overlapping rate was small. Of total of 28,140 attenders in the AHPS, only approximately 2.04% (4,049) re-attend NCIS. After interaction assessment, gender difference in uptake of two screening regimes was modified by place of residence. After being stratified by place of residence and gender, all socio-demographic variables were statistically related to uptake of each or both of screening regimes after controlling for health status and the severity of health. For the elderly cohort, there was lacking of interaction terms between any of two variables and the main effects of all socio-demographic variables were statistically significant. For the part of independence of two screening regimes, all socio-demographic variables, medical utilization, and the severity of health made additional 14.13% contribution to uptake of out-reaching service given uptake of reach-in service for the elderly cohort whereas the corresponding figure was 37.64% for the young cohort.

Conclusions The present study compared two health check-up programmes, reach-in service and out-reaching service, to assess geographic and socio-demographic inequality in uptake of two programmes. Although out-reaching service did not substantially enhance the absolute coverage rate of reach-in service two programmes complement each other in solving geographic and socio-demographic inequality in uptake of preventive services.

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ABBREVIATIONS

AHPS	Adults' Health Promotion Service
AIC	Akaike's Information Criteria
CATMOD	Categorical Data Modeling
CIS	Community-based Integrated Screening
CRC	Colorectal Cancer
DF	Degree of Freedom
DM	Diabetes Mellitus
FOBT	Fecal Occult Blood Test
NCIS	Nantou Community-based Integrated Screening
NHI	National Health Insurance
OR	Odds Ratio
SAS	Statistical Analysis System
SD	Standard Deviation
95% CI	95% Confidence Interval

1. INTRODUCTION

Health check-up for the prevention of cancer or chronic disease has increasingly gained attention in the new era of public health. In the absence of efficient approach for primary prevention, secondary prevention through population-based screening plays an important role in reducing mortality and disability.

Screening benefits which contribute to mortality reduction from cancers has been demonstrated in earlier studies, such as breast cancer screening by mammography[1-3], colorectal cancer screening by fecal occult blood test (FOBT)[4-6], cervical cancer screening by Papanicolaou smear[7,8], liver cancer screening by ultrasound[9], and oral cancer by visual inspection[10]. In addition to cancer mortality reduction, early detection in asymptomatic chronic diseases including hypertension, hyperlipdemia, and type 2 diabetes mellitus (DM) has also been proven to prevent cardiovascular heart disease and avoid disability[11-14].

It is well believed that success or failure in a screening programme depends on the participation rate from individual level and the coverage rate from population level. A positive public health impact of a population-based screening programme relies on a large extent on optimising coverage rate. High coverage and attendance rate are highly remarked in Miller's principles of screening[15]. Earlier meta-analysis illustrated that 40% mortality reduction from breast cancer could be achieved among

women aged 50-69 years given high attendance rate[16].

High participation rate and coverage rate are very important not only to secondary prevention such as screening but also to primary prevention like health promotion. This is of paramount important to the developing country where secondary and primary prevention on heath are planned in a nascent condition. For example, Adults' Health Promotion Service (AHPS) has been proposed in Taiwan since 1995 after the introduction of National Health Insurance (NHI)[17]. AHPS is an institution-based screening service aimed at adult aged 40 years or older. Items covered in AHPS include preventable cancers such as breast cancer and colorectal cancer and chronic diseases including diabetes mellitus, hypertension, and hyperlipdemia. Since AHPS is a reach-in screening service per se whether residents dwelling in area such as rural or aboriginal district, where medical resource is scanty, are accessible to AHPS has been often criticized after the introduction of AHPS. To the best of our knowledge, around 10% to 20% coverage rate of AHPS has been achieved at the inception of NHI. Moreover, it seems that AHPS has been utilized by merely a group of people, particularly residents in metropolitan area, who frequently go "shopping" different clinics or hospitals. Little is known about socio-economic characteristics, medical utilization, and heath status for these attenders. Moreover, as the coverage rate varies with regions, geographical inequality has been frequently criticized.

To solve geographical or socio-demographic inequality of AHPS, a community-based integrated screening (CIS), has been introduced to complement the coverage rate of AHPS for those who have not been involved in AHPS either due to the lack of health motivation or due to the incapacity of accessing to AHPS. In

essence, the CIS is an out-reaching screening service in contrast to institution-based and reach-in service of AHPS. The programme has been experimented in Keelung City, the northernmost region of Taiwan, and has been demonstrated to enhance coverage rate and participation rate of Pap smear screening[18]. After then, this programme has been extended to other counties in Taiwan. However, as Keelung City is an urban-type region the amelioration of geographic inequality due to the supplementation of CIS is therefore less remarkable.

To test whether CIS programme and AHPS programme can complement each other by different districts, we selected one of counties having CIS, Nantou, located in middle Taiwan, of which townships are composed a mixture of urban, rural, and aboriginal area. This out-reaching screening service is called Nantou Community-based Integrated Screening (abbreviated as NCIS hereafter) that is organized by local health authorities.

In the face of two existing adult check-up programmes, it is necessary to investigate how the coverage rate of each programme varies with geographical area, socio-demographic characteristics, and two health-related variables. In addition, although AHPS has been conducted since 1995, little is known about the disparity across different types of townships and how socio-demographic and health-related factors affect uptake of AHPS.

More importantly, few studies were conducted to assess two screening programmes with one served on institution basis and the other on out-reaching basis. It is very interesting to assess whether two screening regimes are overlapped in terms of attenders. It is also very interesting to identify relevant factors affecting uptake of

out-reaching service like NCIS given routine institution-based service like AHPS.

The present study is therefore to make use of a population cohort from Nantou County to estimate the coverage rate in two regimes and to assess the relationship of uptake of two regimes to socio-demographic characteristics, place of residence, medical utilization, and health status.

2. AIMS OF THE STUDY

The purpose of present study is to assess whether AHPS and NCIS complement each other in terms of coverage rate and explore whether geographical or socio-demographic inequality exists and, if any, how socio-demographic features affect uptake of two screening regimes. The specific objectives were therefore:

1) to assess whether and how the population covered by AHPS is similar or different from that covered by NCIS according to different types of townships (urban, rural and aboriginal).

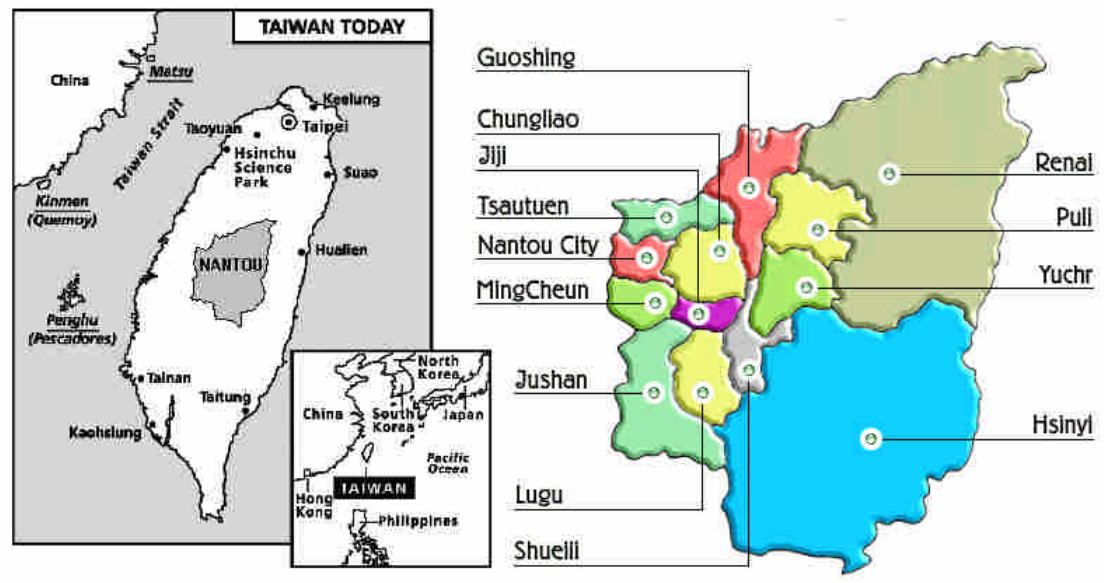
2) to assess whether and how AHPS or NCIS vary with socio-demographic features after controlling health-related variables.

3) to investigate whether uptake of NCIS can be affected by uptake of AHPS given geographical and socio-demographic inequality.

3. MATERIALS AND METHODS

3.1 Background of Nantou County

Figure 1 Geographical profile and distribution of administration districts in Nantou County



Nantou County, also known as “the mother of this land of Taiwan”, is located in the heart of Taiwan (see Figure 1). Geographically, at about 20,000,000 years ago, Taiwan Island was under the tectonic plate squeeze and emerged above the ocean surface. Jade Mountain, at 3,952 meters of height, is the highest in northeast Asia. Because most part of the Mt. Jade is spanned over Nantou County, the unique geographical environment renders the lifestyle of inhabitants residing in this area different from other people and also creates many barriers for Nantou people to access

health care or for medical professional to unwillingly provide medical care in this area. Medical resources are therefore unevenly distributed in Nantou County.

The Nantou County consists of a total of 463,298 residents according to household registration statistics in 1998. There are thirteen administrative districts in Nantou County. The character of township in Nantou is a mixture of urban (Nantou City 88,370, Puli 76,071, Tsautuen 83,173, Jiji 10,669, Ming-Cheun 37,194), rural (Jushan 53,311, Lugu17,237, Chungliao 15,040, Yuchr 15,330, Guoshing 19,425, Shueili 20,138), and aboriginal type (Hsinyi 14,832, and Renai 12,508).

Up to date, the indigenous tribesmen in Taiwan have been categorised into 12 tribes and many of the indigenous tribes live across the Nantou County, including the Tayal (泰雅) people, the Bunun (布農) people, the Tsou (邵) people and the Shou (鄒) people, who live just beside Sun-moon Lake. The indigenous tribes have a relative small population and a unique lifestyle (wild animal hunting, home-made wine drinking).

3.2 Adults' Health Promotion Service (AHPS)

Despite the improvement of accessibility to medical care, numerous people such as the elderly, the disabled, women, and children, and the uninsured may not have access to medical care when they suffer from illnesses. This issue in Taiwan has been constantly tackled by the introduction of NHI since 1995.

The implementation of the NHI on March 1st, 1995, rendered all equally accessible to health care. The NHI not only covers dependent groups such as children and the elderly, but also exempts citizens from co-payments related to major illness or injury.

Up to 2000 more than 97% of the populace has been covered by the NHI and approximately 98% of all private and public medical care institutions have signed a contract with the NHI to provide healthcare services.

In order to implement health promotion and earliness of detection of disease, Adults' Health Promotion Service (AHPS) has been initiated since 1995. The target subject of AHPS includes whole populace from cradle to grave. The contents of AHPS comprise both screening project for cancers and long-term illnesses in first phase and health consultation with physicians in second stage. Biochemical examination, physical examination, and health related information collection are performed in the first phase and referral and health consultation are provided in the second phase.

Although AHPS covers all ages, this thesis was only focused on adult aged 40 years or order. Two inter-screening intervals are applied according to age groups,

People aged 65 years or older are invited to attend health check-up annually and those who aged 40-64 have a three-year interval health check-up service.

AHPS before 2004 was an institution-based services rather than out-reach service because it is forbidden to provide out-reaching medical care services except first aid or medical emergencies by hospitals and clinics according to Article 8th in the “Law on Physicians” (of Taiwan).

3.3 Nantou Community-based Integrated Screening (NCIS)

Although the coverage rate, after the introduction of preventive care in AHPS, was enhanced, accessibility to this programme in area where medical resources are scanty like the Nantou County may be hampered. Some have sufficient medical resources and some rural-like townships were lacking medical manpower and facilitates. To tackle geographic inequality with respect to preventive services, a community-based screening in Nantou has been proposed as mentioned before. Accordingly, the main difference between AHPS and NCIS is that the former service is limitedly to institution but latter is to offer out-reaching service.

3.4 Data Sources

Three data were used in this study, including population registry, AHPS derived from claimed data on national health insurance, and NCIS from community-based out-reaching screening service. The details of three datasets are delineated as follows.

3.4.1 Population Registry

A total of 198,834 residents aged 40 years or older recorded in population registry of Nantou by the end of 1998 formed the study cohort in the current study. The population registry is regulated by the household registration office. Table 1 shows the frequencies of population size by the young (aged 40-64 years) and elderly cohort (65 years or above) in thirteen townships.

Note that since the inter-screening interval was three years for the young residents and annual for the elderly cohort during the period from 1998 to 2000. Table 1 only lists the population size of 1998 for the young cohort and of 1998-2000 for the elderly cohort. Information obtained from population registry included age, gender, married status, place of residence, and education classified in to five levels, illiterate, primary school, junior high school, senior high school, and college or above (see Table 2).

Table 1 The distribution of population size by two age cohorts in thirteen townships

	Young Cohort 1998		Elderly Cohort 1998		Elderly Cohort 1999		Elderly Cohort 2000	
Township	No.	%	No.	%	No.	%	No.	%
Nantou City	27,350	18.74	9,178	17.36	9,910	17.30	10,608	17.21
Puli	24,011	16.45	7,982	15.10	8,623	15.06	9,321	15.12
Tsautuen	26,041	17.84	7,763	14.69	8,503	14.85	9,222	14.96
Jushan	16,863	11.55	6,024	11.4	6,570	11.47	7,090	11.50
Jiji	3,444	2.36	1,595	3.02	1,738	3.03	1,873	3.04
Ming-Cheun	11,438	7.84	4,570	8.65	4,954	8.65	5,340	8.66
Lugu	5,748	3.94	2,686	5.08	2,896	5.06	3,098	5.03
Chungliao	5,088	3.49	2,503	4.74	2,694	4.70	2,916	4.73
Yuchr	5,132	3.52	2,357	4.46	2,535	4.43	2,714	4.40
Guoshing	6,624	4.54	2,766	5.23	2,990	5.22	3,204	5.20
Shueili	6,544	4.48	2,693	5.09	2,924	5.11	3,131	5.08
Hsinyi	4,010	2.75	1,448	2.74	1,563	2.73	1,672	2.71
Renai	3,685	2.52	1,291	2.44	1,375	2.40	1,457	2.36
Total	145,978	100	52,856	100	57,275	100	61,646	100

Table 2 Operational definition of variable

Variable	Labels
Socio-demographic	
Age	Five (5)-year-age group is used
Gender	Male and female
Place of residence	Nantou county is composed of 13 townships and classified as urban (Nantou City, Puli, Tsautuen, Jiji, Ming-Cheun), rural (Jushan, Lugu, Chungliao, Yuchr, Guoshing, Shueili), and aboriginal district (Hsinyi, Renai) as Nantou County
Married status	Single, married, divorced, and widowhood
Education level	Illiterate, primary school, senior high school, senior high school, and college or above
Medical utility	
None	Never use any medical resource, 1997
Scant	Medical utilization 1-4 times, 1997
Low	Medical utilization 5-12 times, 1997
Moderate	Medical utilization 13-52 times, 1997
Frequent	Medical utilization more than 53 times, 1997
Health status	
Normal	Without any of the chronic diseases D
Moderate	At maximum two of the chronic diseases D
Severe	At least three of the chronic diseases D

D: brain apoplexy, asthma, diabetes mellitus, heart disease, hypertension

3.4.2 AHPS Data

Information on attenders of AHPS was collected through the period from 1998 to 2000. The operational definition of variables is listed in Table 2. In addition to demographic characteristics, medical utilization and health status were also collected. Subject health status was determined by brain apoplexy, asthma, diabetes mellitus, heart disease, and hypertension defined by ICD coded in the claimed data of NHI. Three levels of health status were defined and shown in Table 2 Medical utilization was classified as frequent, moderate, low, scant, and none by number of outpatient visits.

By the linkage of population registry with data on AHPS by personal identification number a total of 28,140 residents had uptake of AHPS between 1998 and 2000. In addition to demographic variables (age, gender, education level, married status, and place of residents) collected from population registry. Medical utilization and health status were also collected. Table 3 lists the frequencies of socio-demographic variables, utilization, and health status for these 28,140 attenders on AHPS.

3.4.3 NCIS Data

Table 3 also lists the distribution of relevant variables for attenders of NCIS as seen in AHPS.

Table 3 The frequencies of attendants of AHPS and NCIS

	AHPS		NCIS	
	No.	%	No.	%
Sex				
Female	15,742	55.94	10,018	61.87
Male	12,398	44.06	6,174	38.13
Age				
40-44	2,379	8.45	1,956	12.08
45-49	2,862	10.17	2,156	13.32
50-54	2,564	9.11	1,839	11.36
55-59	3,056	10.86	2,289	14.14
60-64	3,691	13.12	2,641	16.31
65-69	5,268	18.72	2,345	14.48
70-74	4,419	15.70	1,811	11.18
75-79	2,419	8.60	808	4.99
80+	1,482	5.27	347	2.14
Education				
Illiteracy	4,323	15.36	1,828	11.29
Elementary	17,479	62.11	10,254	63.33
Junior	2,681	9.53	1,685	10.41
Senior	2,395	8.51	1,607	9.92
University	1,262	4.48	818	5.05
Married status				
Married	20,951	74.45	12,643	78.08
Widowhood	5,790	20.58	2,876	17.76
Divorced	691	2.46	403	2.49
Single	708	2.52	270	1.67
Place of residence				
Urban	15,057	53.51	6,683	41.27
Rural	12,177	43.27	7,417	45.81
Aboriginal	906	3.22	2,092	12.92
Medical utilization				
Frequent	1,514	5.38	651	4.02
Moderate	13,548	48.14	7,213	44.55
Low	7,014	24.93	4,490	27.73
Scant	4,147	14.74	2,604	16.08
None	1,917	6.81	1,234	7.62
Health status				
Severe	3,561	12.65	1,442	8.91
Mild	11,122	39.52	6,034	37.27
Non-chronic	13,457	47.82	8,716	53.83
Total	28,140	100	16,192	100

3.5 Outcome Measurement

The primary outcome of interest in the current study was uptake of adult health check-up. Linkage between AHPS and NCIS dataset yielded four types of outcome, including failure of attending two regimes, uptake of AHPS only, uptake of NCIS only, and uptake of both regimes. As mentioned before, the available period of AHPS was only from 1998 to 2000. Although the NCIS dataset have been conducted until 2002 however, only data before 2000 was used in the current study in order to match the study period of AHPS.

3.6 Factors Related to Attendance

According to previous literatures, a number of factors affect attendance rate of screening regime. However, as our study places emphasis on geographical or socio-demographic inequality as mentioned before the present study was only focused on socio-demographic variables and treated two health-related variables as extraneous controlled variables. Instead, we would like to compare two regimes in terms of only socio-demographic and health-related variables. Furthermore, NCIS is also proposed to complement AHPS in respect of geographic and socio-demographic inequality after controlling for health status and medical utilization. The operational definitions of these factors are described in Table 2.

3.7 Independence of Two Programmes

Let $P(U_{x1})$ and $P(U_{x2})$ denote two probabilities of attending AHPS (X_1) and NCIS (X_2). Note that U stands for uptake of X_1 or X_2. Although two programmes are independent, there are a number of residents who may attend either of two or both. It should be noted that X_1 was initiated since national health insurance has been introduced whereas X_2 was implemented after X_1 and was to enhance the coverage rate of AHPS. We assume those who had uptake of X_1 had higher likelihood of showing up in X_2 if X_2 comes after X_1. The null and alternative hypotheses are therefore operated by the following expression:

$$\begin{aligned} H_0 &: P\left(U_{X_2} \mid U_{X_1}\right) = P\left(U_{X_2}\right) \\ H_1 &: P\left(U_{X_2} \mid U_{X_1}\right) > P\left(U_{X_2}\right) \end{aligned} \tag{1}$$

The event of U may be affected by a constellation of K factors denoted by a vector of $C = (C_1, C_2, \ldots C_k)$. In our study, they may consist of age, gender, place of residence, education level, married status, health status, and medical utilization. Suppose C can fully account for U, we expect the alternative hypothesis mentioned above to be modified into to the following expression:

$$P\left(U_{X_2} \mid U_{X_1}, C\right) \approx P\left(U_{X_2} \mid C\right) \tag{2}$$

If the expression (2) is modeled by logistic regression, this postulate is assessed by the two logistic regression models:

$$\textit{Model I: Logit } P\left(U_{X_2}=1\right)=\alpha+\beta_a\left(U_{X_1}\right)+C^T\beta$$

$$\textit{Model II: Logit } P\left(U_{X_2}=1\right)=\alpha+\beta_u\left(U_{X_1}\right) \tag{3}$$

The logic for the expression mentioned above is upheld by the following statements.

Suppose a vector of covariates, say *C*, can capture uptake of U_{X_2} regardless of the presence of U_{X_1}, this gives the following expression:

$$F\left(U_{X_2}\mid U_{X_1},C\right)=F\left(U_{X_2}\mid C\right) \tag{4}$$

Consider the null hypothesis that U_{X_1} is independent of *C*. This gives

$$P\left(U_{X_1}\mid C\right)=P\left(U_{X_1}\right) \tag{5}$$

and the following decomposition:

$$\begin{aligned} &F\left(U_{X_2}\mid U_{X_1}\right)\\ &=\sum_j F\left(U_{X_2}\mid U_{X_1},C_j\right)f\left(C_j\mid U_{X_1}\right)\\ &=\sum_j F\left(U_{X_2}\mid C_j\right)f\left(C_j\right) \end{aligned} \tag{6}$$

So

$$F\left(U_{X_2} \mid U_{X_1}\right) = F\left(U_{X_2}\right) \tag{7}$$

Hence any test on the null hypothesis (7) will test the null hypothesis (5) under the criterion (4). Note that for departure from (5) an additional condition should be met

$$F\left(U_{X_2} \mid C_j\right) \neq F\left(U_{X_2}\right) \tag{8}$$

This suggests that C_j must be a significant correlates for uptake of U_{X_2}.

To let these logic arguments be operated with logistic regression, the following expressions were developed:

$$\frac{P(U_{X_2}=1 \mid U_{X_1}=1)}{P(U_{X_2}=1 \mid U_{X_1}=0)}$$

$$= \frac{P(U_{X_2}=1 \mid U_{X_1}=1, C)}{P(U_{X_2}=1 \mid U_{X_1}=0, C)} \times \frac{P(U_{X_1}=1 \mid C)}{P(U_{X_1}=0 \mid C)} \tag{9}$$

This gives

$$R = \frac{P(U_{X_1}=1 \mid C)}{P(U_{X_1}=0 \mid C)} = \frac{A}{B} \tag{10}$$

Where $A = \dfrac{P(U_{X_2}=1 \mid U_{X_1}=1)}{P(U_{X_2}=1 \mid U_{X_1}=0)}$ $\qquad$ $B = = \dfrac{P(U_{X_2}=1 \mid U_{X_1}=1, C)}{P(U_{X_2}=1 \mid U_{X_1}=0, C)}$

The left component of (10) is similar to test the expression (5).

Hence, the larger the value of *R*, the greater extent the departure from the expression (5) is. If we take the logarithm of *R*, thus, we can compared the difference between *log A* and *log B*, which coincide with two logistic regression models mentioned in the expression (3).

3.8 Statistical Analysis

Chi-square test was used to assess the relationships of attendance with AHPS to the risk factors of interest, and polychotomous logistic regression was used for multivariate analysis. The two-way interactions between these factors of interest were also examined. We used the CATMOD procedures of the SAS system, version 8.2, for the analyses.

For the independence of two screening regimes, we calculated *[1-(β_a/β_u)×100%]* to account for the additional contribution made from *C* to uptake of NCIS given uptake of AHPS, including place of residence, age, gender, married status, education, and disease severity. The 95% confidence interval was also calculated by using Feller Theorem:

$$1-\frac{\beta_a \times \beta_u \pm \sqrt{\beta_a{}^2 \times \beta_u{}^2 - [\beta_a{}^2 - Var(\beta_a)][\beta_u{}^2 - Var(\beta_u)]}}{\beta_u{}^2 - Var(\beta_u)} \qquad (11)$$

Suppose we have *C* (living area, medical utilization, age, gender, marital status, education level, and disease severity), the present study was to assess what's additional contribution to uptake of NCIS given uptake of AHPS.

4 RESULTS

4.1 Basic Findings

A total of 198,834 residents who were characterised as two cohorts by age were enrolled in the present study. Of 198,834, 145,978 (73.42%) subjects were classified in young cohort that defined as aged 40-64 years and 52,856 subjects were classified in elderly cohort that defined as aged more than 65 years. The median age was 50.30 (SD=7.30) and 72.54 (SD=6.08) in young cohort and elderly cohort, respectively.

Table 3 shows the distributions of attenders of AHPS and NCIS in the light of socio-demographic, medical utilization, and health status. Compared with AHPS, female predominated in the NCIS. NCIS served more residents in aboriginal area but less in urban area than AHPS. The distributions of the rest of variables were identical between NCIS and AHPS.

Table 4 shows similar distributions as listed in Table 3 by the stratification of four types of outcome, AHPS only, NCIS only, both, and none of both. For attenders of NCIS only, female still had a higher proportion than male.

Table 5 lists the coverage rate of AHPS only, NCIS only and both. For the young cohort, the overall coverage rate was 8.65% for AHPS only with 10.5% for female

and 6.8% for male. The NCIS gives an incremental 6.1% of coverage rate to AHPS. Attendant involved in both programme was only 1.4%. The coverage rate increased with age from 5.3% for residents aged 40-44 years to 13.3% for residents aged 60-64 years for AHPS, from 4.2% for residents aged 40-44 years to 8.7% for residents aged 60-64 years for NCIS only, and from 0.6% for residents aged 40-44 years to 2.7% for residents aged 60-64 years for both. The lower the education level, the higher the coverage rate is. This was more remarkable for AHPS but less for NCIS only. The highest coverage rate was observed in widow status followed by married, divorced and single. Residents in urban or rural had higher coverage rate but lower rate in aboriginal area for AHPS programme. However, the reverse was observed for attenders with NCIS only. The more medical utilization or the severe health status, the higher the attendance rate was. This phenomenon was also remarkable for AHPS only.

For the elderly cohort, the overall coverage rate was 21.9% for AHPS only with 22% for female and 21.8% for male. The NCIS adds an incremental 6.2% of coverage rate to AHPS. Attendant involved in both programme was only 3.8%.There was no substantial difference across age groups for AHPS but an increasing rate with age for uptake of NCIS only or both. Unlike the young cohort, there was lacking of substantial difference with respect to education level. Coverage rate regarding AHPS did not vary with married status. However, the married or the widowed were more likely to have uptake of NCIS or both compared with the divorced or the single. Residents in urban or rural had higher coverage rate but lower rate in aboriginal area for AHPS programme. However, the reverse was observed for attenders with NCIS only. Again, the more medical utilization or the sever health status, the higher the attendance rate was.

Table 4 The distribution of each correlate by uptake of AHPS only, NCIS only, and both.

	No.	AHPS only		NCIS only		Both		Non-uptake	
		No.	%	No.	%	No.	%	No.	%
Sex									
Female	96,108	13,182	54.7	7,458	61.4	2,560	46.0	72,908	63.2
Male	102,726	10,909	45.3	4,685	38.6	1,489	54.0	85,643	36.8
Age									
40-44	40,800	2,152	8.9	1,729	14.2	227	23.1	36,692	5.6
45-49	35,285	2,521	10.5	1,815	15.0	341	19.3	30,608	8.4
50-54	23,765	2,227	9.2	1,502	12.4	337	12.4	19,699	8.3
55-59	23,116	2,559	10.6	1,792	14.8	497	11.5	18,268	12.3
60-64	23,012	3,061	12.7	2,011	16.6	630	10.9	17,310	15.6
65-69	20,211	4,418	18.3	1,495	12.3	850	8.5	13,448	21.0
70-74	15,945	3,708	15.4	1,100	9.1	711	6.6	10,426	17.6
75-79	9,444	2,096	8.7	485	4.0	323	4.1	6,540	8.0
80+	7,256	1,349	5.6	214	1.8	133	3.5	5,560	3.3
Education level									
Illiteracy	20,129	3,709	15.4	1,214	10.0	614	9.2	14,592	15.2
Elementary	107,926	14,835	61.6	7,610	62.7	2,644	52.3	82,837	65.3
Junior	27,660	2,324	9.7	1,328	10.9	357	14.9	23,651	8.8
Senior	28,353	2,119	8.8	1,331	11.0	276	15.5	24,627	6.8
University	14,766	1,104	4.6	660	5.4	158	8.1	12,844	3.9
Married status									
Married	153,282	17,904	74.3	9,596	79.0	3,047	77.4	122,735	75.3
Widowhood	28,728	4,913	20.4	1,999	16.5	877	13.2	20,939	21.7
Divorced	8,084	611	2.5	323	2.7	80	4.5	7,070	2.0
Single	8,740	663	2.8	225	1.9	45	4.9	7,807	1.1
Place of residence									
Urban	123,372	13,524	56.1	5,150	42.4	1,533	65.1	103,165	37.9
Rural	65,028	9,873	41.0	5,113	42.1	2,304	30.1	47,738	56.9
Aboriginal	10,434	694	2.9	1,880	15.5	212	4.8	7,648	5.2
Medical Utilization									
Frequent	5,597	1,293	5.4	430	3.5	221	2.3	3,653	5.5
Moderate	66,097	11,396	47.3	5,061	41.7	2,152	30.0	47,488	53.2
Low	50,997	5,989	24.9	3,465	28.5	1,025	25.6	40,518	25.3
Scant	41,351	3,662	15.2	2,119	17.5	485	22.1	35,085	12.0
None	34,792	1,751	7.3	1,068	8.8	166	20.1	31,807	4.1
Health status									
Severe	13,600	3,025	12.6	906	7.5	536	5.8	9,133	13.2
Mild	55,161	9,372	38.9	4,284	35.3	1,750	25.1	39,755	43.2
Non-chronic	130,073	11,694	48.5	6,953	57.3	1,763	69.2	109,663	43.5
Total	198,834	24,091	100	12,143	100	4,049	100	158,551	100

Table 5 The attendance rate of both screening regimes by each correlate for the two age cohorts.

	Young cohort								Elderly cohort							
	AHPS only		**NCIS only**		**Both**		**Non-uptake**			AHPS only		NCIS only		**Both**		**Non-uptake**	
	No.	%	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	No.	%
Gender									**Gender**								
Female	7,318	10.5	5,591	8.1	1,405	2.0	55,155	79.4	Female	5,864	22.0	1,867	7.0	1,155	4.3	17,753	66.6
Male	5,202	6.8	3,258	4.3	627	0.8	67,422	88.1	Male	5,707	21.8	1,427	5.4	862	3.3	18,221	69.5
Age									**Age**								
60-64	3,061	13.3	2,011	8.7	630	2.7	17,310	75.2	80+	1,349	21.9	214	7.4	133	4.2	5,560	66.5
55-59	2,559	11.1	1,792	7.8	497	2.2	18,268	79.0	75-79	2,096	23.3	485	6.9	323	4.5	6,540	65.4
50-54	2,227	9.4	1,502	6.3	337	1.4	19,699	82.9	70-74	3,708	22.2	1,100	5.1	711	3.4	10,426	69.3
45-49	2,521	7.1	1,815	5.1	341	1.0	30,608	86.8	65-69	4,418	18.6	1,495	3.0	850	1.8	13,448	76.6
40-44	2,152	5.3	1,729	4.2	227	0.6	36,692	89.9									
Education level									**Education level**								
Illiteracy	795	12.5	472	7.4	145	2.3	4,960	77.8	Illiteracy	2,914	21.2	742	5.4	469	3.4	9,632	70.0
Elementary	7,791	10.3	5,384	7.1	1,339	1.8	61,418	80.9	Elementary	7,044	22.0	2,226	7.0	1,305	4.1	21,419	67.0
Junior	1,655	6.7	1,162	4.7	230	0.9	21,746	87.7	Junior	669	23.3	166	5.8	127	4.4	1,905	66.5
Senior	1,560	6.1	1,239	4.8	209	0.8	22,749	88.3	Senior	559	21.5	92	3.5	67	2.6	1,878	72.3
University	719	5.5	592	4.5	109	0.8	11,704	89.2	University	385	23.5	68	4.1	49	3.0	1,140	69.4
Married status									**Married status**								
Married	10,516	8.7	7,422	6.1	1,726	1.4	101,132	83.7	Married	7,388	22.7	2,174	6.7	1,321	4.1	21,603	66.5
Widowhood	1,179	11.3	943	9.0	226	2.2	8,128	77.6	Widowhood	3,734	20.5	1,056	5.8	651	3.6	12,811	70.2
Divorced	453	6.2	289	3.9	60	0.8	6,540	89.1	Divorced	158	21.3	34	4.6	20	2.7	530	71.4
Single	372	5.1	195	2.7	20	0.3	6,777	92.0	Single	291	21.2	30	2.2	25	1.8	1,030	74.9
Place of residence									**Place of residence**								
Urban	6,712	7.3	3,982	4.3	838	0.9	80,752	87.5	Urban	6,812	21.9	1,168	3.8	695	2.2	22,413	72.1
Rural	5,426	11.8	3,477	7.6	1,087	2.4	36,009	78.3	Rural	4,447	23.4	1,636	8.6	1,217	6.4	11,729	61.6
Aboriginal	382	5.0	1,390	18.1	107	1.4	5,816	75.6	Aboriginal	312	11.4	490	17.9	105	3.8	1,832	66.9
Medical Utilization									**Medical Utilization**								
Frequent	363	15.2	224	9.4	62	2.6	1,735	72.8	Frequent	930	28.9	206	6.4	159	5.0	1,918	59.7
Moderate	5,018	12.2	3,410	8.3	967	2.4	31,815	77.2	Moderate	6,378	25.6	1,651	6.6	1,185	4.8	15,673	63.0
Low	3,508	9.0	2,628	6.8	592	1.5	32,181	82.7	Low	2,481	20.5	837	6.9	433	3.6	8,337	69.0
Scant	2,407	7.1	1,706	5.0	297	0.9	29,528	87.0	Scant	1,255	16.9	413	5.6	188	2.5	5,557	75.0
None	1,224	4.1	881	3.0	114	0.4	27,318	92.5	None	527	10.0	187	3.6	52	1.0	4,489	85.4
Health status									**Health status**								
Severe	808	15.2	431	8.1	166	3.1	3,896	73.5	Severe	2,217	26.7	475	5.7	370	4.5	5,237	63.1
Mild	3,990	12.0	2,795	8.4	751	2.3	25,676	77.3	Mild	5,382	24.5	1,489	6.8	999	4.6	14,079	64.1
Non-chronic	7,722	7.2	5,623	5.2	1,115	1.0	93,005	86.5	Non-chronic	3,972	17.6	1,330	5.9	648	2.9	16,658	73.7
Total	12,520		8,849		2,032		122,577		**Total**	11,571		3,294		2,017		35,974	

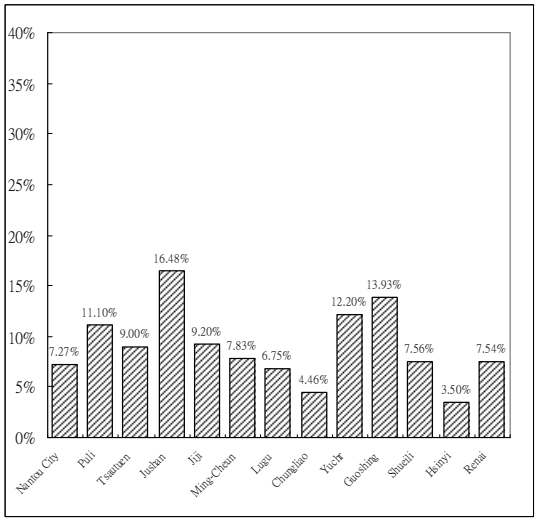
4.2 Comparison of AHPS and NCIS

Figures 2 (a)-(d) show coverage rates by townships for two age cohorts. For the young cohort, the coverage rate of AHPS varied across areas with high rate of 15% or above observed in Jushan, Jiji, and Yuchr, with moderate rate between 10%-15% in Puli, Guoshing, Shueili, with poor rate of 10% or below in Nantou City, Tsautuen, Ming-Cheun, Lugu, Chungliao, Hsinyi, and Renai. Low coverage rate of AHPS in some townships, particularly aboriginal ones, was offset by high coverage rate of NCIS. The similar and more pronounced phenomenon was also observed for the elderly cohort. The coverage rate of geographical distribution is also shown in Figure 3 (a)-(d). Clearly, two coverage rates complemented each other.

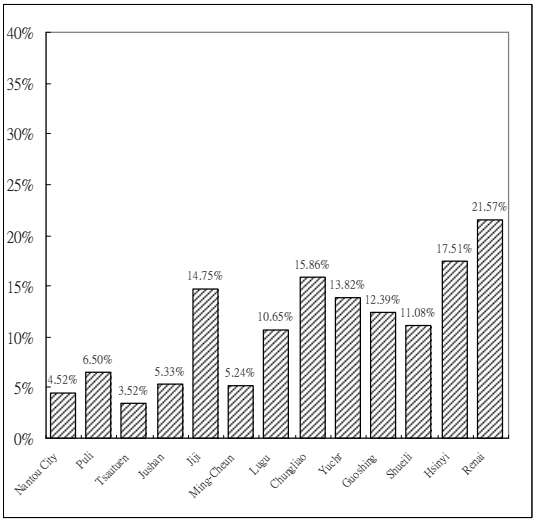
Figure 4 shows Venn Diagram of two screening regimes, AHPS and NCIS. There were a total of 40,283 (A+B+C) attenders either involved in AHPS or NCIS. Of total of 28,140 attenders in the AHPS, only approximately 2.04% (4,049) re-attend NCIS. This suggests that the overlapping of two screening regimes was small.

Figures 2 (a)-(d) The coverage rates by townships for two age cohorts.

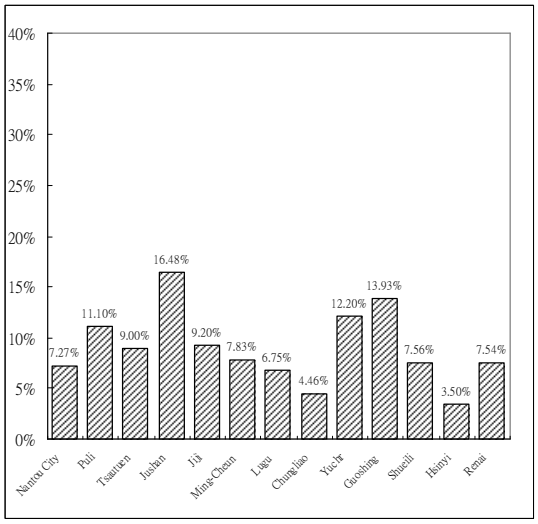
(a) Young cohort AHPS coverage rate



(b) Young cohort NCIS coverage rate



(c) Elderly cohort AHPS coverage rate



(d) Elderly cohort NCIS coverage rate

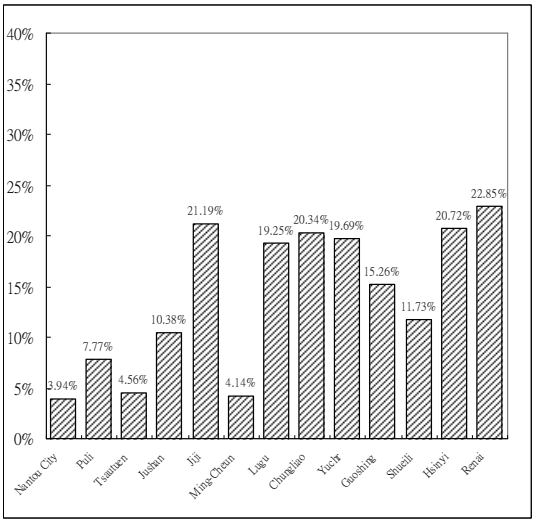
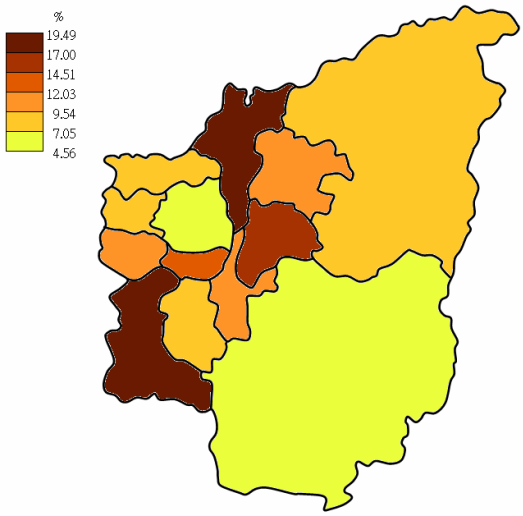
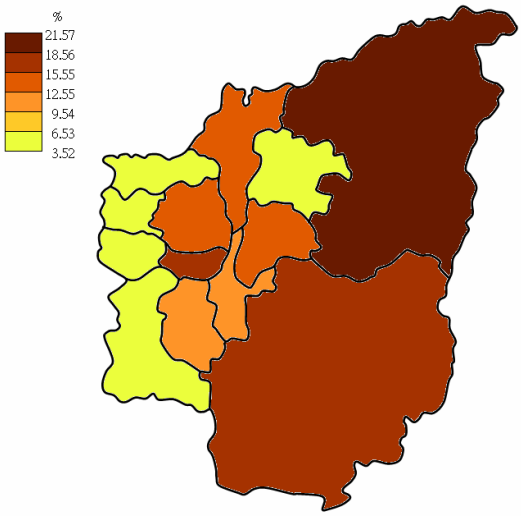


Figure 3 (a)-(d)　Coverage rate of geographical distribution for two age cohorts.

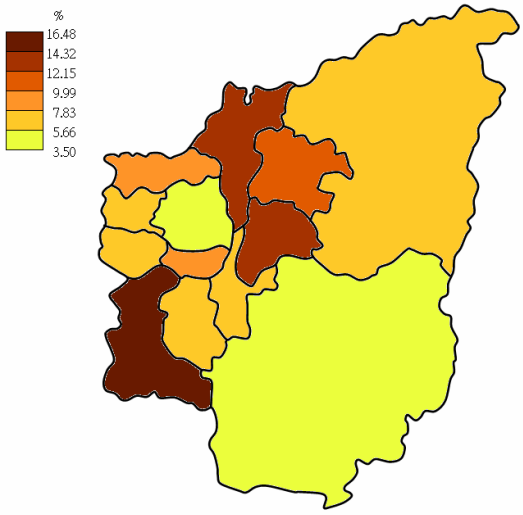
(a) Young cohort AHPS coverage rate



(b) Young cohort NCIS coverage rate



(c) Elderly cohort AHPS coverage rate



(d) Elderly cohort NCIS coverage rate

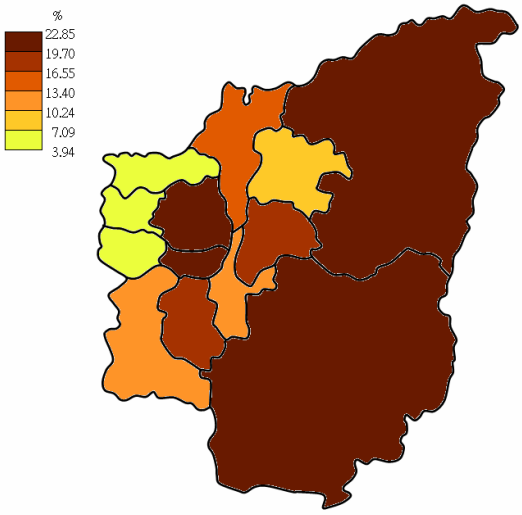
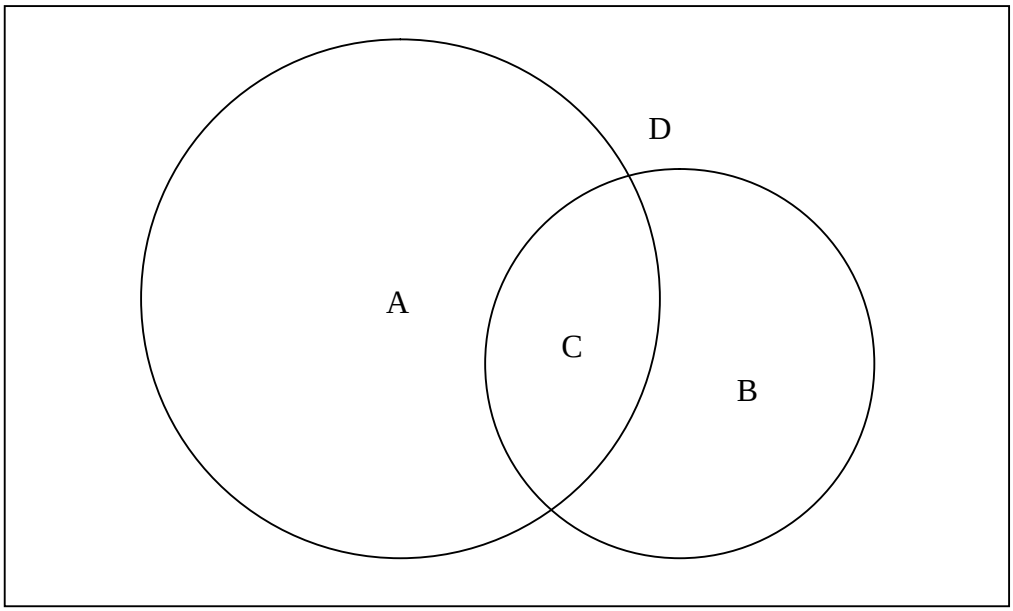


Table 6 also shows the corresponding results by urbanization and age groups. In urban area, the coverage rate of either AHPS or NCIS was 8.9% for male and 16.3% for female in the young age group 40-64. The corresponding figures were 26.8% for male and 29.1% for female in the elderly people aged 65 year or older. In rural area, the coverage rate of either AHPS or NCIS was 16.2% for male and 28.1% for female in the young cohort. The corresponding figures were 37.3% for male and 39.4% for female in the elderly people. In aboriginal district, the coverage rate of two screening regimes was 20.1% for male and 30.1% for female in the young cohort. The corresponding figures were 28.4% for male and 38.1% for female in the elderly cohort.

It is very interesting to note that for the elderly cohort the total coverage rate in the urban area was close to that in the aboriginal district. The coverage rate of AHPS was lower but that of NCIS was higher in the aboriginal district compared with urban area. The coverage rates of NCIS in rural or urban area almost that in aboriginal district. On the other hand, the coverage rate of NCIS was higher in rural area or even higher in aboriginal district. The similar findings were noted for those who had uptake of both regimes. This can also account for why the highest coverage rate was seen in rural area in part because of high coverage rate of AHPS and in part because of moderate coverage rate of NCIS.

The similar results were also observed in the young cohort. Note that urban area had very lower coverage rate of attending two screening regimes. Unlike the elderly cohort, the difference in coverage rate of AHPS across three areas was not conspicuous in the young cohort.

Figure 4 Venn Diagram of two screening regimes, AHPS and NCIS.



Overall

A: 24,091 (12.12%)
B: 12,143 (6.11%)
C: 4,049 (2.04%)
D: 158,551 (79.74%)

Table 6 Coverage rate by urbanization and age groups.

	Urban area				Rural area				Aboriginal district			
	Male		Female		Male		Female		Male		Female	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Young cohort												
A	2,732	5.8	3,980	8.9	2,303	9.3	3,123	14.7	167	3.9	215	6.4
B	1,226	2.6	2,756	6.1	1,369	5.5	2,108	9.9	663	15.3	727	21.6
C	235	0.5	603	1.3	355	1.4	732	3.5	37	0.9	70	2.1
D	43,227	91.2	37,525	83.6	20,731	83.7	15,278	71.9	3,464	80.0	2,352	69.9
Elderly cohort												
A	3,400	21.8	3,412	22.1	2,144	23.4	2,323	23.4	163	11.5	149	11.3
B	485	3.1	683	4.4	735	8.0	901	9.1	207	14.6	283	21.4
C	289	1.9	406	2.6	540	5.9	677	6.9	33	2.3	72	5.4
D	11,454	73.3	10,959	70.9	5,754	62.7	5,975	60.6	1,013	71.5	819	61.9

A: AHPS only, **B:** NCIS only, **C:** Both, and **D:** Non-undertake

4.3 Factors Associated with Uptake of Two Programmes

4.3.1 Model Selection

Table 7 shows a series of results of model selection using AIC criteria for the comparison betweens the two consecutive models for the young cohort. As far as the interaction was concerned, gender difference in uptake of two screening regimes was modified by place of residence. The other significant interaction term was age×gender.

For the elderly cohort, see Table 8, the main effects of all variables were statistically significant. However, there was lacking of any interaction term with respect to age, gender, education, and married status.

Table 7 Model selection in young cohort

Model	-2log likelihood	df	AIC	P value
None	171315.390		0.000	
C_1	161783.770	6	9519.620	0.00E+00
$C_1 + C_2$	158188.120	12	3571.650	0.00E+00
$C_1 + C_2 + C_3$	156122.190	12	2041.930	0.00E+00
$C_1 + C_2 + C_3 + C_4$	154664.700	3	1451.490	0.00E+00
$C_1 + C_2 + C_3 + C_4 + C_5$	154522.130	9	124.570	1.55E-22
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6$	154388.840	12	109.290	8.27E-18
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7$	154319.940	6	56.900	1.91E-10
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_3$	154238.260	12	57.680	5.96E-08
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_1$	154198.490	6	27.770	1.04E-04
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_6$	154181.270	12	-6.780	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_5$	154278.820	9	-98.330	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_7$	154189.010	6	-2.520	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_2$	154190.000	12	-15.510	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_6$	154129.450	48	-26.960	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_5$	154167.480	36	-40.990)	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_1$	154149.500	24	0.990	1.00E+00
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_7$	154161.860	24	-11.370	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_2$	154138.110	48	-35.620	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_6*C_5$	154138.770	36	-12.280	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_6*C_1$	154124.440	24	26.050	3.51E-01
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_6*C_7$	154182.600	24	-32.110	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_6*C_2$	154141.860	48	-39.370	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_5*C_1$	154169.500	18	-7.010	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_5*C_7$	154183.060	18	-20.570	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_5*C_2$	154123.770	36	2.720	1.00E+00
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_1*C_7$	154186.200	12	-11.710	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_1*C_2$	154155.400	24	-4.910	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_7*C_2$	154180.070	24	-29.580	NA

C_1: Place of residence
C_2: Medical utilization
C_3: Age
C_4: Gender
C_5: Married status
C_6: Education level
C_7: Disease severity

Table 8 Model selection in elderly cohort

Model	-2log likelihood	df	AIC	P value
None	94297.747		0.000	
C_1	89730.903	6	4554.844	0.00E+00
$C_1 + C_2$	88286.382	12	1420.521	5.23E-297
$C_1 + C_2 + C_3$	87757.877	9	510.505	3.24E-104
$C_1 + C_2 + C_3 + C_4$	87698.857	3	53.020	1.82E-11
$C_1 + C_2 + C_3 + C_4 + C_5$	87612.075	9	68.782	2.64E-11
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6$	87552.121	6	47.954	1.21E-08
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7$	87485.850	12	42.271	3.00E-05
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_3$	87470.356	9	-2.506	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_6$	87453.362	12	8.488	7.46E-01
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_5$	87478.939	9	-11.089	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_1$	87476.358	6	-2.508	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_7$	87474.902	6	-1.052	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_4*C_2$	87477.078	12	-15.228	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_6$	87445.482	36	-31.632	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_5$	87451.191	27	-19.341	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_1$	87463.238	18	-13.388	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_7$	87457.025	18	-7.175	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_3*C_2$	87451.592	36	-37.742	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_6*C_5$	87446.629	36	-32.779	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_6*C_1$	87439.773	24	-1.923	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_6*C_7$	87467.223	24	-29.373	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_6*C_2$	87451.768	48	-61.918	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_5*C_1$	87452.242	18	-2.392	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_5*C_7$	87464.166	18	-14.316	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_5*C_2$	87441.246	35	-25.396	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_1*C_7$	87469.961	12	-8.111	NA
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_1*C_2$	87436.818	24	1.032	1.00E+00
$C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_7*C_2$	87467.100	24	-29.250	NA

C_1: Place of residence
C_2: Medical utilization
C_3: Age
C_4: Gender
C_5: Married status
C_6: Education level
C_7: Disease severity

4.3.2 Estimated Adjusted Odds Ratio

Table 9 shows the estimated odds ratios (OR) for relevant variables associated with three types of attenders on AHPS or NCIS using polytomous logistic regression.

In univariate analysis, female was more likely to have uptake of AHPS or NCIS than male, with the orders of odds ratio being 1.72 (1.66-1.79) for AHPS only, 2.10 (2.01-2.19) for NCIS only, and 2.74 (2.49-3.01) for both of programmes. As far as age is concerned, the probabilities of having uptake of screening were proportional to advancing age. Education level was inversely associated with uptake of screening. Those who were married, widowhood or divorced had higher likelihood of attending both health check-up programmes compared with single status. By the stratification of area into three categories, urban, rural, and aboriginal district people who sought AHPS were the most frequently seen in rural area, followed by urban area, and aboriginal district. For NCIS, aboriginal district was the most probable for being covered by NCIS. The second was rural area, followed by urban area. Those who attended both programmes were the residents living in rural area, followed by aboriginal district, and urban area.

For health related variables, it can be seen that those whose health status were severe or who had higher medical utilization were more likely to attend health check-up compared with those who were healthy or less frequent in medical utilization. Table 9 also shows the results of multivariate analysis. After adjustment for the variable in each other, all variables still remained statistically significant. This suggests each factor was independent of each other.

Table 9 Univariate analysis of crude and adjusted odds ratios for the association between correlates and the uptake of AHPS among subjects aged 40-64 years

	Crude Odds Ratio (95% CI)						Adjusted Odds Ratio (95% CI)					
	AHPS only		NCIS only		Both		AHPS only		NCIS only		Both	
Sex												
Female	1.72 (1.66-1.79)	p<.0001	2.10 (2.01-2.19)	p<.0001	2.74 (2.49-3.01)	p<.0001	1.48 (1.42-1.54)	p<.0001	2.00 (1.91-2.10)	p<.0001	2.42 (2.19-2.68)	p<.0001
Male	1.00		1.00		1.00		1.00		1.00		1.00	
Age												
60-64	3.02(2.85-3.20)		2.47(2.31-2.64)		5.88(5.05-6.85)		2.23 (2.09-2.39)		2.35 (2.18-2.54)		4.63 (3.89-5.50)	
55-59	2.39(2.25-2.54)		2.08(1.94-2.23)		4.40(3.75-5.15)		1.87 (1.75-1.99)		1.99 (1.85-2.15)		3.58 (3.01-4.25)	
50-54	1.93(1.81-2.05)	p<.0001	1.62(1.51-1.74)	p<.0001	2.77(2.33-3.27)	p<.0001	1.62 (1.52-1.73)	p<.0001	1.57 (1.46-1.70)	p<.0001	2.41 (2.02-2.88)	p<.0001
45-49	1.40(1.32-1.49)		1.26(1.18-1.35)		1.80(1.52-2.13)		1.29 (1.21-1.38)		1.27 (1.18-1.36)		1.73 (1.46-2.06)	
40-44	1.00		1.00		1.00		1.00		1.00		1.00	
Education												
Illiteracy	2.61 (2.35-2.90)		1.88 (1.66-2.14)		3.14 (2.44-4.03)		1.19 (1.06-1.34)		0.67 (0.59-0.77)		0.70 (0.54-0.92)	
Elementary	2.07 (1.91-2.23)		1.73 (1.59-1.89)		2.34 (1.92-2.85)		1.33 (1.22-1.44)		0.91 (0.83-0.99)		0.95 (0.77-1.16)	
Junior	1.24 (1.14-1.36)	p<.0001	1.06 (0.96-1.17)	p<.0001	1.14 (0.90-1.43)	p<.0001	1.20 (1.09-1.31)	p<.0001	0.91 (0.82-1.01)	p<.0001	0.98 (0.77-1.23)	p<.0001
Senior	1.12 (1.02-1.23)		1.08 (0.98-1.19)		0.99 (0.78-1.24)		1.12 (1.02-1.22)		0.99 (0.90-1.10)		0.95 (0.75-1.20)	
University	1.00		1.00		1.00		1.00		1.00		1.00	
Married Status												
Married	1.89 (1.70-2.11)		2.55 (2.21-2.95)		5.78 (3.72-8.98)		1.27 (1.14-1.41)		1.77 (1.53-2.05)		3.01 (1.93-4.69)	
Widowhood	2.64 (2.34-2.98)	p<.0001	4.03 (3.44-4.72)	p<.0001	9.42 (5.97-14.88)	p<.0001	1.21 (1.06-1.37)	p<.0001	1.77 (1.51-2.09)	p<.0001	2.67 (1.68-4.24)	p<.0001
Divorced	1.26 (1.10-1.45)		1.54 (1.28-1.85)		3.11 (1.87-5.16)		1.10 (0.95-1.27)		1.29 (1.07-1.55)		2.46 (1.48-4.10)	
Single	1.00		1.00		1.00		1.00		1.00		1.00	
Area												
Urban	1.27 (1.14-1.41)		0.21 (0.19-0.22)		0.56 (0.46-0.69)		1.28 (1.15-1.43)		0.19 (0.18-0.20)		0.52 (0.43-0.64)	
Rural	2.29 (2.06-2.55)	p<.0001	0.40 (0.38-0.43)	p<.0001	1.64 (1.34-2.00)	p<.0001	2.27 (2.03-2.53)	p<.0001	0.38 (0.35-0.41)	p<.001	1.53 (1.25-1.87)	p<.0001
Aboriginal	1.00		1.00		1.00		1.00		1.00		1.00	
Health Status												
Severe	2.50 (2.31-2.70)		1.83 (1.65-2.03)		3.55 (3.01-4.20)		2.53 (2.33-2.74)		2.88 (2.62-3.17)		6.02 (4.98-7.28)	
Mild	1.87 (1.80-1.95)	p<.0001	1.80 (1.72-1.89)	p<.0001	2.44 (2.22-2.68)	p<.0001	2.11 (1.95-2.29)	p<.0001	2.44 (2.22-2.68)	p<.0001	4.66 (3.85-5.64)	p<.0001
Non-chronic	1.00		1.00		1.00		1.00		1.00		1.00	
Medical Utility												
Frequent	4.67 (4.11-5.30)		4.00 (3.43-4.67)		8.56 (6.26-11.71)		3.05 (2.66-3.49)		2.47 (2.09-2.92)		4.31 (3.10-5.99)	
Moderate	3.52 (3.30-3.75)		3.32 (3.08-3.59)		7.28 (6.00-8.85)		2.57 (2.39-2.76)		2.34 (2.16-2.55)		4.27 (3.48-5.26)	
Low	2.43 (2.28-2.60)	p<.0001	2.53 (2.34-2.74)	p<.0001	4.41 (3.61-5.39)	p<.0001	2.05 (1.91-2.19)	p<.0001	2.06 (1.90-2.24)	p<.0001	3.22 (2.62-3.96)	p<.0001
Scant	1.82 (1.70-1.95)		1.79 (1.65-1.95)		2.41 (1.94-2.99)		1.68 (1.56-1.80)		1.62 (1.49-1.76)		2.05 (1.65-2.55)	
None	1.00		1.00		1.00		1.00		1.00		1.00	

As the interaction between gender and place of residence was noted, Tables 10 (a)-(f) show the estimated adjusted odds ratios for gender by place of residence. In urban area the results for female were similar to Table 9 without the stratification by gender and area. However, the effect of education was not apparent for female in urban area. The similar findings were also noted for male but the effects of education for residents in both areas were not apparent.

Table 10 (a) The estimated results of adjusted odds ratios for female in urban area.

	Adjusted Odds Ratio (95% CI)		
	AHPS only	NCIS only	Both
Age			
60-64	2.16 (1.92-2.44)	1.93 (1.68-2.23)	4.82 (3.48-6.67)
55-59	1.85 (1.65-2.09)	1.89 (1.65-2.16)	3.64 (2.63-5.04)
50-54	1.61 (1.43-1.81)	1.54 (1.35-1.76)	2.84 (2.05-3.93)
45-49	1.40 (1.26-1.56)	1.30 (1.16-1.47)	1.96 (1.43-2.70)
40-44	1.00	1.00	1.00
Education			
Illiteracy	1.35 (1.11-1.65)	0.61 (0.50-0.76)	0.64 (0.41-1.00)
Elementary	1.51 (1.29-1.78)	0.74 (0.63-0.86)	0.85 (0.60-1.20)
Junior	1.38 (1.15-1.65)	0.83 (0.69-0.98)	0.70 (0.46-1.06)
Senior	1.22 (1.02-1.46)	0.99 (0.84-1.18)	0.70 (0.46-1.05)
University	1.00	1.00	1.00
Married Status			
Married	1.08 (0.88-1.34)	2.23 (1.63-3.03)	3.02 (1.24-7.33)
Widowhood	1.06 (0.85-1.34)	2.20 (1.59-3.06)	2.63 (1.06-6.56)
Divorced	1.16 (0.89-1.51)	1.82 (1.26-2.63)	3.02 (1.13-8.05)
Single	1.00	1.00	1.00
Health Status			
Severe	2.31 (2.00-2.67)	2.13 (1.78-2.55)	5.40 (3.80-7.67)
Mild	1.98 (1.72-2.29)	2.09 (1.76-2.48)	4.08 (2.86-5.82)
Non-chronic	1.00	1.00	1.00
Medical Utility			
Frequent	3.34 (2.64-4.22)	2.19 (1.62-2.98)	2.73 (1.28-5.83)
Moderate	2.69 (2.34-3.10)	2.13 (1.82-2.49)	4.76 (2.98-7.59)
Low	1.97 (1.71-2.26)	1.81 (1.55-2.11)	3.82 (2.40-6.11)
Scant	1.68 (1.45-1.95)	1.46 (1.24-1.71)	2.77 (1.70-4.52)
None	1.00	1.00	1.00

Table 10 (b) The estimated results of adjusted odds ratios for male in urban area.

	Adjusted Odds Ratio (95% CI)		
	AHPS only	NCIS only	Both
Age			
60-64	2.62 (2.28-3.01)	2.69 (2.20-3.29)	4.54 (2.79-7.39)
55-59	2.01 (1.75-2.31)	2.37 (1.95-2.88)	4.14 (2.57-6.68)
50-54	1.72 (1.50-1.97)	1.85 (1.52-2.25)	2.18 (1.30-3.65)
45-49	1.26 (1.11-1.44)	1.29 (1.07-1.55)	1.27 (0.76-2.15)
40-44	1.00	1.00	1.00
Education			
Illiteracy	1.24 (0.88-1.77)	0.99 (0.61-1.62)	1.37 (0.47-4.01)
Elementary	1.23 (1.08-1.40)	0.75 (0.63-0.89)	1.24 (0.80-1.91)
Junior	1.12 (0.97-1.30)	0.78 (0.63-0.95)	1.24 (0.75-2.06)
Senior	1.08 (0.93-1.24)	0.95 (0.79-1.14)	1.09 (0.66-1.79)
University	1.00	1.00	1.00
Married Status			
Married	1.26 (1.03-1.54)	1.38 (1.01-1.87)	2.57 (0.95-6.96)
Widowhood	1.36 (1.02-1.82)	1.17 (0.73-1.86)	1.93 (0.56-6.66)
Divorced	1.15 (0.88-1.51)	0.97 (0.63-1.49)	1.63 (0.46-5.79)
Single	1.00	1.00	1.00
Health Status			
Severe	3.20 (2.71-3.78)	3.36 (2.63-4.30)	7.95 (4.59-13.76)
Mild	2.45 (2.07-2.91)	2.96 (2.32-3.77)	7.26 (4.22-12.47)
Non-chronic	1.00	1.00	1.00
Medical Utility			
Frequent	3.14 (2.37-4.16)	2.78 (1.77-4.36)	5.68 (2.18-14.77)
Moderate	2.29 (2.00-2.63)	2.20 (1.81-2.69)	5.53 (3.27-9.32)
Low	1.93 (1.70-2.20)	2.27 (1.89-2.73)	3.38 (2.00-5.71)
Scant	1.68 (1.48-1.91)	1.61 (1.33-1.94)	2.68 (1.58-4.56)
None	1.00	1.00	1.00

Table 10 (c) The estimated results of adjusted odds ratios for female in rural area.

	Adjusted Odds Ratio (95% CI)		
	AHPS only	NCIS only	Both
Age			
60-64	1.88 (1.63-2.17)	2.28 (1.93-2.70)	3.91 (2.92-5.25)
55-59	1.67 (1.45-1.92)	1.99 (1.69-2.35)	3.25 (2.43-4.35)
50-54	1.51 (1.32-1.74)	1.55 (1.31-1.83)	2.22 (1.65-3.00)
45-49	1.19 (1.04-1.36)	1.25 (1.07-1.46)	1.80 (1.35-2.41)
40-44	1.00	1.00	1.00
Education			
Illiteracy	1.28 (0.94-1.74)	0.80 (0.57-1.11)	0.70 (0.40-1.21)
Elementary	1.49 (1.13-1.98)	1.02 (0.75-1.37)	0.84 (0.51-1.40)
Junior	1.21 (0.90-1.64)	0.94 (0.68-1.30)	1.07 (0.62-1.84)
Senior	1.21 (0.89-1.65)	1.09 (0.78-1.51)	1.14 (0.65-1.99)
University	1.00	1.00	1.00
Married Status			
Married	1.49 (1.09-2.03)	3.12 (1.88-5.17)	5.24 (1.67-16.43)
Widowhood	1.38 (1.00-1.92)	3.19 (1.90-5.36)	4.96 (1.56-15.81)
Divorced	1.14 (0.77-1.67)	2.34 (1.31-4.16)	3.45 (0.99-12.04)
Single	1.00	1.00	1.00
Health Status			
Severe	2.09 (1.77-2.48)	2.81 (2.30-3.43)	4.71 (3.40-6.52)
Mild	1.86 (1.57-2.20)	2.45 (2.01-2.99)	3.91 (2.82-5.41)
Non-chronic	1.00	1.00	1.00
Medical Utility			
Frequent	2.51 (1.85-3.41)	2.34 (1.61-3.41)	5.14 (2.94-9.00)
Moderate	2.56 (2.17-3.00)	2.50 (2.07-3.02)	4.38 (3.01-6.38)
Low	2.23 (1.91-2.62)	2.19 (1.82-2.64)	3.24 (2.22-4.71)
Scant	1.63 (1.38-1.93)	1.68 (1.38-2.04)	1.75 (1.16-2.62)
None	1.00	1.00	1.00

Table 10 (d) The estimated results of adjusted odds ratios for male in rural area.

	Adjusted Odds Ratio (95% CI)		
	AHPS only	NCIS only	Both
Age			
60-64	2.33 (2.00-2.73)	3.66 (2.99-4.47)	8.03 (5.19-12.42)
55-59	1.99 (1.70-2.32)	2.56 (2.09-3.13)	4.86 (3.12-7.57)
50-54	1.60 (1.37-1.87)	1.82 (1.47-2.24)	2.81 (1.75-4.50)
45-49	1.22 (1.05-1.42)	1.36 (1.11-1.66)	1.92 (1.21-3.06)
40-44	1.00	1.00	1.00
Education			
Illiteracy	1.44 (1.01-2.06)	0.85 (0.51-1.43)	0.31 (0.09-1.06)
Elementary	1.22 (1.01-1.48)	1.14 (0.89-1.45)	0.77 (0.51-1.18)
Junior	1.18 (0.96-1.44)	1.20 (0.92-1.56)	0.89 (0.55-1.44)
Senior	1.04 (0.85-1.28)	1.16 (0.89-1.51)	0.91 (0.56-1.47)
University	1.00	1.00	1.00
Married Status			
Married	1.41 (1.14-1.75)	1.70 (1.24-2.32)	2.24 (1.05-4.78)
Widowhood	1.41 (1.03-1.93)	1.90 (1.26-2.86)	1.90 (0.75-4.78)
Divorced	0.84 (0.61-1.16)	0.94 (0.60-1.48)	2.04 (0.81-5.15)
Single	1.00	1.00	1.00
Health Status			
Severe	2.88 (2.39-3.48)	5.20 (4.12-6.57)	12.63 (8.00-19.94)
Mild	2.46 (2.04-2.96)	3.64 (2.87-4.63)	7.64 (4.75-12.30)
Non-chronic	1.00	1.00	1.00
Medical Utility			
Frequent	2.58 (1.84-3.63)	3.08 (2.01-4.71)	5.54 (2.80-10.95)
Moderate	2.56 (2.20-2.98)	2.78 (2.28-3.40)	3.66 (2.41-5.56)
Low	1.96 (1.70-2.27)	2.27 (1.88-2.75)	3.01 (2.00-4.52)
Scant	1.62 (1.40-1.87)	1.95 (1.61-2.36)	1.94 (1.27-2.97)
None	1.00	1.00	1.00

Table 10 (e) The estimated results of adjusted odds ratios for female in aboriginal district.

	Adjusted Odds Ratio (95% CI)		
	AHPS only	NCIS only	Both
Age			
60-64	2.12 (1.28-3.52)	1.95 (1.45-2.62)	2.31 (0.97-5.51)
55-59	1.34 (0.79-2.28)	1.67 (1.26-2.22)	3.23 (1.47-7.10)
50-54	2.14 (1.33-3.45)	1.58 (1.20-2.08)	1.80 (0.76-4.22)
45-49	1.57 (1.00-2.48)	1.26 (0.98-1.62)	1.29 (0.56-2.94)
40-44	1.00	1.00	1.00
Education			
Illiteracy	1.31 (0.41-4.12)	0.45 (0.18-1.10)	0.24 (0.02-2.82)
Elementary	0.60 (0.21-1.76)	1.20 (0.55-2.61)	0.82 (0.11-6.31)
Junior	0.49 (0.15-1.56)	1.18 (0.53-2.65)	0.58 (0.06-5.22)
Senior	0.73 (0.23-2.36)	0.84 (0.36-1.97)	0.63 (0.06-6.27)
University	1.00	1.00	1.00
Married Status			
Married	0.51 (0.23-1.12)	1.35 (0.72-2.56)	-
Widowhood	0.40 (0.17-0.93)	1.51 (0.78-2.91)	-
Divorced	0.52 (0.19-1.38)	0.93 (0.44-1.98)	-
Single	1.00	1.00	1.00
Health Status			
Severe	1.56 (0.84-2.90)	2.08 (1.42-3.04)	3.12 (1.09-8.94)
Mild	0.98 (0.50-1.91)	1.78 (1.23-2.57)	4.37 (1.71-11.16)
Non-chronic	1.00	1.00	1.00
Medical Utility			
Frequent	6.37 (2.68-15.16)	2.12 (1.28-3.52)	2.94 (0.70-12.40)
Moderate	3.50 (1.71-7.17)	1.84 (1.32-2.58)	2.44 (0.78-7.62)
Low	2.24 (1.08-4.63)	1.46 (1.04-2.05)	1.38 (0.43-4.48)
Scant	2.11 (0.98-4.52)	1.26 (0.88-1.81)	0.74 (0.18-3.01)
None	1.00	1.00	1.00

Table 10 (f) The estimated results of adjusted odds ratios for male in aboriginal district.

	Adjusted Odds Ratio (95% CI)		
	AHPS only	NCIS only	Both
Age			
60-64	1.70 (0.94-3.08)	1.98 (1.48-2.64)	1.89 (0.59-6.06)
55-59	1.77 (1.04-3.03)	1.37 (1.02-1.83)	1.72 (0.56-5.35)
50-54	1.81 (1.10-2.97)	1.17 (0.88-1.55)	2.11 (0.74-5.96)
45-49	1.68 (1.08-2.62)	1.16 (0.90-1.48)	1.28 (0.45-3.60)
40-44	1.00	1.00	1.00
Education			
Illiteracy	0.37 (0.05-3.11)	1.56 (0.74-3.31)	-
Elementary	1.07 (0.53-2.18)	1.75 (1.13-2.71)	-
Junior	1.26 (0.57-2.78)	1.43 (0.88-2.32)	-
Senior	1.29 (0.60-2.75)	0.94 (0.58-1.53)	-
University	1.00	1.00	1.00
Married Status			
Married	1.17 (0.60-2.28)	1.66 (1.14-2.41)	3.98 (0.51-30.94)
Widowhood	0.88 (0.29-2.68)	1.83 (1.08-3.10)	6.82 (0.66-70.29)
Divorced	1.23 (0.52-2.94)	1.23 (0.74-2.04)	3.11 (0.27-35.85)
Single	1.00	1.00	1.00
Health Status			
Severe	1.36 (0.63-2.95)	2.45 (1.68-3.58)	1.68 (0.39-7.14)
Mild	1.42 (0.70-2.87)	1.70 (1.15-2.49)	1.53 (0.36-6.40)
Non-chronic	1.00	1.00	1.00
Medical Utility			
Frequent	4.67 (1.58-13.76)	1.72 (0.97-3.04)	0.00 (0.00-0.00)
Moderate	4.38 (2.23-8.62)	1.67 (1.23-2.26)	2.32 (0.74-7.29)
Low	4.14 (2.15-7.67)	1.71 (1.29-2.28)	2.68 (0.92-7.77)
Scant	3.30 (1.69-6.44)	1.39 (1.04-1.86)	0.80 (0.21-3.04)
None	1.00	1.00	1.00

Table 11 also shows the equivalent associations for attenders aged 65 years or older. Gender was still a significant factor. Residents aged 70-74 years had the highest demand for AHPS followed by those aged 65-69 years, those aged 75-79 years, and the lowest in those aged 80 years or older. However, uptake of NCIS was inversely proportional to advancing age. No statistically significant association between education and uptake of AHPS were noted. Low education level had higher demand for NCIS.

Table 11 Univariate analysis of crude and adjusted odds ratios for the association between correlates and the uptake of AHPS among subjects aged more than 65 years

	Crude Odds Ratio (95% CI)						Adjusted Odds Ratio (95% CI)					
	AHPS only		NCIS only		Both		AHPS only		NCIS only		Both	
Sex												
Female	1.05(1.01-1.10)	p<.0001	1.34(1.25-1.44)	p<.0001	1.38(1.26-1.51)	p<.0001	1.04 (0.99-1.09)	p=0.12	1.45 (1.33-1.57)	p<.0001	1.46 (1.31-1.62)	p<.0001
Male	1.00		1.00		1.00		1.00		1.00		1.00	
Age												
65-69	1.35(1.26-1.45)		2.89(2.49-3.34)		2.64(2.20-3.18)		1.34 (1.25-1.45)		2.58 (2.21-3.01)		2.47 (2.03-3.00)	
70-74	1.47(1.37-1.57)	p<.01	2.74(2.36-3.18)	p<.0001	2.85(2.36-3.44)	p<.0001	1.42 (1.32-1.53)	p<.0001	2.49 (2.13-2.91)	p<.0001	2.63 (2.17-3.20)	p<.0001
75-79	1.32(1.22-1.43)		1.93(1.63-2.27)		2.06(1.68-2.53)		1.27 (1.17-1.37)		1.79 (1.51-2.12)		1.91 (1.55-2.35)	
80+	1.00		1.00		1.00		1.00		1.00		1.00	
Education												
Illiteracy	0.90(0.79-1.01)		1.29(1.00-1.67)		1.13(0.84-1.53)		0.90 (0.79-1.02)		0.89 (0.68-1.17)		0.70 (0.51-0.96)	
Elementary	0.97(0.86-1.10)		1.74(1.36-2.33)		1.42(1.06-1.90)		0.98 (0.86-1.10)		1.18 (0.92-1.53)		0.96 (0.71-1.30)	
Junior	1.04(0.90-1.20)	p<.0001	1.46(1.09-1.96)	p<.0001	1.55(1.11-2.17)	p<.0001	1.01 (0.87-1.17)	p=0.011	1.19 (0.88-1.60)	p<.0001	1.20 (0.85-1.69)	p<.0001
Senior	0.88(0.76-1.02)		0.82(0.60-1.13)		0.83(0.57-1.21)		0.88 (0.75-1.02)		0.76 (0.55-1.06)		0.78 (0.53-1.14)	
University	1.00		1.00		1.00		1.00		1.00		1.00	
Married Status												
Married	1.21(1.06-1.38)		3.46(2.40-4.98)		2.52(1.69-3.76)		0.93 (0.81-1.07)		2.62 (1.81-3.80)		1.61 (1.07-2.41)	
Widowhood	1.03(0.90-1.18)	p<.0001	2.83(1.96-4.09)	p<.0001	2.09(1.40-3.14)	p<.0001	0.83 (0.72-0.94)	p<.0001	2.23 (1.53-3.25)	p<.0001	1.40 (0.93-2.11)	p=0.0049
Divorced	1.06(0.85-1.32)		2.20(1.33-3.64)		1.55(0.86-2.83)		0.90 (0.72-1.13)		1.68 (1.01-2.79)		1.14 (0.62-2.08)	
Single	1.00		1.00		1.00		1.00		1.00		1.00	
Area												
Urban	1.78 (1.58-2.02)		0.19 (0.17-0.22)		0.54 (0.44-0.67)		1.95 (1.72-2.21)		0.20 (018-0.22)		0.59 (0.48-0.73)	
Rural	2.23 (1.96-2.52)	p<.0001	0.52 (0.47-0.58)	p<.0001	1.81 (1.47-2.22)	p<.0001	2.47 (2.17-2.80)	p<.0001	0.54 (0.48-0.60)	p<.0001	2.05 (1.66-2.52)	p<.0001
Aboriginal	1.00		1.00		1.00		1.00		1.00		1.00	
Health Status												
Severe	1.78(1.67-1.89)		1.14(1.02-1.27)		1.82(1.59-2.07)		1.20 (1.12-1.29)		0.83 (0.73-0.94)		1.06 (0.92-1.23)	
Mild	1.60(1.53-1.68)	p<.0001	1.32(1.23-1.43)	p<.0001	1.82(1.65-2.02)	p<.0001	1.18 (1.11-1.24)	p<.0001	0.97 (0.89-1.06)	p<.001	1.16 (1.04-1.30)	p=0.0192
Non-chronic	1.00		1.00		1.00		1.00		1.00		1.00	
Medical Utility												
Frequent	4.13(3.67-4.65)		2.58(2.10-3.17)		7.16(5.21-9.83)		3.76 (3.30-4.28)		2.50 (1.99-3.12)		6.65 (4.75-9.30)	
Moderate	3.47(3.15-3.81)		2.53(2.17-2.95)		6.53(4.93-8.63)		3.09 (2.78-3.42)		2.44 (2.06-2.89)		5.66 (4.22-7.60)	
Low	2.54(2.29-2.80)	p<.0001	2.41(2.05-2.84)	p<.0001	4.48(3.36-5.99)	p<.0001	2.32 (2.09-2.58)	p<.0001	2.27 (1.91-2.69)	p<.0001	3.91 (2.91-5.27)	p<.0001
Scant	1.92(1.72-2.15)		1.78(1.49-2.13)		2.92(2.14-3.98)		1.84 (1.65-2.05)		1.68 (1.40-2.01)		2.67 (1.95-3.64)	
None	1.00		1.00		1.00		1.00		1.00		1.00	

4.4 Independence of Two Programmes

By the application of two logistic regression models in the expression of (3), we found a constellation of covariates in question may account for 14% additional contribution to uptake of NCIS for the elderly cohort and 38% for the young cohort. Table 12 shows one of comparisons between two models *P(NCIS|AHPS)*, and *P(NCIS|AHPS, place of residence (C_1))*. Before adjustment for place of residence, the regression coefficient was 0.8103. The corresponding coefficient was 0.7783 after adjustment for place of residence. This gives 3.89% $\left[1-\left(0.7788/0.8103\right)\times 100\%\right]$ extra contribution from place of residence.

Table 12 The comparison of regression coefficients between two models for estimating the independent effect of place of residence contributing to uptake of NCIS

Model	Variable	Regression coefficient		SE	OR
P(N | A)	Uptake of AHPS	0.8103	*(β_u)*	0.0263	2.25 (2.14-2.37)
P(N | A, C_1)	Uptake of AHPS	0.7788	*(β_a)*	0.0268	2.18 (2.07-2.30)
	Urban	-		-	1.00
	Rural	0.6375	*(C_1)*	0.0217	1.89 (1.81-1.97)
	Aboriginal district	1.5051		0.0325	4.50 (4.23-4.80)

Table 13 shows a series of step-by-step models for assessing respective contribution from each variable. For the elderly cohort, respective contribution to the model included 0.03% for the addition of place of residence, 9.63% for the addition of medical utilization, and 14.13% for the addition of age, gender, married status, education level, and disease severity. For the young cohort, respective contribution to the model included 3.89% for the addition of place of residence and 37.64% for the addition of age, medical utilization, gender, married status, education level, and disease severity.

Table 13 A series of step-by-step models for assessing respective contribution from each variable by regression-based method

Model type	β	Regression-based Method	
Young cohort			
$P(N\|A)$	0.8103	-	
$P(N\|A, C_1)$	0.7788	3.89%	(-0.76-8.34)
$P(N\|A, C_1, C_3)$	0.6655	17.87%	(13.49-22.07)
$P(N\|A, C_1, C_3, C_2)$	0.5609	30.78%	(26.64-34.77)
$P(N\|A, C_1, C_3, C_2, C_4)$	0.5057	37.59%	(33.56-41.49)
$P(N\|A, C_1, C_3, C_2, C_4, C_5)$	0.5028	37.95%	(33.92-41.84)
$P(N\|A, C_1, C_3, C_2, C_4, C_5, C_6)$	0.5047	37.71%	(33.69-41.61)
$P(N\|A, C_1, C_3, C_2, C_4, C_5, C_6, C_7)$	0.5053	37.64%	(33.61-41.54)
Elderly cohort			
$P(N\|A)$	0.6438	-	
$P(N\|A, C_1)$	0.6436	0.03%	(-6.91-6.53)
$P(N\|A, C_1, C_2)$	0.5818	9.63%	(4.72-14.14)
$P(N\|A, C_1, C_2, C_3)$	0.5558	13.67%	(7.13-19.83)
$P(N\|A, C_1, C_2, C_3, C_4)$	0.5561	13.62%	(7.07-19.79)
$P(N\|A, C_1, C_2, C_3, C_4, C_5)$	0.5552	13.76%	(7.21-19.93)
$P(N\|A, C_1, C_2, C_3, C_4, C_5, C_6)$	0.5508	14.45%	(7.92-20.59)
$P(N\|A, C_1, C_2, C_3, C_4, C_5, C_6, C_7)$	0.5528	14.13%	(7.59-20.30)

N: Uptake of NCIS
A: Uptake of AHPS
C_1: Place of residence
C_2: Medical utilization
C_3: Age
C_4: Gender
C_5: Married status
C_6: Education level
C_7: Disease severity

5. DISCUSSION

It has been demonstrated that high coverage rate of screening regime is the most cost-effective and may save more life years[16]. Coverage rate of health check-up was also related to health inequality in geographic areas and socio-demographic features. However, to tackle such geographic and socio-demographic inequality, one may need reach-in and out-reaching service. While institution-based adult health check-up, called Adults' Health Promotion Service (AHPS), has become a routine preventive service in Taiwan concern is raised as to whether residents, particularly the elderly people, who dwell in rural or remote area or those who are low socio-economic class are inaccessible to this service. Another out-reaching service programme, called NCIS, was therefore proposed to solve such geographic inequality. However, while two screening regimes exist other concerns are also raised, including whether additional programme can really enhance the coverage rate of routine preventive service and whether residents have duplicate use of two screening regimes. The latter programme is important to allocation of medical resources related to preventive service especially when medical resources are limited. There are niggardly of studies addressing this issue. In addition, whether factors affecting adult health check-up programme vary with institution-based reach-in or community-based out-reaching property is also elusive.

The current study selected a mixture of three township types in Nantou County

as an illustration to investigate the subjects related to uptake of two screening regimes. The results show routine AHPS, reach-in service per se, may merely cover 8.65% for the young cohort and 21.9% for the elderly cohort in the underlying population. The consideration of out-reaching service like NCIS add 6.1% coverage rate for the young cohort and 6.2% for the elderly cohort. The duplication rate for those attending both regimes was 1.4% for the young cohort and 3.8% for the elderly cohort. As the overlapping proportion was small concern over duplication use of adult health check-up programme is minimized. Instead, out-reaching service, as a matter of fact, may enhance accessibility to adult health check-up and also enhance coverage rate for some areas such as aboriginal districts (Figure 2, 3). To the contrary, in some urban-type townships, the coverage rate was high for AHPS but low for NCIS. In this sense, we believe both screening regimes are not contradictory but complement each other. If both screening regimes can be taken into account, geographic inequality with respect to accessibility to preventive service may be minimized.

Achieving high participation and attendance rates among eligible individuals is dependent on various potential factors. However, factors related to uptake of AHPS and NCIS were similar, albeit the magnitude may be different, in respect of gender, age, education, married status, health status, and medical utilization except geographic area. The influence of the latter has been explained above.

Our findings on geographic and socio-economic difference are consistent with some previous results. A France population-based survey reported that the socio-demographic features and cultural characteristics are responsible for the intention to uptake of screening test. The French survey indicated that four characteristics are predictive of taking the FOBT screening such as insurer’s advance,

low or medium socioeconomic status, widowhood or living with partner, and without knowing someone with cancer[19]. In addition, an US cross-sectional study explored knowledge, attitude, and practice of low-income, elderly black women on breast cancer screening announced that age was inversely associated with knowledge and screening practices[20]. This result was consistent with our finding. A Canada non-randomized trial among women who had undertaken mammography and those who had not reported that earlier experience is the strongest predictor of screening compliance. Women who had undergone mammography previously were more likely to be compliant than those who had not[21]. Our results also found those who had uptake of AHPS may be more likely to attend NCIS as seen in Table 13. However, this dependence can be partially accounted for by geographic and socio-demographic variables as seen in Table 13. These findings support the descriptive results showing the complement of NCIS to AHPS in terms of geographic and socio-demographic inequality. However, the geographic area, socio-demographic features, and health-related variables have higher influence on uptake of NCIS given AHPS for the young cohort compared with the elderly cohort as seen in Table 13. This suggests that more variables should be ascertained in the elderly cohort to explain the variation of uptake of NCIS given uptake of AHPS. This disparity should be clarified in the future.

From methodological viewpoint, we develop an idea and algorithm of evaluating the independence of two screening regimes as presented in the current study given a set of explained variables. This method can be extended to evaluate three or more screening regimes and identified surrogate factors for accounting for the dependence between or among screening regimes.

There are two major limitations in this study. First, we did not collect

information on other correlates affecting uptake of both regimes, including knowledge, attitude, and practice related to uptake of adult health check-up. However, as our study did not tempt to investigate individual correlates the current result cannot be directly compared with the results of previous studies. Holroyd et al. (2003) indicated that Hong Kong Chinese women's attendance for cervical cancer screening was affected by education, knowledge of risk perception, the social value of early detection, culture-oriented factors such as the embarrassment caused by Pap smear screening[22]. The latter situation may be observed in our reach-in service in women in aboriginal area. Whether out-reaching service initiated by local health people who are acquainted with local women attenders may overcome this embarrassment. Results of multivariate analyses showed that family history of colorectal cancer, personal history of polyps, and physician recommendation were strongest predictors of colorectal cancer screening (CRC)[23].

Second, we concluded out-reaching and community-based and reach-in and institution-based adult health check-up may complement each other without duplication in the mixture of urban, rural and other township types. Taking both regimes into account may not only enhance coverage rate but also reduce geographic inequality in respect of preventive service. Socio-demographic features and heath-related variables affecting uptake of both regimes were similar. However, the additional contribution of these socio-demographic features and heath-related variables to attending NCIS in the young subject was larger than that in the elderly cohort. The real cause should be clarified in future studies.

In conclusion, the present study compared two health check-up programmes, reach-in service and out-reaching service, to assess socio-demographic and

geographic inequality in uptake of two programmes. Although out-reaching service did not substantially enhance the absolute coverage rate of reach-in service two programmes complement each other in solving geographic and socio-demographic inequality in uptake of preventive services.

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