

251 campus. We highly recommend that PCC or the government have to take the initiative in  
252 establishing a regular health monitoring system, at least covering behavioral (Step 1) and  
253 physical (Step 2) measurements, for their members.

254 Because of the convenient sampling applied in our survey, a major weakness remained in  
255 the data set, namely low participation of non-PCC students (25%). It might be possible that the  
256 college students had better access to the information of the survey and more free time to join in  
257 than the other young people outside the college. This concern might make it inadequate to  
258 generalize the findings to all Palauan population at the 18-24 age group. Although probability  
259 sampling was not employed for the current study, its results still could reflect the current status  
260 of NCD risk factors and provide valuable information for this specific age group.

261 In conclusion, the current survey revealed a high prevalence of risk factors for NCDs among  
262 young people in Palau. It indicates that swift measures against NCDs are required even for the  
263 young age group of 18-24 years, which was not included in the Palauan national STEPS. The  
264 findings can serve as a baseline epidemiological data and help the policymakers in devising  
265 proper strategies against NCDs for the population. Moreover, this first-time comprehensive  
266 survey will also offer a reference for the further development of NCD surveillance systems in  
267 Palau.

268

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278

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**Table 1 Percentages of behavioral factors among adults aged 18-24 years in Palau, 2013**

Factor		Male (n=174)		Female (n=182)		Total (n=356)	
		n	(Valid %)	n	(Valid %)	n	(Valid %)
Alcohol drinking	current drinker <sup>a</sup>	116	(66.7)	66	(36.3)	182	(51.1)
	ex-drinker	46	(26.4)	69	(37.9)	115	(32.3)
	non-drinker	12	(6.9)	47	(25.8)	59	(16.6)
Smoking	current smoker	71	(40.8)	22	(12.1)	93	(26.1)
	ex-smoker	63	(36.2)	63	(34.6)	126	(35.4)
	non-smoker	40	(23.0)	97	(53.3)	137	(38.5)
Betel nut and tobacco chewing	current chewer	109	(62.6)	98	(53.8)	207	(58.1)
	non-chewer	65	(37.4)	84	(46.2)	149	(41.9)
Tobacco product use	current user	139	(79.9)	111	(61.0)	250	(70.2)
	non-user	35	(20.1)	71	(39.0)	106	(29.8)
Fruits/Vegetables (servings/day)	<1	34	(20.0)	50	(27.9)	84	(24.1)
	1-2.9	85	(50.0)	93	(52.0)	178	(51.0)
	3-4.9	31	(18.2)	23	(12.8)	54	(15.5)
	≥5	20	(11.8)	13	(7.3)	33	(9.5)
	missing	4		3		7	
Physical activity	no	5	(2.9)	25	(13.7)	30	(8.4)
	yes <sup>b</sup>	169	(97.1)	157	(86.3)	326	(91.6)

<sup>a</sup> Those who answered that they consumed an alcoholic drink within the past 30 days or 1 month.

<sup>b</sup> Those who answered that they have vigorous- or moderate-intensity physical activities in their daily life.

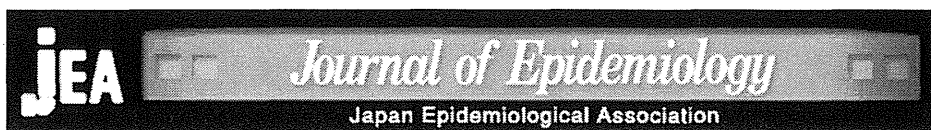
**Table 2** BMI, blood pressure, blood levels of glucose and lipids among adults aged 18-24 years in Palau, 2013

		Male (n=174)		Female (n=180)		Total (n=354)	
		n	(Valid %)	n	(Valid %)	n	(Valid %)
Body mass index (kg/m <sup>2</sup> )	<18.5	11	(6.5)	13	(7.3)	24	(6.9)
	18.5-25	79	(46.7)	75	(41.9)	154	(44.3)
	25-29.9	45	(26.6)	50	(27.9)	95	(27.3)
	≥30	34	(20.1)	41	(22.9)	75	(21.6)
	missing	5		1		6	
Systolic blood pressure (mmHg)	<120	30	(17.6)	100	(55.9)	130	(37.2)
	120-129	49	(28.8)	54	(30.2)	103	(29.5)
	130-139	63	(37.1)	23	(12.8)	86	(24.6)
	140-159	27	(15.9)	1	(0.6)	28	(8.0)
	≥160	1	(0.6)	1	(0.6)	2	(0.6)
	missing	4		1		5	
Diastolic blood pressure (mmHg)	<70	67	(39.4)	65	(36.3)	132	(37.8)
	70-79	68	(40.0)	76	(42.5)	144	(41.3)
	80-89	28	(16.5)	35	(19.6)	63	(18.1)
	90-99	6	(3.5)	2	(1.1)	8	(2.3)
	≥100	1	(0.6)	1	(0.6)	2	(0.6)
	missing	4		1		5	
Hypertension	no	140	(82.4)	176	(98.3)	316	(90.5)
	yes	30	(17.6)	3	(1.7)	33	(9.5)
	missing	4		1		5	
Fasting glucose (mg/dL)	<100	112	(67.9)	136	(76.4)	248	(72.3)
	100-109	36	(21.8)	29	(16.3)	65	(19.0)
	110-125	6	(3.6)	12	(6.7)	18	(5.2)
	≥126	11	(6.7)	1	(0.6)	12	(3.5)
	missing	9		2		11	
Triglycerides (mg/dL)	<100	122	(74.4)	136	(77.3)	258	(75.9)
	100-149	30	(18.3)	26	(14.8)	56	(16.5)
	150-199	6	(3.7)	8	(4.5)	14	(4.1)

	≥200	6 (3.7)	6 (3.4)	12 (3.5)
	missing	10	4	14
Total cholesterol (mg/dL)	<160	23 (14.0)	29 (16.5)	52 (15.3)
	160-189	77 (47.0)	88 (50.0)	165 (48.5)
	190-199	31 (18.9)	21 (11.9)	52 (15.3)
	200-239	32 (19.5)	37 (21.0)	69 (20.3)
	≥240	1 (0.6)	1 (0.6)	2 (0.6)
	missing	10	4	14
HDL-cholesterol (mg/dL)	<40	3 (1.8)	1 (0.6)	4 (1.2)
	40-49	10 (6.1)	8 (4.5)	18 (5.3)
	50-59	27 (16.5)	17 (9.7)	44 (12.9)
	≥60	124 (75.6)	150 (85.2)	274 (80.6)
	missing	10	4	14

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HDL indicates high density lipoprotein.



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**Profile of Non-communicable Disease (NCD) Risk Factors among Adults in the Republic of Palau: Findings of a National STEPS Survey**

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1 **ABSTRACT**

2 **Background:** Palau, similar to other Pacific island countries, is currently highly burdened  
3 with non-communicable diseases (NCDs). The WHO STEPS was launched in 2011 to  
4 comprehensively survey indicators for NCDs in the country. This paper aims to describe the  
5 prevalence of key NCD risk factors assessed by the survey.

6 **Methods:** The WHO instrument, including behavioral, physical and biochemical  
7 measurements, was adopted to the nationwide survey for all residents aged 25 to 64 years. A  
8 cluster-based sampling method was performed to obtain a national representative data.

9 **Results:** Valid data from 2,184 individuals were selected for the analyses, of which 75% were  
10 Palauans and 19% were Filipinos. Prevalence of current cigarette smoking was 25% in men  
11 and 10% in women. Betel nut chewing with tobacco was prevalent particularly among  
12 Palauans (58% in men, 69% in women) compared to the other ethnic groups. In terms of all  
13 types of tobacco use, 60% of men and 58% of women were current users. Overweight or  
14 obesity was very common among Palauans (84% in men, 86% in women) as well as Filipinos  
15 (52% in men, 40% in women). Hypertension was found in 55% of men and 49% of women,  
16 with the stage 2 hypertension being 21% and 19%, respectively. The prevalence of diabetic  
17 level hyperglycemia was more than 20%. Raised total cholesterol was detected in 16% of men  
18 and 20% of women.

19 **Conclusions:** This survey revealed an alarmingly high prevalence of NCD risk factors,

20 especially tobacco use, obesity, hypertension and raised blood glucose. The data would be

21 useful baseline information to develop effective NCD strategies in Palau.

22

23 **Key words:** Non-communicable disease, WHO STEPS, obesity, hypertension, betel nut and

24 tobacco chewing

## 25 INTRODUCTION

26 Non-communicable diseases (NCDs) have undoubtedly become a major challenge in the  
27 Pacific Islands, which account for around 70% of all deaths in the region, including a high  
28 percentage of premature deaths (before the age of 60).<sup>1,2</sup> The Republic of Palau, a small island  
29 country in the western Pacific bears a high burden of NCDs, as well as other Pacific island  
30 countries and territories. According to the data released by the Ministry of Health of Palau in  
31 2011, cardiovascular disease (24.3%), cancer (21.4%), chronic respiratory diseases (12.7%),  
32 and diabetes (9.8%) are the leading four causes of death in the country.<sup>3</sup> Being aware of the  
33 seriousness of the issue, the President of Republic of Palau signed an executive order  
34 declaring a state of health emergency on NCDs in 2011. However, the authorities did not have  
35 valid population baseline data of key indicators for NCDs to establish evidence-based  
36 strategies for controlling NCDs. Although several previous population-based surveys were  
37 conducted in Palau, none of them could provide complete information, including behavioral  
38 and biological risk factor of NCDs. For example, the Palau Health Survey in 1991 did not  
39 include blood tests, and the Palau Community Health Assessment in 2003 or the behavioral  
40 risk factor surveillance system (BRFSS) in 2010 and 2012 did not include physical and  
41 biochemical measurements. The Ministry of Health, therefore, collaborated with the World  
42 Health Organization (WHO) to start the WHO STEPwise approach to risk factor Surveillance  
43 (STEPS) in late 2011, which would be the first comprehensive national survey for NCD risk

44 factors in Palau.

45 This paper aims to perform a preliminary analysis on the population representative dataset  
46 and describe the prevalence of each major common risk factor for NCDs.

47

## 48 **METHODS**

49 Palau is a Micronesian island country, located east of the Philippines, west of the Federated  
50 States of Micronesia (FSM) and northeast of Indonesia. It is classified as an upper middle  
51 income country by the World Bank and has relatively high living standards in comparison  
52 with other island countries in the region. According to the latest national population and  
53 housing census conducted in 2005, the total population is about 20,000, of which 73% are of  
54 Palauan descent and foreign nationals comprise the rest. Filipinos, estimated at 16% to  
55 roughly 20% of the total population, are the largest group of the foreign residents, and most of  
56 them are migrant workers from the Philippines after the 1990s.

57 A population-based survey for NCD risk factors, referred to as Palau NCD STEPS Survey,  
58 was started in September 2011 by adopting the WHO STEPS Instrument,<sup>4</sup> and the data  
59 collection was completed in June 2013. Two-stage cluster random sampling was designed to  
60 select 2,807 households nationwide, based on the 2009 Household Survey. One resident aged  
61 25 to 64 years within each of the households was recruited for the survey using the Kish  
62 methods.

63 As detailed below, there are three component parts, called “Steps”, of the survey  
64 instrument, *i.e.* behavioral, physical and biochemical measurements. (1) Apart from questions  
65 for basic demographic information, a structured questionnaire was used to assess four  
66 common behavioral risk factors of NCDs by face-to-face interviews. Participants were asked  
67 about personal dietary habits, particularly fruit and vegetable intakes, as well as tobacco use,  
68 alcohol consumption and physical activity in their daily lives. (2) The second Step consisted  
69 of measurements of height, weight, waist and hip circumferences, and resting blood pressure.  
70 The anthropometric measurements were taken in light indoor clothing, and without shoes or  
71 other heavy accessories. Blood pressure in the sitting position was measured three times in the  
72 upper arm, using an electronic sphygmomanometer (Omron HEM-7200). Three  
73 measurements of blood pressure were taken for each participant in the survey, and the  
74 arithmetic mean of the second and third readings were used. (3) Biochemical blood tests were  
75 performed in the morning after roughly 10 to 12 hours of fasting. Fresh capillary whole blood  
76 samples were drawn from the fingertip, followed by biochemical tests on portable devices,  
77 namely ACCU-CHEK Performa system (Roche Diagnostics, North America) for fasting  
78 blood glucose and Accutrend Plus system (Roche Diagnostics, North America) for blood  
79 levels of total cholesterol and triglycerides.

80 Data were entered by using the EpiData software and categorized into different groups for  
81 the analysis based on well-defined criteria. Body mass index (BMI) is defined as the weight in

82 kilograms divided by the square of the height in meters. As the current WHO classification,  
83 cutoff points of 18.5, 25 and 30 kg/m<sup>2</sup> were used to define underweight, normal weight,  
84 overweight and obesity. Hypertension was defined as having a systolic blood pressure ≥140  
85 mmHg, a diastolic blood pressure ≥90 mmHg, or currently being on antihypertensive  
86 medication. People with systolic blood pressure ≥160 mmHg or diastolic blood pressure ≥100  
87 mmHg were grouped as stage 2 hypertension, by applying the criteria of the Seventh Report  
88 of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High  
89 Blood Pressure (JNC 7).<sup>5</sup> According to the recommendations by the WHO and American  
90 Diabetes Association (ADA), values of fasting blood glucose ≥126 mg/dL or those on diabetic  
91 treatment were categorized as diabetic. Two values for the upper limit of normal fasting blood  
92 glucose were used: 110 mg/dL by the WHO or 100 mg/dL by the ADA criteria.<sup>6,7</sup> The levels  
93 of blood lipids were classified as follows: normal (<150 mg/dL), borderline-high (150-199  
94 mg/dL) and high (≥200 mg/dL) for triglycerides, and desirable (<200 mg/dL), borderline-high  
95 (200-239 mg/dL) and high (≥240 mg/dL) for total cholesterol.<sup>8</sup> We conducted all data  
96 analyses using the statistical software, IBM SPSS Statistics for Windows, Version 22.0 (IBM  
97 Corp, Armonk, NY, USA).

98 The survey proposal was reviewed and approved by the WHO and Institutional Review  
99 Board of the Ministry of Health, Republic of Palau prior to implementation. Written informed  
100 consent was obtained from all of the participants after adequate explanations of the objectives

101 and procedures of the project. This study is part of a joint research project between Palau and  
102 Japan, which was also approved by the Bioethics Review Committee of Nagoya University  
103 School of Medicine.

104

## 105 RESULTS

106 Valid data of 2,184 individuals were selected for the analyses in this study, excluding those  
107 who were not within the target age range of 25-64 years, who did not give a clear answer of  
108 sex, and women who were pregnant at the moment of the survey. About 75% of the subjects  
109 were Palauans and 19% were Filipinos, the main foreign population in the country. Table 1  
110 shows the characteristics of participants by gender and age group, and Table 2 shows that by  
111 ethnic background.

112 A quarter of male participants were current cigarette smokers, but female smokers were  
113 less than 10%. Betel nut and tobacco chewing was a common practice among Palauans, as  
114 58% of men and 69% of women had the habit. In the total participants, 60% of men and 58%  
115 of women reported current use of any kind of tobacco products, including smoking and  
116 chewing. Infrequent fruit intake, namely one day or less per week, occurred in 44% of men  
117 and 32% of women. As for infrequent vegetable intake ( $\leq 1$  day/week), it was observed in 15%  
118 and 9% of men and women, respectively.

119 Most of Palauan males (84%) and females (86%) were overweight or obese ( $BMI \geq 25$ )



120 kg/m<sup>2</sup>), with the mean BMI being 30.8 kg/m<sup>2</sup> and 31.3 kg/m<sup>2</sup> in males and females,  
121 respectively. Filipino residents also had a high prevalence of overweight or obesity, *i.e.* 52%  
122 in males and 40% in females, and the mean BMI was 25.4 kg/m<sup>2</sup> in males and 24.5 kg/m<sup>2</sup> in  
123 females. As for percentage of obesity alone (BMI  $\geq$  30 kg/m<sup>2</sup>), it is much higher among  
124 Palauan residents (51% in males and 55% in females) than that among Filipinos (9% in males  
125 and 10% in females).

126 Approximately 8% of males and 14% of females among the total adult subjects reported  
127 that they had taken antihypertensive medication during the past two weeks. Including those  
128 who were on medication, more than half of Palauan males (60%) and females (54%) were  
129 considered hypertensive, followed by 46% of males and 34% of females in the Filipino  
130 population. Moreover, 20% of the total participants were stage 2 hypertensive ( $\geq$  160/100  
131 mmHg).

132 About one out of five participants in this survey were regarded as diabetic. The prevalence  
133 is higher in the older age group, *e.g.* 29% of males and 35% of females were diabetic among  
134 the oldest age group of 55-64 years.

135 Borderline-high or high levels of triglycerides were found in 48% of men and 41% of  
136 women in the total subjects, whereas borderline-high or high levels of total cholesterol  
137 including those on medication were observed among 16% of men and 20% of women.

138

139 **DISCUSSION**

140 This is the first comprehensive population based survey on risk factors of NCDs among adults  
141 in Palau, which included physical and biochemical measurements. The results revealed a high  
142 percentage on each of the major risk factors, especially tobacco use, overweight or obesity,  
143 hypertension, and raised blood glucose.

144 Findings of this survey confirmed that cigarette smoking was more prevalent among men  
145 than women in Palau (25% vs. 10%:  $P < 0.001$ ). The prevalence was almost the same as that  
146 reported in the Palau Community Health Assessment,<sup>3</sup> a national household survey in 2003,  
147 indicating that smoking rate of adults had hovered during the past decade in this country.  
148 Compared with the other Pacific island countries, the prevalence of smoking in Palau was not  
149 high.<sup>9</sup> For instance, it was much lower than the findings from a previous survey carried out in  
150 the adjacent Micronesian country, Federated States of Micronesia (FSM), in which 42% of  
151 men and 32% of women were reported as current smokers.<sup>10</sup>

152 However, cigarette smoking solely can hardly illustrate the fact of tobacco use in Palau.  
153 Chewing betel nut with tobacco, smokeless tobacco, is a broadly acceptable practice within  
154 all sectors of the population in Palau.<sup>11</sup> According to the results, Palauan adults, especially  
155 women, had an extremely high proportion of betel nut and tobacco chewing, which was not  
156 commonly observed in other ethnic groups living in this country. Although the neighboring  
157 country, FSM, has the same tradition of betel nut chewing, the percentage of smokeless

158 tobacco users was significantly lower in comparison to Palau, namely 22% in men and 3% in  
159 women. As regards the gender difference in betel nut and tobacco chewing, Cambodia is the  
160 other country in the WHO Western Pacific Region which reported women had a significantly  
161 higher prevalence than men.<sup>12</sup> Three reasons for the use of chewing tobacco and betel nut  
162 among Cambodian women were suggested in a previous study: (1) as an addictive stimulant,  
163 (2) as part of a female rite of passage into adulthood and reproductive age, and (3) as a  
164 remedy to relieve pregnancy-related symptoms.<sup>13</sup> However, the reasons for the high  
165 prevalence of chewing betel nut with tobacco among Palauan women are still not clear.  
166 Further studies might be designed to gain insight into the social context. Based on the findings  
167 in this survey, the Palauan government may have to develop gender- and ethnic-specific  
168 tobacco control measures for the population.

169 Obesity is a common major challenge of public health in the Pacific region. More than half  
170 of adult population in each of the Pacific island countries are observed to be overweight or  
171 obese ( $\text{BMI} \geq 25 \text{ kg/m}^2$ ), with the exception of Papua New Guinea.<sup>14</sup> Likewise, about three in  
172 four participants were considered as overweight or obesity in this survey. With regard to the  
173 difference by ethnic background, more than half of Palauan adults were obese ( $\text{BMI} \geq 30$   
174  $\text{kg/m}^2$ ), whereas the proportions of obesity in both Filipino men and women were less than  
175 10%. Most of the Filipinos living in Palau are migrant workers engaged in physical labors and  
176 having lower income levels than Palauans. (see Table 2). Considering the socio-economic

177 background, lower prevalence of obesity among Filipinos than among Palauans might be  
178 attributable to the differences in dietary habits, physical activities, working conditions, etc. In  
179 comparison with the data reported from the Palau Health Survey in 1991, the mean BMI of  
180 adults aged 35-64 years had increased from roughly 27.6 to 29.6 kg/m<sup>2</sup> for men and 29.6 to  
181 30.1 kg/m<sup>2</sup> for women over the past two decades.<sup>15</sup> Dietary patterns and lifestyle changes with  
182 the economic growth in Palau might explain the increased BMI. Subsequent analyses or  
183 further studies are required to investigate the factors contributing to overweight or obesity in  
184 the population.

185 This survey revealed an alarmingly high prevalence of hypertension in Palau, of which  
186 more than half of the adults had a raised blood pressure, particularly among ethnic Palauans.  
187 Even the youngest age group (25-34 years) demonstrated a high percentage of hypertension  
188 (36% in men and 25% in women). However, the proportion of participants who were on  
189 antihypertensive medication was relatively low (8% in men and 14% in women). As  
190 hypertension rarely causes symptoms in the early stages, those who have undiagnosed  
191 hypertension or ignore self-management of blood pressure should be targeted first in NCD  
192 control policies.<sup>16</sup> Among published data of WHO STEPS surveys for Pacific island countries  
193 and territories, Palau has the highest prevalence of hypertension in both sexes (55% in men  
194 and 49% in women), even though the prevalence of obesity is not noticeably high compared  
195 to the others.<sup>17</sup> Factors might contribute to this result, such as salt intakes, need to be