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Hepatitis Associated Factors Influence Time to Adopt Ion of Cancer Screening by Diffusion of Innovative Theory in Taiwan

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Abstract

Background: Hepatitis infection is a global burden disease, screening for hepatitis to early detection asymptomatic hematoma for reduced mortality were emphasized in community health policy.

Aim: To assess the association between liver function related biomarkers and the time to adoption the novelty multiple cancer screening program underpinning the Diffusion of Innovation (DOI) theory.

Design: A longitudinal follow up study.

Method: Based on the definition of DOI theory, all participants were classified the adoption of innovativeness community based integrated screening program in Keelung, Taiwan since 2001 to 2010, according to time to firstly attend screening into five categories. Structured questionnaires for collection the demographic information and lifestyle related factors, as well as biomarkers were drawn from blood sample by standard laboratory. The *Chi-square* tests were used to examine the significant difference between these explanatory factors and levels of innovativeness. The survival time was defined as the time interval between January 1st, 2001 and the day of first adoption. The multi variable cox proportional hazards regression model was further applied by including all significant factors.

Results: In a total of 57,939 subjects were recruited in the current analysis. The mean time to adopt the innovation screening was 3.48 (± 2.70) years. The characteristics of married elderly female with lower educational level and with healthy lifestyle of regular exercise, no smoking and no drinking habits groups had higher proportion of being adopted the innovative screening earlier ($p<0.0001$). Subjects with elevated level of albumin, globulin, total protein and ALT, negative status of HBsAg ($p<0.0001$) and anti HCV positive ($p=0.0222$) were earlier to adopt the innovation.

Conclusion: This innovativeness screening program was successfully diffused in community. Health professional should prioritize provide education and integrated screening to community population may threatening of hepatitis and liver function change for early prevention the cancer and reduce mortality.

Keywords: Diffusion of innovation theory; Community based integrated screening; Hepatitis B Virus and Hepatitis C Virus infection (HBV and HCV infection)

Introduction

Both Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) infection are associated with the cause of cirrhosis and induced Hepatocellular Carcinoma (HCC) [1]. Acute hepatitis infection is manifested asymptomatic in early childhood stage, that fewer people are diagnosed during the acute phase until decades after infectionwhen symptoms develop secondary to serious liver damage [2]. The world epidemiology of hepatitis infection rate found some regions have very high infection rate of HBV, HCV and cirrhosis, such as central Asia, Oceania, Eastern and Western sub-Sahara Africa, Eastern Europe and central Latin American [3].In Asia, hepatitis prevention is an important issue in health promotion for publics, reference from a large community based population study results showed 7.1% death for hepatitis B and C co infection and raised risk for 12.2 times on liver related death of hepatitis infection. Especially in young people with HCV and co-infection of HBV and HCV faced a higher mortality risk in drug users [4].

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The World Health Organization (WHO) has already estimate the incidence and prevalence of the disease, mortality, medical cost were associate with HBV and HCV infection to identified as a global burden disease.

The evidence shows that global age standard death rate from HBV and HCV caused liver cirrhosis were 4.8% and 4.4%, caused of liver cancer were 5.2% and 3.0%, there are approximately half of the total liver cancer death was attribute to HBV infection with smaller friction of HCV and alcohol consumption [5]. Therefore routinely vaccination and screening has been suggested as a preventive strategy for early detection of hepatitis infection to control the incidence of cirrhosis and the outcome of HCC.

In Taiwan, HBV and HCV infection still a health problem harassed the community population, as well as liver cancers [6]. The liver disease treatment and prevention foundation in Taiwan was initial the screening for general population from 1996. The results showed HBV infection in Taiwan with geographic variation, the highest prevalence of HBV area was Keelung city of 29.1% and the highest anti HCV positive rate (7.6%) are was Miaoli county [7]. During this period, cancer screening policies were established by the city government for early detection the liver cancer, liver cirrhosis and asymptomatic hepatitis infectious carriers in Taiwan. However, the lower coverage rate for traditional screening due to focused on single disease or specific cancer for high risk population; it is limit extrapolation for general population. It needs effective strategy to increase the screening coverage rate for community subjects, as well as to relieve the hesitation that berried general public's willing to accept screening policy still the plight for public health nurses. Some complex reasons may berry people's health screening behavior.

Researchers found the barriers for screening behavior are include that people who were lack of awareness, lack of knowledge and limited of support to access care or lack of the ability or appropriate setting, social stigma or discrimination for early detecting and treatment for the potential risk of hepatitis infection, liver cirrhosis and HCC [8]. The integrated community based model has been widely suggested as the implementation will be overcome the barriers for prevention hepatitis infection in primary care settings [9]. Single disease screening has been demonstrated significantly decrease mortality and morbidity for specific disease, but integrated multiple diseases screening with the advantage of simultaneous ascertainment of two or more asymptomatic disease in one time, because of some chronic diseases with existing comorbidity, as well as the characteristics of family aggression. Therefore the community-based integrated screening was constructed in Keelung, the Northern Taiwan so called KCIS (Keelung community based integrated screening) [10].

KCIS is based on the core concept of "family as a unit", it is a novel multiple out reaching service for several diseases which were set for screening and examined for detecting asymptomatic and early stage of diseases from individual to all family members. This policy was developed from 1999 and implementation between 2000 and 2009, bases on Papanicolaou (Pap) smear program for cervical cancer first, later on were developed as an innovative program of integrate multi disease screening, including cancers (liver, breast cancer,colorectal, oral, and cervical cancers) and chronic diseases (hypertension, diabetes, hyperlipidemia, metabolic syndrome) by out reaching service in each visit.

Population registry data for adults were invited to join this public health service from health bureau of Keelung city [11].

Compared with single disease screening program, the KCIS is a novelty health policy for subjects at that time. But what's the preference of community subjects been adopt the innovative screening is still limit, as well as the related factors are need to be clarified, such as lifestyle behavior and personal health status may motivate people earlier or berry people hesitate to adopt innovative screening program. Diffusion of Innovation (DOI) theory is a macro level theory, it has been applied to investigate a health policy implementation to community publics from explore the interaction of independent variables with personal behavior change [12].

Follow the definition of DOI theory by Rogers. It can be divided into two parts, "innovation" and "diffusion". The phrase "innovation" refers to the novel idea in preventing, so KCIS is an innovation by delivering integrated preventive service to community residents or groups and of cultivating and changing human attitudes and behavior. According to Rogers, the diffusion is the process by which an innovation communicated overtime among the participants in the social system. Diffusion studies have demonstrated a mathematically consistent sigmoid pattern (the S-shaped curve) of over time adoption for innovations that are perceived to be consequential by potential adopters. Five types of adaptors been categorized by the time to adoption innovativeness as an S curve. The first 2.5% adopters are the most quickly portion to adopt an innovation been defined as innovators. The adopters followed the next 13.5% portion been defined as "early innovator", the third adopters been called "early majority", who are staying the portion between the first and second standard deviations. The adopters of "late majority" are left behind 50% people to adopt the innovation and the adopters of "laggards" are lying off standards deviations portion from average time of adoption.

Rogers synthesis the diffusion studies and suggested that attribute is the characteristics for an innovative intervention been disseminated in social system, there are five attribute elements that will influence an innovation whether successful adoption or not, the relative advantage, compatibility, complexity, trialability and observability. Compared with traditional health promotion strategies, the relative advantage means policy makers designed the intervention with cost effectiveness and beneficial with communities; the compatibility means a degree of an innovation been perceived compatibility with existing value, e.g., early screenings for cancers are compatible with medical benefit for participants. The complexity means the degree of difficult or easy to follow up, so that a clinical procedure is more likely to be adopted if it is simple and well defined. Trialablity means an innovation can be trialed or tested a successful intervention which can be applied and accepted by publics. Observability means the visibility of innovativeness been argue or discuss by populations, such as new technique equipment or procedure will popular if it has been wildly circulate [13].

For a better understanding of the characteristics of people who are quicker or late for adopt this new multiple cancer screening program and the related factors may influence the adaptors' behavior as well as to testing the effectiveness of KCIS. Those are the key components for a public health policy been successfully implemented. Therefore, the aim of this study is to explore the different time to adoption and the adoption rate for screening attendees, to find out the related factors of

characteristics of lifestyle and liver function related biomarkers that influence the time to adoption and adoption rate of the innovative screening program for community population.

Materials and Methods

Study source

The study population was derived from the cohort of attendees to KCIS. The KCIS program has been launched since September, 1999 to invite residents in Keelung city, the Northern Taiwan; to attend a state run health examination program subsided partly by the national health insurance program and partly by the Keelung city program. Per the fact that the KCIS program is a novel health checkup modality, which is the very first integrated screening program in the world to incorporate screening items for cancers as well as for chronic diseases and also the handicap of accessibility to the medical institutes for the free-of charge adult health check-up services funded by the national health insurance program, the Keelung city health bureau planned the KCIS program as an outreaching program to provide multiple health check-up items in the local resident activity centers at the village level for the neighborhood in a single day. To promote the program, the news of each screening activity was distributed a fortnight ahead thorough public mass media, advertisement and propaganda (Figure 1). The detailed protocol, design, and relevant results have been described in full elsewhere [14].

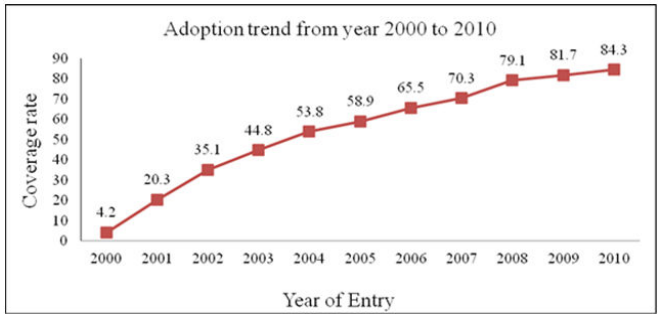

Figure 1: The coverage rate of the adoption trend within ten years of KCIS.

In the current study, we would like to assess the association between liver function related biomarkers and the adoption rate of the KCIS program underpinning the Diffusion of Innovation (DOI) theory. Because the KCIS program started the liver function related examination from 2001, we limited the cohort of those first attending the KCIS between 2001 and 2009 as the study cohort. In total, 57,939 subjects were recruited in the current analysis. This study was reviewed by the ethics committee of Chang Gung memorial hospital and approved by the institutional review board with issued number 103-4784B and 104-0263C.

Classification of innovativeness with DOI theory

Based on the definition of DOI theory, we classified the innovativeness according to time to firstly attend the KCIS program since January 1st, 2001 into five categories of innovators, early adopters, early majority, late majority and laggards. The first 2.5% were defined as "innovators" (loving new things, fascination with novelty, and willingness to accept new ideas), followed by the next 13.5% as early "adopters" (who were the follower of innovators to adoption the new things), then the largest two portions of 34% of "early majority" (they are more risk adverse than early adopters, before make decision they would prefers taking consideration of related information from the early adaptors, who were still in the first half of adopters) and late majority (the first 34% of the second half of adopters) and finally the latest 16% as laggards.

Data collection

Each participant of the KCIS program gave the written inform consent for the academic and health administrative use of his/her data. In addition, a structured questionnaire was issued for the information on demographic features (age, gender, education, marital status), and lifestyle (habits of smoking, alcohol drinking, and regular exercise). The anthropometry measurements for body height, weight, the circumference of waist and hip, and blood pressure were taken by trained public health nurses. The blood sample were drawn for the examination of albumin, globulin, total protein, Glutamic Oxaloacetic Transaminase (GOT), Glutamic Pyruvic Transaminase (GPT), hepatitis B antigen, and anti-hepatitis C virus. This study was reviewed by the ethics committee and approved by the Institutional Review Board of university hospital. (IRB number: 103-4784B and 104-0263C).

Statistical analysis

The descriptive analysis were firstly presented as distribution of demography features, lifestyle factors and dichotomous levels of liver functions categorized by clinically used cut off points by the five levels of innovativeness to the KCIS program. The *Chi-square* tests were used to examine the significant difference between these explanatory factors and levels of innovativeness. The univariate Cox proportional hazards regression model was used to estimate the crude Hazard Ratio (HR) and its 95% Confidence Interval (CI) to adopt the KCIS program. The survival time was defined as the time interval between January 1st, 2001 and the day of first adoption of the KCIS. The multi variable Cox proportional hazards regression model was further applied by including all significant factors recognized in the univariate analysis.

In addition, considering the ordinal property of the five levels of innovativeness, we used the proportional odds model to estimate the crude and adjusted odds ratios for the late adoption of the KCIS program. The proportional odds assumption was tested for each model. If the proportional odds assumption fails, the logistic regression models with dichotomous innovativeness (late majority/laggards versus innovators/early adopters/early majority) were further applied to evaluate the risk factors for the delayed adoption of the KCIS program. A two sided p value less than 5% was considered statistically significant. All analyses were conducted with SAS version 9.3 (SAS® Institute, Cary, NC).

Results

Table 1 shows the distribution of demographic factors and variables relevant to liver function by the categories of DOI theory. Among 57,939 subjects attending the KCIS program between January 1st, 2000 and December 31st, 2010, the first 2.7% (n=1,551) were categorized as innovators, followed by the coming 13.4% (n=7,771), 34.1% (n=19,780), 33.9% (n=19,630) and 15.9% (n=9,207) as early adopters, early majority, late majority, and laggards, respectively. The

mean time to adopt the KCIS was 3.48 (± 2.70) years. Subjects of elderly age groups had higher proportion of being innovators, early adopters, and early majority and less proportion in the groups of late majority and laggards (p<0.0001). Time to adopt the KCIS ranged from 3.44 (± 2.50) years for residents aged 30's to 2.44 (± 2.13) years for those aged 60's.

Table 1: Distribution of demography and life style factors and liver function by the diffusion categories to the KCIS, 1999-2009.

Variable		Innovators (N=1551, 2.7%)		Early adopters (N=7771, 13.4%)		Early majority (N=19780, 34.1%)		Late majority (N=19630, 33.9%)		Laggards (N=9207, 15.9%)		P-value	Time to adoption	
		N	%	N	%	N	%	N	%	N	%		Mean	SD
Demography and life style factors														
Age	30-39	451	2.40%	2051	11.00%	6083	32.50%	6585	35.20%	3542	18.90%	<0.0001	3.44	2.5
	40-49	487	2.50%	2322	11.90%	6392	32.90%	6817	35.10%	3416	17.60%		3.37	2.47
	50-59	285	2.60%	1629	14.70%	3908	35.30%	3643	32.90%	1601	14.50%		3.08	2.39
	60-69	328	3.80%	1769	20.30%	3397	38.90%	2585	29.60%	648	7.40%		2.44	2.13
Gender	Male	535	2.30%	2520	10.60%	8247	34.80%	8137	34.30%	4285	18.10%	<0.0001	3.39	2.47
	Female	1016	3.00%	5251	15.30%	11533	33.70%	11493	33.60%	4922	14.40%		3.07	2.41
Education	<6 years	584	2.90%	3475	17.30%	7214	36.00%	6292	31.40%	2487	12.40%	<0.0001	2.85	2.36
	6-12 years	677	2.40%	3189	11.50%	9476	34.10%	9616	34.60%	4811	17.30%		3.34	2.46
	>12 years	290	2.90%	1107	11.00%	3071	30.40%	3721	36.80%	1909	18.90%		3.5	2.46
Marital status	Married	1256	2.70%	6468	13.90%	16285	35.10%	15512	33.40%	6860	14.80%	<0.0001	3.1	2.4
	Unmarried	84	2.60%	284	8.90%	1065	33.40%	1164	36.50%	596	18.70%		3.54	2.46
	Other	211	2.50%	1019	12.20%	2430	29.00%	2954	35.30%	1751	20.90%		3.59	2.57
Smoking	No	1098	2.80%	5752	14.40%	13635	34.20%	13413	33.70%	5954	14.90%	<0.0001	3.12	2.42
	Yes	427	2.40%	1953	11.10%	5976	34.00%	5988	34.10%	3238	18.40%		3.38	2.49
Alcohol drinking	No	1194	2.80%	6029	14.30%	14282	33.90%	14009	33.30%	6615	15.70%	<0.0001	3.16	2.45
	Yes	329	2.20%	1665	11.10%	5172	34.50%	5236	35.00%	2577	17.20%		3.32	2.45
Regular exercise	No	533	2.50%	2467	11.50%	7477	34.90%	7594	35.50%	3341	15.60%	<0.0001	3.24	2.38
	Yes	998	2.80%	5263	14.70%	12128	33.80%	11636	32.40%	5854	16.30%		3.17	2.48
Liver function														
Albumin	<5	1484	2.80%	7417	14.10%	16460	31.30%	18535	35.30%	8672	16.50%	<0.0001	3.28	2.46
	>=5	8	0.20%	81	1.80%	3026	68.30%	884	20.00%	432	9.70%		2.37	1.96
Globulin	<4	1484	2.60%	7446	13.30%	19041	34.00%	19034	34.00%	9020	16.10%	<0.0001	3.21	2.44
	>=4	8	0.80%	52	5.40%	445	45.80%	384	39.50%	82	8.40%		3.18	2.02
Total protein	<9	1492	2.60%	7492	13.20%	19353	34.10%	19367	34.10%	9097	16.00%	<0.0001	3.22	2.44
	>=9	0	0.00%	6	3.00%	133	67.20%	52	26.30%	7	3.50%		2.47	1.58
AST	<40	1415	2.60%	7091	13.30%	18166	33.90%	18332	34.30%	8505	15.90%	0.5412	3.21	2.43
	>=40	77	2.20%	407	11.70%	1320	37.80%	1088	31.20%	599	17.20%		3.19	2.48
ALT	<40	1306	2.60%	6508	13.10%	16617	33.60%	17216	34.80%	7856	15.90%	<0.0001	3.23	2.43
	>=40	186	2.50%	990	13.20%	2869	38.30%	2204	29.40%	1248	16.60%		3.11	2.5
AFP	<20	1487	2.60%	7431	13.20%	18968	33.70%	19344	34.40%	9073	16.10%	0.0979	3.23	2.44
	>=20	5	2.50%	37	18.50%	63	31.50%	64	32.00%	31	15.50%		3.1	2.56
HBsAg	Negative	1295	2.60%	6558	13.40%	16809	34.30%	16521	33.80%	7767	15.90%	<0.0001	3.19	2.44
	Positive	197	2.40%	940	11.70%	2734	33.90%	2891	35.80%	1306	16.20%		3.31	2.41
Anti-HCV	Negative	1429	2.60%	7169	13.10%	18861	34.40%	18606	33.90%	8746	16.00%	0.0222	3.21	2.44
	Positive	63	2.80%	329	14.80%	682	30.70%	811	36.50%	334	15.10%		3.2	2.4

Female subjects had larger proportion of early adoption than male (p<0.0001) with mean time to adoption of 3.07 (± 2.41) years for female compared to 3.39 (± 2.47) for male. The similar finding was observed for less educated (p<0.0001). The low educated subjects

(education <6 years) with mean time to adoption of 2.85 (± 2.36) years were more likely to being early adoption than high educated subjects (>12 years) with mean time to adoption of 3.50 (± 2.46) years.

Regarding the marital status, married subjects were more likely to adopt KCIS in the early phase because the proportion in the innovators, early adopters and early majority was larger than divorced, widowed and unmarried subjects (p<0.0001).

Subjects with habit of regular exercise had higher proportion of being innovators, early adopters, and early majority and less proportion in the groups of late majority and laggards (p<0.0001) than those without regular exercise. Time to adoption for the former (3.17 ± 2.48 years) were faster than that for the latter (3.24 ± 2.38 years). In the contrast, it was those without habits of smoking and alcohol drinking had shorter time to adoption than those having the habits (p<0.0001).

As far as liver function was concerned, significantly higher proportion of early adoption, namely the shorter time to adoption, was also shown for those with elevated level of albumin (p<0.0001), globulin (p<0.0001), total protein (p<0.0001) and ALT (p<0.0001), with negative status of HbsAg (p<0.0001) and anti HCV positive status (p=0.0222) compared to the complementally part in the study population. The distribution of the diffusion categories of innovation theory was not significantly different between different levels of AST (p=0.5412) and AFP (p=0.2971).

Table 2 shows the effects of demographic characteristics and liver function variables on diffusion of KCIS program by Cox proportional hazards regression model. In the univariate analysis, one year advancing year of age had a 1.3% higher chance for early adaption to the KCIS (HR=1.013, 95% CI: 1.012-1.014). Male was less likely being early adopters (HR=0.88 95% CI: 0.86-0.89) than female. Lowest educational level (HR=1.25, 95% CI: 1.22-1.28), Married subjects (HR=1.20, 95% CI: 1.17-1.23), those without smoking (HR=1.11, 95% CI: 1.09-1.13) and without alcohol drinking habits (HR=1.06, 95% CI: 1.04-1.08) were more likely to be early adopters. Elevated levels of albumin (HR=1.47, 95% CI: 1.42-1.52), elevated levels of globulin (HR=1.10, 95% CI: 1.03-1.17) and high total protein (HR=1.49, 95% CI: 1.29-1.71) were also more likely to being early adopters. However, those with HbsAg positive (HR=0.97, 95% CI: 0.95-0.99) were less likely to adopt KCIS early than those with HbsAg negative. In the multivariable model which retained all significant factors from the univariate models, high albumin (≥ 5 ng/mL) was the most significant factor (aHR=1.56, 95% CI:1.51-1.61). The following remarkable significant factors for early adoption were married subjects (aHR=1.33, 95% CI: 1.29-1.36) and high total protein (≥ 9 ng/mL) (aHR=1.30, 95% CI: 1.11-1.51). The trend and direction of effects of the remaining factors were similar to their counterparts in the univariate model, except that HBsAg positive became insignificant, and alcohol drinking became inversely relevant to early adoption of the KCIS (Figure 2).

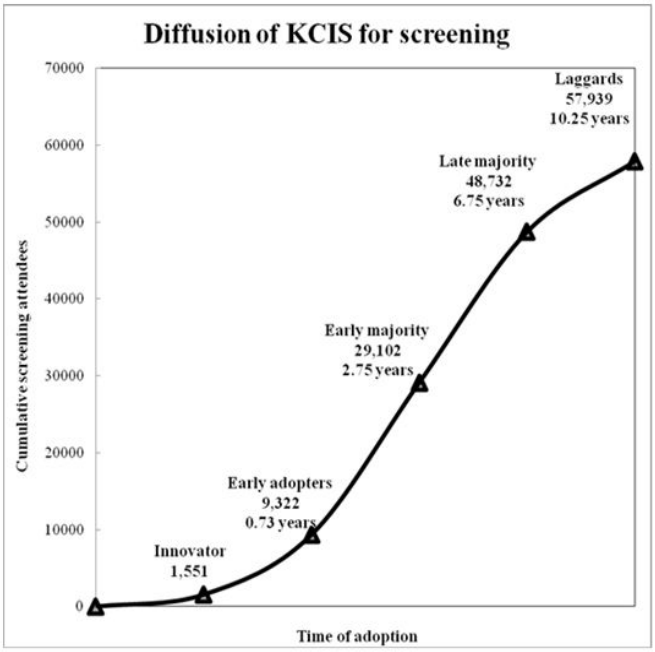

Figure 2: Diffusion of KCIS for the screening population for viral hepatitis.

Table 2: Results of Cox proportional hazards regression for the rate of adopting the KCIS program, 1999-2009.

Variable		Both gender						HR Female						Male					
		Univariate			Multivariate			Univariate			Multivariate			Univariate			Multivariate		
		HR	95% CI		aHR	95% CI		aHR	aHR	95% CI	aHR	95% CI		HR	95%CI		aHR	95% CI	
Age		1.013	1.012	1.014	1.015	1.014	1.016	1.01	1.01	1.01	1.01	1.01	1.02	1.013	1.012	1.015	1.016	1.014	1.017
Gender	Female	1	-																
	Male	0.88	0.86	0.89	0.8	0.78	0.82												
Education level	>12 years	1.00	-					1.00	-					1.00	-				
	6-12 years	1.04	1.02	1.07	1.01	0.99	1.03	1.06	1.02	1.09	1.04	1	1.07	1.01	0.97	1.04	0.98	0.95	1.01
	<6 years	1.25	1.22	1.28	1.05	1.02	1.08	1.25	1.21	1.29	1.09	1.05	1.13	1.2	1.16	1.24	1.01	0.97	1.05

Marital status	Other	1.00	-					1.00	-					1.00	-				
	Unmarried	1.02	0.98	1.07	1.22	1.17	1.27	1	0.94	1.05	1.17	1.1	1.24	1.14	1.07	1.22	1.28	1.19	1.37
	Married	1.2	1.17	1.23	1.33	1.29	1.36	1.24	1.2	1.27	1.33	1.3	1.37	1.25	1.19	1.31	1.3	1.24	1.36
Smoking	Yes	1.00	-					1.00	-					1.00	-				
	No	1.1	1.09	1.13	0.99	0.97	1.01	1.1	1.06	1.14	1.01	0.97	1.05	1	0.98	1.03			
Alcohol use	Yes	1.00	-					1.00	-					1.00	-				
	No	1.06	1.04	1.08	0.95	0.93	0.97	1.07	1.03	1.1	0.99	0.95	1.03	0.96	0.93	0.98	0.92	0.9	0.94
Regular exercise	No	1.00	-					1.00	-					1.00	-				
	Yes	1.01	0.99	1.02				1.02	1	1.04	1	0.98	1.02	1.01	0.98	1.04			
Albumin	<5	1.00	-					1.00	-					1.00	-				
	>=5	1.47	1.42	1.52	1.56	1.51	1.61	1.46	1.4	1.53	1.47	1.41	1.54	1.54	1.48	1.61	1.63	1.57	1.71
Globulin	<4	1.00	-					1.00	-					1.00	-				
	>=4	1.1	1.03	1.17	1	0.93	1.07	1.06	0.98	1.15				1.14	1.02	1.27	1.02	0.9	1.15
Total protein	<9	1.00	-					1.00	-					1.00	-				
	>=9	1.49	1.29	1.709	1.3	1.11	1.51	1.4	1.16	1.69	1.23	1.02	1.49	1.62	1.31	2	1.37	1.08	1.74
AST	<40	1.00	-																
	>=40	0.98	0.95	1.02				0.99	0.94	1.03				1	0.96	1.05			
ALT	<40	1.00	-					1.00	-					1.00	-				
	>=40	1.01	0.98	1.03				1.04	1	1.08	0.99	0.96	1.03	1.03	1	1.07	1.07	1.03	1.1
AFP	<20	1.00	-					1.00	-					1.00	-				
	>=20	1.02	0.89	1.17				1.11	0.92	1.33				0.96	0.78	1.17			
HBsAg	Negative	1.00	-					1.00	-					1.00	-				
	Positive	0.97	0.95	0.99	1.01	0.98	1.03	0.98	0.95	1.01	1	0.96	1.03	0.98	0.95	1.01			
Anti-HCV	Negative	1.00	-					1.00	-					1.00	-				
	Positive	1.01	0.97	1.05				1.03	0.98	1.09				0.96	0.89	1.03			

For female, similar results were presented, but the habit of alcohol drinking was insignificant (aHR=0.99, 95% CI: 0.95-1.03). For male, most of the significant factors related to the rate of adoption were the same as those identified in the multivariable Cox proportional hazards model for both genders. Additionally, subjects with high ALT (≥ 40) were more likely to be early adopters (aHR=1.07, 95% CI: 1.03-1.10).

Discussion

This study was based on the DOI theory to predict the characteristics, lifestyle and liver function related factors that influence participants' health behavior for adoption innovativeness screening in community based sample. This is also the first study to test the DOI theory hypothesis in longitudinal cohort, aim to quantify the time to adoption a new multiple disease screening program could be diffused, as well as to realize the characteristic of different type adopters been categorized by the adoption rate of this new program in subjects susceptible to have liver function change and HBV, HCV infection. As well as decipher why the adoption of the KCIS varied with gender, marital status, educational level and liver function biomarker factors based on the DOI theory.

According to Rodgers's classification, it is interesting to note that it takes 3 months for innovators, 9 months for early adopters, 3 years for early majority adopters (around half of the underlying population), 7 years for late majority adopters, and 10 years for the laggards. The result on adjusted median time is 3.48 (± 2.70) years indicate people to adopt this new program. After adjusting for a constellation of extraneous factors such as age, gender, level of education, marital status and lifestyle habits (e.g., physical activity, smoking and alcohol drinking). The results manifested that half people need spent more than 3 years to adoption the innovation and health behavior and health environment construct residents who were early adoption. The population of liver function change of elevate albumin, globulin, ALT, AFT and anti-HCV positive were the early adaptors due to aware of the threatening of hepatitis and HCC. These findings provide a new insight into not only enhancing the acceptance rate but also facilitating the timeliness of adopting such a new multiple disease screening program for health policy makers and also first line public health professors to find out the target populations, in order to have early diagnosis and early treatment of participants with potential of having asymptomatic cancers. Through identification of HBV and HCV infection is the solution to early detection of HCC, subjects with elevated albumin, globulin and ALT seems to adopted screening

earlier than others, the same finding were also found from the research results of adherence of screening among patients with cirrhosis and chronic hepatitis B, patient with hepatitis B infection were poor adherence to HCC screening, but the frequency of clinical visit will increasing the adherence to screening behavior for HCC [15].

Additionally, this present study provides the evidence of the KCIS innovative integrated screening adopted successfully in community especially the minority population in northern Taiwan. The design of KCIS were meet the important elements include relative advantage, compatibility, complexity, trialability, and observability of DOI theory [15]. Compared with traditional single disease screening program were only focused on the target population, the KCIS with the advantage of integrated with multiple disease in each time, and from individual diffuse to whole family members, as well as with the human resource and cost effectiveness when the policy administered [16]. Thoroughly the delicate design the screening process by public health nurses to decrease the complexity of integrated multiple cancer screening. Time to adopt innovation during 10 years cohort data differential 5 categories adopters' characteristics provide the facts of KCIS been observalility in community populations.

According to the suggestion of Lancet commission for attaining excellent health care for liver disease from lifestyle issues, to improve support services in the community setting for screening of high risk patients and early detection of liver disease and treatment in primary setting [17]. KCIS program was the actually referral services and follow up documentation by community health nurses for the subject with detected neoplasm and illness after screening to meet the trialablily elements. Because of KCIS constructed interdisciplinary leadership skills, through an innovation collaborative health policy by integrated prevention medicine, community health nursing and public health education the key elements of innovation been successful diffused. Furthermore, in this study, community health nurses are the health advocator for community residents; they present an important media to transmission the information of health policy. Nurses are experts at translating technical health information (e.g., procedures, complex medication regimens) into a format that most families can understand, use and adapt to their own circumstances. They construct an nursing family partnership by build an communication platform to make an effective efforts to improve health and reduce gap in health needs for screening, the strategy included regularly home visit, individual phone call invitation, direct mail to subjects, diffusion flysheet on the street, beauty salon, department store, advertisement on local buses and mass media to announcement the screening information [18].

Some important factors and gender difference are found from this study, the demographic factors found of female, elderly and married subjects who are quickly to adopted innovation, it may be contribute with gender role, culture specific and social support [19]. The same finding from Hu, et al., the patient's personal factor, providers and health care system are the barrier that influence patient to accept HBV screening. Another finding from Wai, et al., found the uncomfortable, embarrassing were the barrier for screening, but remember the date of screening is the only cue for action.

The information is limited only with the participants who are participated this program, no information for those who never attending the community based screening are limitation of this study. But it can be compensate with the regular physical examination in workplace or private medical services. Because of Taiwan government policy requires the employer must provide employees to participate in workplace medical examination yearly [20].

Conclusion

The commission for liver disease prevention in UK suggests for regularly screening HBV and HCV infection and routinely monitoring the liver function in primary settings. This study was based on DOI theory to investigate the participant time and social-demographics, and liver function factors influence the community population willing to adopt a novelty cancer screening program. Subjects with elevated liver function and HBV infection were adopting the innovation screening program earlier. We found the well social interaction; well support system and good personal health condition will improving early adopt the innovation. Regularly screening may lead to improve the clinical outcome.

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