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The Prevalence and Associated Factors of Cancer Screening Uptake Among a National Population-Based Sample of Adults in Marshall Islands

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Abstract

Background: The study aimed to estimate the prevalence and associated factors of cancer screening among men and women in the general population in Marshall Islands.

Methods: The national cross-sectional sub-study population consisted of 2,813 persons aged 21-75 years (Median = 37.4 years) from the "2017/2018 Marshall Islands STEPS survey". Information about cancer screening uptake included Pap smear or Vaginal Inspection with Acetic Acid (=VIA), clinical breast examination, mammography, faecal occult blood test (FOBT), and colonoscopy.

Results: The prevalence of past 2 years mammography screening was 21.7% among women aged 50-74 years, past year CBE 15.9% among women aged 40 years and older, past 3 years Pap smear or VIA 32.6% among women 21-65 years, past year FOBT 21.8% among women and 22.3% among men aged 50-75 years, and past 10 years colonoscopy 9.1% among women and 7.3% among men aged 50-75 years. In adjusted logistic regression, cholesterol screening (AOR: 1.91, 95% CI: 1.07-3.41) was associated with past 2 years mammography screening among women aged 50-74 years. Blood pressure screening (AOR: 2.39, 95% CI: 1.71-3.35), glucose screening (AOR: 1.59, 95% CI: 1.13-2.23), dental visit in the past year (AOR: 1.51, 95% CI: 1.17, 1.96), binge drinking (AOR: 1.88, 95% CI: 1.07-3.30), and 2-3 servings of fruit and vegetable consumption a day (AOR: 1.42, 95% CI: 1.03-1.95) were positively and high physical activity (30 days a month) (AOR: 0.56, 95% CI: 0.41-0.76) was negatively associated with Pap smear or VIA screening among women aged 21-65 years. Higher education (AOR: 2.58, 95% CI: 1.02-6.58), and cholesterol screening (AOR: 2.87, 95% CI: 1.48-5.59), were positively and current smoking (AOR: 0.09, 95% CI: 0.01-0.65) was negatively associated with past 10 years colonoscopy uptake among 50-75 year-olds.

Conclusion: The study showed a low cancer screening uptake, and several factors were identified that can assist in promoting cancer screening in Marshall Islands.

Keywords

cancer screening, men, women, determinants, Marshall islands

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Introduction

Globally, "cancer is the second leading cause of death; 70% of deaths from cancer occur in low- and middle-income countries."[1] Some of the most common cancers are lung, breast, colorectal, and prostate cancer.[1] The "cervical cancer burden in the Pacific Region is substantial, with age-standardized incidence rates ranging from 8.2 to 50.7 and age-standardized mortality rates from 2.7 to 23.9 per 100,000 women per year."[2] In the Marshall Island's (an upper middle income country in the Pacific) cancer is the second leading cause of death (after diabetes),[3,4] and the most prevalent cancers are cervical, lung, and breast cancers.[4] The "age-standardized rate of cervical cancer was 74 per 100,000" (the highest in the world) in Marshall Islands.[4] The breast cancer and colorectal cancer incidence rates 2007-2012 were 28.6 and 5.5, respectively, in Marshall Islands.[4] Due to low screening rates (7.8% in 2013) and late diagnosis, breast cancer in the Marshall Islands is associated with high mortality rates.[4]

Some cancers can be fatal if not identified and treated early, emphasizing the importance of organized cancer screening.[5] Marshall Islands offer various cancer screening modalities, e.g. breast cancer screening (clinical breast examination = CBE with no specific recommendations on age and frequency and mammography, recommended every 2 years in women 50-74 years), cervical cancer screening (Vaginal Inspection with Acetic Acid = VIA or Pap Smear/Cytology, and others, recommended every 3 years in women 21-65 years) and colorectal cancer screening (fecal occult blood examination = FOBT, recommended every year in women and men 50-75 years and colonoscopy, recommended every 10 years in women and men 50-75 years).[4] Marshall Islands developed a national Comprehensive Cancer Control Plan 2017-2022, including cancer screening uptake targets as follows: 30% updated breast cancer screening in women ages 20-75 years, 60% cervical cancer screening at least once in the past 3 years in women 21-65 years, and 20% updated colorectal cancer screening in men and women aged 50-75 years.4 Cancer screening efforts in Marshall Islands include skills-training on clinical breast examination and Pap smear testing, purchase of new mammogram machines, and VIA was introduced as a core option for cervical cancer screening.[4] It is believed that screening rates are below the recommended targets but no national study has reported on the current cancer screening uptake in Marshall Islands. In addition, it would be of outmost importance to have an understanding of the possible facilitators and barriers of cancer screening in Marshall Islands. Knowing the national prevalence and possible factors associated with different cancer screening methods could help in developing programs to improve cancer screening in Marshall Islands.

As part of the national Demographic and Health Surveys in 18 countries (women 21-49 years), the prevalence of the utilization of ever cervical cancer screening was 29.2% in 18 countries,[6] in India 27.2%,[6] in Tajikistan 10.6%,[6] and in Turkey ever cervical cancer screening (women 30 years and older) 22.0%.[7] In an analysis of nationally representative household surveys in 55 low- and middle-income countries, the country level median of lifetime cervical cancer screening among women aged 30-49 years 43.6%.[8] The prevalence of breast cancer screening (mammography in the past 5 years) among women aged 40 years and older was 38.4% in China, 10.8% in India, and 15.6% in South Africa.[9] In Italy, the uptake of past 3 years Pap smear or HPV test was 77% (25-64 years old women), past 2 years mammography was 70% (50-69 years old women), and past 2 years colorectal screening was 38% (50-69 year olds).[10] In Brunei Darussalam, the prevalence of a pap smear test (women 18-69 years) was 56.5%, mammography (women 18-69 years) 11.3%, clinical breast examination (= CBE)(women 18-69 years) 56.2%, fecal occult blood test (men and women 18-69 years) 20.0%, and colonoscopy (men and women 18-69 years) 7.9%.[11]

Factors associated with cancer screening may include sociodemographic factors, health system factors, health status, and lifestyle factors.[5,12] Sociodemographic factors associated with cancer screening uptake include higher socioeconomic position, [7,13-15] older age,[16] younger age,[17] and urban living.[18,19] Health system issues associated with cancer screening uptake include increased access to health care,[20] had health insurance,[18,21] having had blood cholesterol test,[22] general health care utilization,[13,16,17,21] and complementary medicine use.[23] Health status associated with cancer screening uptake include having chronic conditions,[24] having multimorbidity or comorbidity,[11,25] family history of non-communicable diseases,[11] not having mental distress or illness or having depressive symptoms,[17,26,27] not having obesity,[17,28] good self-rated health status,[29] and better physical functioning.[17] Positive lifestyle behaviors associated with cancer screening uptake include such as physical activity, fruit and vegetable consumption, and not smoking,[7,17,30] and not consuming alcohol.[11] The study aimed to estimate the prevalence and associated factors of cancer screening uptake among adults a national population-based survey in Marshall Islands.

Methods

Sample and Procedures

Cross-sectional data from the 2017/2018 Marshall Islands STEPwise approach to Surveillance (STEPS) survey were analyzed.[31] Individuals aged 18 years or older participated in the survey from the islands of Majuro, Kwajalein, Arno, Jaluit, Wotje, and Kili, making up 83% of the overall population of Marshall Islands; the final response rate was 92.3%.[32] "Sample size was determined based on overall adult populations on selected islands in the Republic of the Marshall Islands (Majuro = 1659; Ebeye = 627; Kili = 200; Wotje = 207; Jaluit = 207; Arno = 207)."32 A multi-stage sampling design was used: Stage 1: Households were identified at random according to geographical stratification in Majuro and Ebeye.[32] The country was stratified into 2 major groups, Urban (Majuro and Ebeye) and Rural (all outer islands).[32] In Majuro and Ebeye, household cluster sampling was used to randomly select households in

these areas.[32] Stage 2: In Majuro and Ebeye, 1 individual was selected at random from each household. All adults in Kili, Arno, Wotje, and Jabwor, Jaluit atolls were included in the sample because the adult populations are about 200 each on these atolls.[32] "Participants eligible for the survey were Marshall Islands residents aged 18 years and older, and who were able to comprehend either English or Marshallese and provide consent."[32] Data were collected electronically using a tablet by trained surveyors that conducted face-to-face administration of structured questionnaires and anthropometric measurements.[32] Quality control of completed questionnaires was ensured at different stages during the questionnaire-processing phase.[32] The total sample included 3,029 persons 18 years and older, but since we were investigating cancer screening, the sample was restricted to individuals aged 21-75 years. The sample size of this subsample was 2,813.

Sample size calculation for cancer screening. All sample sizes calculated with acceptable margin 5%, 95% confidence level, the minimum sample size for cervical cancer screening is 316 (estimated based on a prevalence of 29.2% in 18 countries6), for mammography 261 (estimated based on a prevalence of 21.6%, average of 3 countries, China, India and South Africa9), for CBE 378 (based on prevalence of 56.2% in Brunei Durassalam11), for FBOT 246 (based on 20.0% in Brunei Durassalam11) and for colonoscopy 113 (based on prevalence of 7.9% in Brunei Durassalam11)

Table 1. Sample Characteristics of Men and Women Aged 21-75 years, Marshall Islands, STEPS Survey, 2017.

Variable	Total N (%)	Male N (%)	Female N (%)
All	2813	1329 (47.2)	1484 (52.8)
Age in years			
21-29	670 (23.8)	305 (22.9)	365 (24.6)
30-39	837 (29.8)	377 (28.4)	460 (31.0)
40-49	607 (21.6)	286 (21.5)	321 (21.6)
50-59	430 (15.3)	222 (16.7)	208 (14.0)
60-75	269 (9.6)	139 (10.5)	130 (8.8)
Education			
<High school	729 (25.9)	319 (24.0)	410 (27.6)
High school	1547 (55.0)	716 (54.0)	831 (56.0)
>High school	535 (19.0)	292 (22.0)	243 (16.4)
Household income			
<10000	1077 (38.3)	555 (41.8)	522 (35.2)
≥10000	471 (16.7)	275 (20.7)	196 (13.2)
Do not know/refused to answer	1265 (450)	499 (37.5)	766 (51.6)
Blood pressure screening	1548 (55.3)	730 (55.2)	818 (55.3)
Glucose screening	1537 (54.9)	729 (55.2)	808 (54.7)
Cholesterol screening	594 (21.5)	273 (20.9)	321 (22.0)
Dental visit in past 12 months	1017 (36.2)	444 (33.5)	573 (38.7)
Current smoking	684 (24.5)	599 (45.3)	85 (5.8)
Current chewing tobacco	311 (11.2)	180 (13.6)	131 (9.0)
Binge drinking	461 (16.4)	385 (29.0)	76 (5.1)
Fruit and vegetable intake (servings/day)			
0-1	1929 (71.5)	916 (72.0)	1013 (71.0)
2-3	501 (18.6)	243 (19.1)	258 (18.1)
4 or more	269 (10.0)	114 (9.0)	155 (10.9)
Physical activity			
0 days	950 (34.0)	335 (25.3)	615 (41.8)
1-29 days	868 (31.0)	445 (33.6)	423 (28.8)
30 days	978 (35.0)	545 (41.1)	433 (29.4)
Cardiovascular disorder	129 (4.6)	66 (5.0)	63 (4.3)
Body mass index			
Under/normal	640 (24.2)	366 (29.6)	274 (19.5)
Overweight	754 (28.5)	416 (33.7)	338 (24.0)
Obesity	1247 (47.2)	453 (36.7)	794 (56.5)
Use of traditional medicine	244 (8.7)	116 (8.7)	128 (8.6)

Measures

Cancer Screening

Colon cancer screening (use showcard): 1) "Have you ever had a colonoscopy? (Yes, No, Don't know, Refuse) (time since last colonoscopy, 1 = within the past year to 6 = 10 or more years ago)" and 2) "A blood stool test is a test that determines whether the stool contains blood. Have you ever had this test? (Yes, No, Don't know, Refuse) (time since last blood stool test, 1 = within the past year to 5 = 5 or more years ago)".32 Outcome variables were defined as past 10 years colonoscopy uptake in 50-75 year-olds, and past year FOBT uptake in 50-75 year-olds.

Women cancer screening (use showcard): 1) "Have you ever had a mammogram? A mammogram is done with a machine (Yes, No, Don't know, Refuse) (time since the last mammogram, 1 = within the past year to 5 = 5 or more years ago)", 2) "A clinical breast exam is when a doctor, nurse, or other health professional feels the breasts for lumps. Have you ever had a clinical breast exam? (Yes, No, Don't know, Refuse) (time since last clinical breast exam, 1 = within the past year to 5 = 5 or more years ago)", and 3) "Have you ever had a Pap or VIA test? (Yes, No, Don't know, Refuse) (time since last Pap or VIA test, 1 = within the past year to 5 = 5 or more years ago)".[32] Those who responded "don't know" or "refuse" were excluded from the analysis. Outcome variables were defined as past 2 years mammography in women 50-74 years, past year CBE in women 40 years and older, and past 3 years Pap smear or VIA in women 21-65 years.

Socio-demographic factor questions included age (years), sex (male, female), highest level of education (1 = never attended school to 6 = college or university completed), and past year household income (1 = less than US$ 5000 to 5 = US$ 20000 or more, Don't know, Refused to answer).32

Other health screenings and visits included blood pressure, blood sugar, cholesterol, and dental visits, as follows: 1) "Have you ever had your blood pressure checked by a doctor, nurse, or other health worker?" (Yes, No) 2) "Have you ever had your blood sugar checked by a doctor, nurse, or other health worker?" (Yes, No) 3) "Blood cholesterol is a fatty substance found in the blood. Have you ever had your blood cholesterol checked by a doctor, nurse, or other health worker?" (Yes, No) 4) "How long

Table 2. Cancer Screening.

Cancer screening (# missing cases)	N	% (95% CI)
Mammography screening in the past 2 years (women 50-74 years) (#14)		
No	253	78.3 (73.5-82.5)
Yes	70	21.7 (17.5-26.5)
Clinical breast examination in past year (women 40+ years) (#13)		
No	551	84.1 (81.1-86.7)
Yes	104	15.9 (13.3-18.9)
Pap smear or VIA in the past 3 years (women 21-65 years) (#36)		
No	922	67.2 (64.9-69.9)
Yes	445	32.6 (30.1-35.1)
Faecal occult blood test in the past year (women 50-75 years) (#17)		
No	251	78.2 (73.3-82.4)
Yes	70	21.8 (17.6-26.7)
Faecal occult blood test in the past year (men 50-75 years) (#6)		
No	276	77.7 (73.1-81.8)
Yes	79	22.3 (18.2-26.9)
Colonoscopy in the past 10 years (women 50-75 years) (#9)		
No	299	90.9 (87.2-93.6)
Yes	30	9.1 (6.4-12.8)
Colonoscopy in the past 10 years (men 50-75 years) (#5)		
No	330	92.7 (89.5-95.0)
Yes	26	7.3 (5.0-10.5)

VIA = Vaginal Inspection with Acetic Acid; CI = Confidence Interval.

has it been since you last visited a dentist or a dental clinic for any reason? Include visits to dental specialists, such as orthodontists." (1 = within the past year to 5 = 5 or more years ago).[32]

The health risk behavior variables included current smoking (Yes, No), current chewing tobacco (Yes, No), past month binge drinking (≥5 units for men and ≥4 units for women), consumption of fruit and vegetables per day (number of days in a week and number of servings a day), and physical activity ("During the past 30 days, other than your regular job, on how many days did you participate in any physical activities or exercises such as running, sports, walking, or going to the gym, specifically for exercise?").[32] Cronbach alpha for the fruit and vegetable consumption measure was 0.82 in this study. Body Mass Index was measured: "<18.5kg/m2 underweight, 18.5-24.4kg/m2 normal weight, 25-29.9kg/m2 overweight and ≥30 kg/m2 obesity."[32]

Cardiovascular disorders included self-reported "coronary heart disease; angina, also called angina pectoris; a heart attack (also called myocardial infarction); any kind of heart condition or heart disease (other than the ones I just asked about) (Yes, No)"[32]

The utilization of traditional medicine included 3 questions on currently taking any herbal or traditional remedy for your high blood sugar or diabetes, or high blood pressure or hypertension or high cholesterol (Yes, No).[32]

Overall, the "STEPS protocols can be utilized to provide aggregate data for valid between-population comparisons."[33]

Data Analysis

Descriptive statistics were used to summarize sample and cancer screening prevalence characteristics. Unadjusted and adjusted (including variables significant $p < 0.05$ at univariate analysis) logistic regression analyses were used to predict the prevalence of mammography, CBE, Pap smear or VIA, FOBT and colonoscopy. Covariates, based on literature review,[5,7,12-17,21,22,24,25,28,30] included sociodemographic factors, health care utilization, health risk behaviors, cardiovascular disorder, body mass index, and use of traditional medicine for all outcome variables. Explanatory variables are statistically significant at $p < 0.05$ and are free from multicollinearity as measured by the variance inflation factor (VIF < 1.8). Model assumptions were checked with residual plots, and the overall fitness of the models was checked with the Hosmer-Lemeshow goodness-of-fit test. Missing values (<2% for all variables except for body weight, 6.1%) were excluded. All statistical analyses were conducted using STATA software version 14.0 (Stata Corporation, College Station, TX, USA).

Ethical Consideration

The Marshall Islands Ministry of Health & Human Services provided ethics approval of the study, and written informed consent was obtained from study participants.[32]

Results

Sample Characteristics

The study population consisted of 2,813 persons aged 21-75 years (Median = 37.4 years, IQR = 28.7-59.5), 1,329 (47.2%) were men and 1,484 (52.8%) were women, 74.0% had high school or higher education, and 38.3% had an annual household income of lower than 10000$. More than half of the

Table 3. Associations With Past 2 Years Mammography Screening (Women 50-74 Years).

	Simple logistic regression		Multiple logistic regression	
Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Education				
<High school	1 (Reference)	0.054	—	
High school	1.80 (0.99, 3.28)	0.035		
>High school	2.52 (1.07, 5.95)			
Household income				
<10000$	1 (Reference)	0.233	—	
≥10000$	1.58 (0.75, 3.32)	0.371		
Do not know/refused to answer	0.76 (0.41, 1.39)			
Blood pressure screening	2.33 (1.19, 4.58)	0.014	1.52 (0.68, 3.41)	0.31
Glucose screening	2.84 (1.17, 6.92)	0.021	1.65 (0.57, 4.74)	0.355
Cholesterol screening	2.41 (1.40, 4.15)	<0.001	1.91 (1.07, 3.41)	0.028
Dental visit in past 12 months	1.53 (0.90, 2.62)	0.116	—	
Current smoking	0.29 (0.04, 2.28)	0.241	—	
Current chewing tobacco (4 cases)	—		—	
Binge drinking (3 cases)	—		—	
Fruit/vegetable intake (servings/day)				
0-1	1 (Reference)	0.337	—	
02-Mar	1.40 (0.71, 2.75)	0.507		
4 or more	1.29 (0.60, 2.77)			
Physical activity				
0 days	1 (Reference)		—	
1-29 days	1.19 (0.62, 2.29)			
30 days	1.05 (0.54, 2.03)			
Cardiovascular disorder	0.97 (0.26, 3.37)	0.96	—	
Body mass index				
Under/normal	1 (Reference)	0.618	—	
Overweight	1.27 (0.50, 3.23)	0.68		
Obesity	1.19 (0.51, 2.78)			
Use of traditional medicine	1.54 (0.85, 2.78)	0.156	—	

COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval.
N = 323.

participants (55.3%) had ever their blood pressure checked and had ever undergone glucose (diabetes) screening (54.9%) by a health care provider, 21.5% had ever their blood cholesterol checked, and 36.2% had a dental visit in the past 12 months.

One in 5 persons (24.5%) were current smokers (45.3% among men), 11.2% were currently chewing tobacco, 16.4% engaged in binge drinking in the past month, 71.5% had 0-1 servings of fruit and vegetables per day, and 35.0% engaged daily in physical activities or exercises. Almost 1 in 10 participants (8.7%) were currently using traditional medicine for diabetes, or hypertension or high cholesterol, 4.6% had some form of cardiovascular disorder (coronary heart disease, angina, heart attack, any kind of heart condition, or heart disease), and 47.2% had obesity (see Table 1).

Prevalence of Cancer Screening

The prevalence of past 2 years mammography screening was 21.7% among women aged 50-74 years, past year CBE 15.9% among women aged 40 years and older, past 3 years Pap smear or VIA 32.6% among women 21-65 years, past year FOBT 21.8% among women aged 50-75 years, past year FOBT 22.3% among men aged 50-75 years, past 10 years colonoscopy 9.1% among women aged 50-75 years and past 10 years colonoscopy 7.3% among men aged 50-75 years (see Table 2).

Associations With Mammography Screening

In adjusted logistic regression, cholesterol screening (AOR: 1.91, 95% CI: 1.07-3.41) was associated with past 2 years mammography screening among women aged 50-74 years. In addition, in univariate analysis, higher education, blood pressure, and glucose screening were associated with mammography screening (see Table 3).

Associations With Clinical Breast Examination

In the adjusted logistic regression analysis, glucose screening (AOR: 5.47, 95% CI: 1.94-15.43), cholesterol screening (AOR: 2.20, 95% CI: 1.35-3.57), and dental visit in the past year (AOR: 1.63, 95% CI: 1.03-2.60) were associated with CBE among women aged 40 years and older. In addition, in univariate analysis, blood pressure screening, 2-3 servings of fruit and

Table 4. Associations With Past Year Clinical Breast Examination (Women 40+ years).

	Simple logistic regression		Multiple logistic regression	
Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Education				
<High school	1 (Reference)	0.117	—	
High school	1.46 (0.91, 2.35)	0.095		
>High school	1.74 (0.91, 3.34)			
Household income				
<10000$	1 (Reference)	0.108	—	
≥10000$	1.59 (0.90, 2.81)	0.18		
Do not know/refused to answer	0.71 (0.44, 1.17)			
Blood pressure screening	3.37 (1.93, 5.90)	<0.001	1.23 (0.61, 2.49)	0.564
Glucose screening	8.06 (3.47, 18.74)	<0.001	5.47 (1.94, 15.43)	<0.001
Cholesterol screening	3.65 (2.36, 5.65)	<0.001	2.20 (1.35, 3.57)	<0.001
Dental visit in past 12 months	1.86 (1.22, 2.84)	0.004	1.63 (1.03, 2.60)	0.037
Current smoking	1.00 (0.38, 2.68)	0.993	—	
Current chewing tobacco	0.24 (0.03, 1.84)	0.171	—	
Binge drinking	1.14 (0.32, 4.04)	0.84	—	
Fruit/vegetable intake (servings/day)				
0-1	1 (Reference)	0.029	1 (Reference)	0.087
02-Mar	1.75 (1.06, 2.89)	0.933	1.61 (0.93, 2.79)	0.863
4 or more	1.03 (0.54, 1.97)		0.94 (0.48, 1.87)	
Physical activity				
0 days	1 (Reference)	0.568	—	
1-29 days	1.16 (0.69, 1.96)	0.649		
30 days	1.13 (0.67, 1.90)			
Cardiovascular disorder	1.10 (0.41, 2.96)	0.847	—	
Body mass index				
Under/normal	1 (Reference)	0.181	—	
Overweight	0.61 (0.30, 1.25)	0.165		
Obesity	0.64 (0.35, 1.20)			
Use of traditional medicine	2.20 (1.34, 3.60)	0.002	1.29 (0.74, 2.22)	0.367

COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval.
N = 655.

vegetable consumption a day, and the use of traditional medicine were associated with CBE (see Table 4).

Associations With Pap Smear or VIA Screening

In the adjusted logistic regression analysis, blood pressure screening (AOR: 2.39, 95% CI: 1.71-3.35), glucose screening (AOR: 1.59, 95% CI: 1.13-2.23), dental visit in the past year (AOR: 1.51, 95% CI: 1.17, 1.96), binge drinking (AOR: 1.88, 95% CI: 1.07-3.30), and 2-3 servings of fruit and vegetable consumption a day (AOR: 1.42, 95% CI: 1.03-1.95) were positively and high physical activity (AOR: 0.56, 95% CI: 0.41-0.76) was negatively associated with Pap smear or VIA screening among women aged 21-65 years. In addition, in univariate analysis, higher education, cholesterol screening, and the use of traditional medicine were associated with Pap smear or VIA screening (see Table 5).

Associations With Fecal Occult Blood Examination

In adjusted logistic regression analysis, glucose screening (AOR: 3.63, 95% CI: 1.43-9.22), cholesterol screening (AOR: 2.04, 95% CI: 1.32-3.15), dental visit in the past year (AOR: 1.78, 95% CI: 1.17-2.71), intake of 2-3 servings of fruit and vegetables a day (AOR: 1.83, 95% CI: 1.13-2.98), the use of traditional medicine (AOR: 1.77, 95% CI: 1.12-2.80), and cardiovascular disorder (AOR: 2.26, 95% CI: 1.35, 4.83) were associated with FOBE among 50-75 year-olds. In addition, in univariate analysis, blood pressure screening was associated with FOBE (see Table 6).

Associations With Colonoscopy

In adjusted logistic regression analysis, higher education (AOR: 2.58, 95% CI: 1.02-6.58), and cholesterol screening (AOR: 2.87, 95% CI: 1.48-5.59), were positively and current smoking (AOR: 0.09, 95% CI: 0.01-0.65) was negatively associated with past 10 years colonoscopy uptake among 50-75 year-olds. In addition, in univariate analysis, glucose screening, 1-29 days physical activity, and the use of traditional medicine were associated with past 10 years colonoscopy uptake (see Table 7).

Table 5. Associations With Past 3 Years Pap Smear or VIA (Women 21-65 Years).

	Simple logistic regression		Multiple logistic regression	
Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age in years				
21-39	1 (Reference)	0.084		
40-65	0.82 (0.65, 1.03)			
Education				
<High school	1 (Reference)	0.062	1 (Reference)	0.096
High school	1.30 (0.99, 1.70)	0.013	1.30 (0.95, 1.76)	0.188
>High school	1.56 (1.10, 2.22)		1.31 (0.88, 1.95)	
Household income				
<10000$	1 (Reference)	0.425	—	
≥10000$	1.15 (0.81, 1.64)	0.321		
Do not know/refused to answer	0.88 (0.68, 1.13)			
Blood pressure screening	3.17 (2.47, 4.06)	<0.001	2.39 (1.71, 3.35)	<0.001
Glucose screening	2.59 (2.03, 3.29)	<0.001	1.59 (1.13, 2.23)	0.008
Cholesterol screening	1.97 (1.51, 2.57)	<0.001	1.00 (0.73, 1.38)	0.99
Dental visit in past 12 months	1.70 (1.35, 2.15)	<0.001	1.51 (1.17, 1.96)	0.002
Current smoking	1.10 (0.68, 1.78)	0.695	—	
Current chewing tobacco	1.14 (0.77, 1.68)	0.51	—	
Binge drinking	1.86 (1.15, 3.01)	0.011	1.88 (1.07, 3.30)	0.029
Fruit/vegetable intake (servings/day)				
0-1	1 (Reference)	<0.001	1 (Reference)	0.031
02-Mar	1.61 (1.21, 2.15)	0.312	1.42 (1.03, 1.95)	0.813
4 or more	1.21 (0.84, 1.75)		0.95 (0.63, 1.43)	
Physical activity				
0 days	1 (Reference)	0.363	1 (Reference)	0.81
1-29 days	1.14 (0.86, 1.50)	0.006	1.04 (0.77, 1.40)	<0.001
30 days	0.66 (0.50, 0.89)		0.56 (0.41, 0.76)	
Cardiovascular disorder	1.01 (0.58, 1.78)	0.97	—	
Body mass index				
Under/normal	1 (Reference)	0.493	—	
Overweight	1.14 (0.79, 1.63)	0.325		
Obesity	1.17 (0.86, 1.60)			
Use of traditional medicine	1.82 (1.23, 2.69)	0.003	1.11 (0.71, 1.74)	0.654

COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval.
N = 1367.

Discussion

The national study in Marshall Islands showed that the prevalence of past 2 years mammography screening (21.7%, women 50-74 years), was higher than in India (10.8% in the past 5 years, 40 years and older),[9] South Africa (15.6% in the past 5 years, 40 years and older),[9] but lower than in China (38.4% in the past 5 years, 40 years and older),[9] and Italy (70%, women 50-69 years).[10] The prevalence of past 3 years Pap smear or VIA (32.6%, women 21-65 years) in Marshall Islands was higher than in 18 national Demographic and Health Surveys (ever 29.2%),[6] including India (ever 27.2%),[6] Tajikistan (ever 10.6%),6 and Turkey (ever 22.0%),[7] similar to a 55 country study in low- and middle-income countries (ever 43.6%, 30-49 years),[8] but lower than in Brunei Darussalam (ever 56.5%, women 18-69 years),11 Italy (77% past 2 years, 25-64 years).[10] The prevalence of past year CBE (15.9%, 40 years and older) in this study was lower than in the Brunei Darussalam STEPS survey (ever 56.2%, 18-69 years),[11] while the prevalence of past year FOBT (22.0%, 50-75 years) was higher than in Brunei (ever 20.0%, 18-69 years),[11] however, the prevalence of past 10 years colonoscopy (7.9%, 50-75 years) was similar to Brunei (7.9%, 18-69 years).[11] Due to the use of different age groups for cancer screening in different countries, comparisons should be taken with caution. The cancer screening uptake still falls short of the 2017-2022 targets in Marshall Islands, i.e. 30% updated breast cancer screening in women aged 20-75 years, 60% cervical cancer screening at least once in the past 3 years in women 21-65 years, and 20% updated colorectal cancer screening in men and women aged 50-75 years.[4] Possible barriers for the low cancer screening uptake in Marshall Islands may include public policy, organizational systems and practice settings, health care providers, and the patients themselves, e.g. lack of awareness or understanding, misperceptions about the benefits.[16,34-37] Various interventions targeting at each of these factors can improve cancer screening rates.[38]

Consistent with some previous research,[7,13-15,39-41] this study showed that a higher socioeconomic position (higher

Table 6. Associations With Past Year Fecal Occult Blood Test (50-75 Years).

	Simple logistic regression		Multiple logistic regression	
Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Sex				
Female	1 (Reference)	0.889	—	
Male	1.03 (0.71, 1.48)			
Education				
<High school	1 (Reference)	0.116	—	
High school	1.39 (0.92, 2.11)	0.834		
>High school	1.07 (0.59, 1.93)			
Household income				
<10000$	1 (Reference)	0.971	—	
≥10000$	1.01 (0.63, 1.63)	0.212		
Do not know/refused to answer	0.76 (0.50, 1.17)			
Blood pressure screening	3.50 (2.02, 6.08)	<0.001	1.24 (0.64, 2.41)	0.517
Glucose screening	8.01 (3.46, 18.56)	<0.001	3.63 (1.43, 9.22)	0.007
Cholesterol screening	3.13 (2.14, 4.57)	<0.001	2.04 (1.32, 3.15)	<0.001
Dental visit in past 12 months	1.81 (1.25, 2.61)	0.002	1.78 (1.17, 2.71)	0.007
Current smoking	1.04 (0.65, 1.65)	0.884	—	
Current chewing tobacco	0.69 (0.15, 3.19)	0.634	—	
Binge drinking	1.41 (0.78, 2.56)	0.252	—	
Fruit/vegetable intake (servings/day)				
0-1	1 (Reference)	0.025	1 (Reference)	0.014
02-Mar	1.66 (1.06, 2.59)	0.303	1.83 (1.13, 2.98)	0.594
4 or more	1.34 (0.77, 2.34)		1.19 (0.63, 2.23)	
Physical activity				
0 days	1 (Reference)	0.015	1 (Reference)	0.283
1-29 days	1.81 (1.12, 2.92)	0.064	1.33 (0.79, 2.26)	0.738
30 days	1.56 (0.97, 2.51)		1.09 (0.65, 1.85)	
Cardiovascular disorder	2.60 (1.33, 5.06)	0.005	2.26 (1.35, 4.83)	0.036
Body mass index				
Under/normal	1 (Reference)	0.899	—	
Overweight	1.04 (0.60, 1.78)	0.934		
Obesity	1.02 (0.61, 1.71)			
Use of traditional medicine	2.65 (1.78, 3.95)	<0.001	1.77 (1.12, 2.80)	0.015

COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval.
N = 676.

education) increased the odds for colonoscopy and in univariate analysis for cervical cancer screening uptake. It is possible that women who have higher education have better knowledge of the health risks related to cancer and therefore engage more likely in cancer screening.[40] Consistent with previous research,[22] this study showed that having ever had blood pressure, glucose, and/or blood cholesterol screening were associated with mammography, CBE, Pap smear or VIA, FOBT and/or colonoscopy. This finding may be explained by the increased possibility of referral to cancer screening during other clinical health screenings and should be utilized in the promotion of integrating cancer screening in routine health services. Furthermore, the study found that the use of traditional medicine for diabetes, hypertension or high cholesterol was associated with a higher uptake of FOBT, and in univariate analysis with CBE and colonoscopy. Similarly, in the US 2017 National Health Interview Survey, individuals who consulted complementary medicine approaches, such as chiropractor, naturopath, or mind-body medicine, were more likely to take up Pap smear test, mammography, and/or colorectal cancer screening.[23] Persons who used traditional medicine in Marshall Islands may have higher health literacy than those who do not use traditional medicine, which may explain the higher uptake of cancer screening.[42,43]

The study found an association between other chronic conditions, such as cardiovascular disorders and cancer screening (FBOT), which is in line with the findings of some previous research.[11,25] It is possible that persons with cardiovascular disorders access health care services more often than those without cardiovascular disorders, which may have led to more chances of the uptake of FBOT.[24] Contrary to a previous review,[28] which found a negative association between having overweight/obesity and cervical cancer screening, this study did not find any significant association between body weight status and cancer screening uptake.

Some previous research showed that the practice of other positive lifestyle behaviors apart from cancer screening increased the odds for cancer screening,[7,11,12,44] which was

Table 7. Associations With Past 10 Years Colonoscopy (50-75 years).

	Simple logistic regression		Multiple logistic regression	
Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Sex				
Female	1 (Reference)	0.387	—	
Male	0.79 (0.45, 1.36)			
Education				
<High school	1 (Reference)	0.133	1 (Reference)	0.212
High school	1.73 (0.85, 3.54)	0.002	1.68 (0.74, 3.81)	0.046
>High school	3.58 (1.60, 8.01)		2.58 (1.02, 6.58)	
Household income				
<10000$	1 (Reference)	0.318	—	
≥10000$	1.43 (0.71, 2.87)	0.894		
Do not know	0.96 (0.49, 1.86)			
Blood pressure screening	1.42 (0.72, 2.82)	0.312	—	
Glucose screening	7.41 (1.78, 30.77)	0.006	3.38 (0.76, 14.97)	0.109
Cholesterol screening	4.39 (2.47, 7.79)	<0.001	2.87 (1.48, 5.59)	0.002
Dental visit in past 12 months	1.45 (0.84, 2.51)	0.184	—	
Current smoking	0.16 (0.04, 0.65)	0.011	0.09 (0.01, 0.65)	0.017
Current chewing tobacco (12 cases)	—			
Binge drinking	0.77 (0.27, 2.21)	0.630)	—	
Fruit/vegetable intake (servings/day)				
0-1	1 (Reference)	0.136	—	
02-Mar	1.63 (0.86, 3.12)	0.27		
4 or more	1.55 (0.71, 3.38)			
Physical activity				
0 days	1 (Reference)	0.02	1 (Reference)	0.286
1-29 days	2.13 (1.13, 4.38)	0.623	1.48 (0.72, 3.06)	0.21
30 days	0.82 (0.38, 1.79)		0.59 (0.26, 1.35)	
Cardiovascular disorder	1.78 (0.66, 4.76)	0.253	—	
Body mass index				
Under/normal	1 (Reference)	0.083	—	
Overweight	2.16 (0.90, 5.18)	0.865		
Obesity	0.92 (0.37, 2.32)			
Use of traditional medicine	2.58 (1.45, 4.57)	<0.001	1.65 (0.87, 3.14)	0.128

COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval.
N = 685.

confirmed in this study for noncurrent smokers with colonoscopy, intake of 2-3 servings of fruit and vegetable consumption with FOBT and Pap smear or VIA, and past 12-month dental visit with CBE, Pap smear or VIA, and FBOT. However, contrary to expectations, this study found a positive association between binge drinking and Pap smear or VIA, and a negative association between physical activity and Pap smear or VIA. Findings may help health planners to improve cancer screening uptake by targeting or promoting facilitators of cancer screening identified in this study.

The study limitations included that this investigation was limited due to the self-report of data and the cross-sectional survey design. Self-report could lead to recall bias resulting in overestimation or underestimation of true screening rates. Due to the cross-sectional design, no causative conclusions can be drawn on the relationship between explanatory and outcome variables. An additional limitation was that the STEPS survey in Marshall Islands did not assess urban and rural residence, knowledge and perceptions about cancer screening, family history of cancer, accessibility of cancer screening, as well as prostate cancer screening, which should be included in future studies.

Conclusion

The study showed a low cancer screening uptake (mammography, clinical breast examination, Pap smear or VIA, FBOT, and colonoscopy). Several protective factors were identified for cancer screening, such as higher education, other health screening (blood pressure, glucose, or cholesterol), health behavior (dental visit, fruit and vegetable consumption, and nonsmoking) and the use of traditional medicine that could assist in programs promoting cancer screening in Marshall Islands. In addition, cancer awareness campaigns, expansion of skills training of health care providers, and improving cancer screening infrastructure could help in improving the uptake of cancer screening.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics

The Marshall Islands Ministry of Health & Human Services provided ethics approval of the study, and written informed consent was obtained from study participants.[15]

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