3. Graphing

Radar plotting is a form of graphing which was reported to be practical and profoundly useful for examining and displaying patterns in multivariate data of medicine researches[11]. To show the characteristics of each pattern, we have drawn radar charts for a typical country from each pattern.

4. Ethical clearance

This study is a part of a study entitled "Multi-Disciplinary Study for Promoting Non-Communicable Disease Control in East Asia and Oceania," funded by Health and Labor Sciences Research Grants (Research on global health issues), Ministry of Health, Labor and Welfare, Japan. The whole study plan was reviewed and approved by the Ethics Review Committee of Nagoya University School of Medicine, Nagoya, Japan (Approval No. 2012-0103).

III. Results

Table 1 shows age-standardized prevalence of obesity, raised blood pressure, raised blood glucose, and raised blood cholesterol for 2008 of the 28 countries in the studied regions. The prevalence of obesity (BMI ≥ 30 kg/m^2) ranged from 1.6% (Vietnam) to 71.1% (Nauru). The highest prevalence of raised blood pressure (systolic blood pressure ≥ 140 mmHg or on medication) was reported in Vanuatu (47.2%) while Republic of Korea reported the lowest (29.8%). The highest prevalence of raised blood glucose (fasting blood glucose ≥ 7.0 mmol/L or on medication) was reported in Marshall Islands (28.7%), while Cambodia reported the lowest (5.1%). The highest prevalence of raised blood cholesterol (total cholesterol ≥ 5.0 mmol/L was reported in Cook Islands (59%), and the lowest was in Cambodia (30%).

The dendrogram generated by cluster analysis presents the clustering process among the studied countries (Fig. 1). Based on the z-scores of the four metabolic risk factors, the most similar countries merged step by step, until all countries were combined into a biggest cluster. Heterogeneity among the clusters increased from left to right. Three major clusters were revealed by setting the cut-off at the rescaled distance cluster combine level of 15. The first cluster, comprised of eight high- and upper-middle-income countries most of which located in Asia (Brunei Darussalam, Thailand, Singapore, Japan, Malaysia, Australia, New Zealand, and Republic of Korea). The second cluster included ten low- and lower-middle-income countries (Vanuatu, Mongolia, Lao PRD, China, Vietnam, Indonesia, Myanmar, Philippines, Cambodia, and Papua New Guinea); most of them located in Asia. The third cluster comprised of ten Pacific insular countries (Palau, Tonga, Fiji, Micronesia, Cook Islands, Nauru, Kiribati, Solomon Islands, Samoa, and Marshall Islands).

Table 2 presents the population z-score means on each variable. Overall, differences among the three patterns were observed on each variable after ANOVA was conducted (All $P < 0.05$). The results of multiple comparisons by Sidak t-test are shown in Table 3. The first pattern showed the highest raised blood cholesterol z-score mean, which was significantly higher than the second pattern ($P < 0.001$) and the third pattern ($P = 0.048$). The second pattern had higher raised blood pressure z-score means than the first pattern ($P = 0.027$), although it was not significantly different from that of the third pattern ($P = 0.747$). The third pattern, presented significantly higher z-score means in obesity than other two patterns, and z-scores of raised blood pressure and raised blood glucose were also relatively high.

Characteristics of the three patterns are shown as radar charts of typical countries categorized in each pattern (Fig. 2). Japan was a typical country in the first pattern, which presented high prevalence of raised blood cholesterol and relatively low prevalence of obesity, raised blood pressure and raised blood glucose. Chart of Mongolia showed the typical characteristics of the second pattern with significantly high prevalence of raised blood pressure compared to the first pattern. The remarkable feature of the third pattern was extremely high prevalence of obesity, as shown in the radar chart of Nauru. The prevalence of raised blood pressure and raised blood glucose were also high in the third pattern.

IV. Discussion

In this study, we applied cluster analysis for identifying NCD risk factor patterns. Cluster analysis is a widely used method in medical researches for classifying similar patterns from large data involving many variables. The most similar individuals merged step

Table 1　Age-standardized prevalence of four major NCD metabolic risk factors

	Obesity [a]	Raised blood pressure [b]	Raised blood glucose [c]	Raised blood cholesterol [d]
	(%)	(%)	(%)	(%)
East Asia				
China	5.1	38.6	9.5	33.4
Japan	4.5	36	5.9	57.1
Mongolia	16.4	47	9.9	37.3
Republic of Korea	7.3	29.8	6.1	42.5
Southeast Asia				
Brunei Darussalam	7.9	34.4	7.4	55.2
Cambodia	2.3	31.5	5.1	30
Indonesia	4.7	41	6.9	35.8
Lao PDR	3	37.3	7.4	31.4
Malaysia	14.1	38	11.4	52.1
Myanmar	4.1	42	6.6	30.4
Philippines	6.4	37.2	6.6	43.3
Singapore	6.4	34.6	6.4	57.5
Thailand	8.5	34.2	7.2	55.5
Vietnam	1.6	36.8	7.7	36.1
Oceania				
Australia	25.1	31.8	8.1	55.2
Cook Islands	64.1	43.6	20.8	59
Fiji	31.9	41.6	14.8	53.2
Kiribati	45.8	37.4	24.2	35.5
Marshall Islands	46.5	36.8	28.7	46.1
Micronesia	42	41.8	17	48.1
Nauru	71.1	43.9	14	46.2
New Zealand	27	32.6	9.9	56.2
Palau	50.7	40.1	18.2	54.7
Papua New Guinea	15.9	32.1	15	38.2
Samoa	55.5	42.7	22.4	34.6
Solomon Islands	32.1	37.4	17.7	33.2
Tonga	59.6	41.1	18.2	49.7
Vanuatu	29.8	47.2	9.4	37.6

[a]Body Mass Index > = 30 kg/m^2; [b]Systolic Blood Pressure > = 140mmHg or on medication;
[c]Fasting Blood Glucose > = 7.0 mmol/L or on medication; [d]Total Cholesterol > = 5.0 mmol/L.
Data source: WHO Global Health Observatory Data Repository for 2008

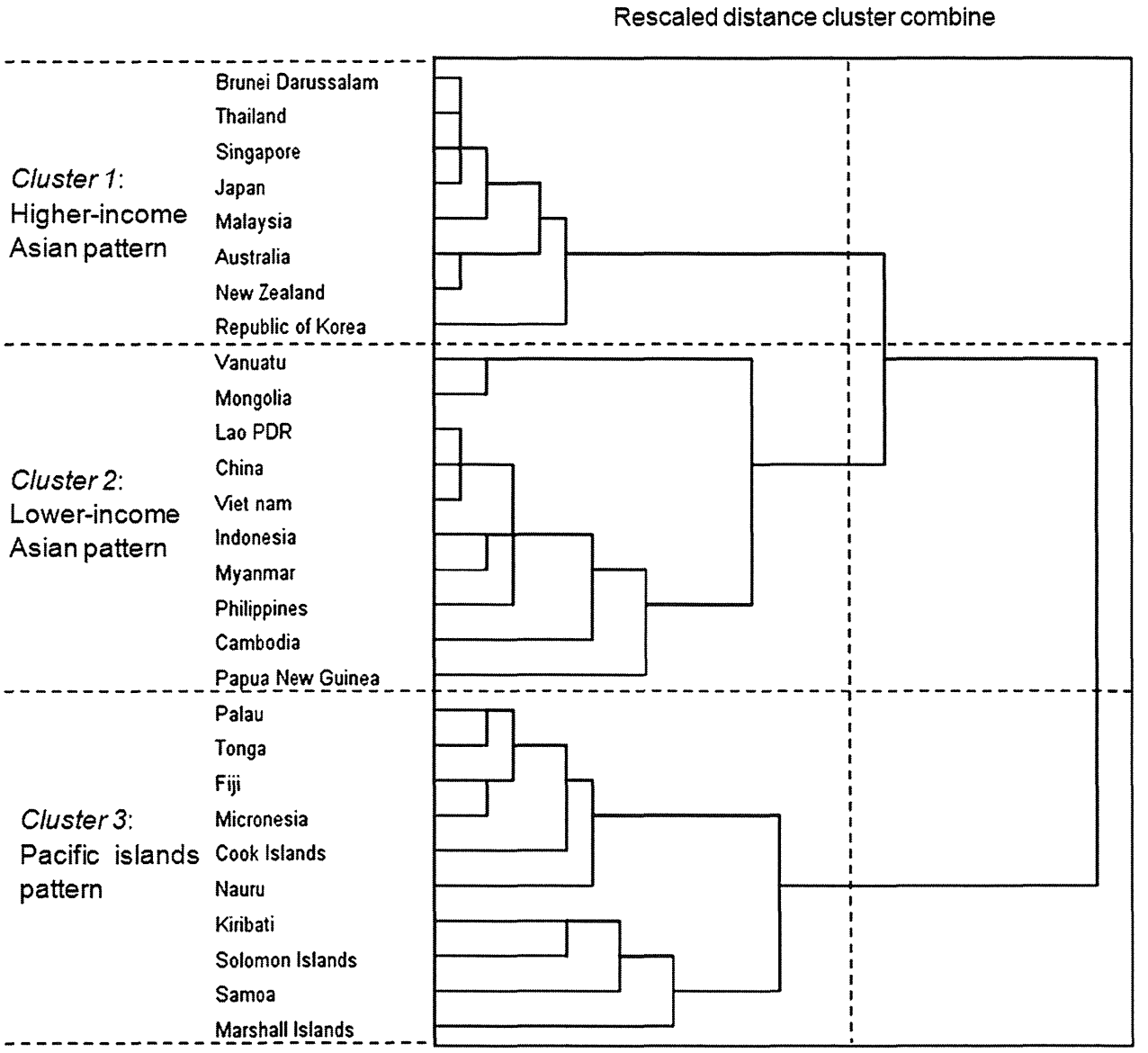

Figure 1 Dendrogram of the patterns of NCD metabolic risk factors

Table 2 Characteristics of the three patterns of NCD metabolic risk factors

	Obesity [a] z-score means (SD)	Raised blood pressure [b] z-score means (SD)	Raised blood glucose [c] z-score means (SD)	Raised blood cholesterol [d] z-score means (SD)
First pattern Higher-income Asian pattern (n=8)	-0.5533 (0.40)	-0.9142 (0.55)	-0.6871 (0.30)	0.9608 (0.50)
Second pattern Lower-income Asian pattern(n=10)	-0.7196 (0.41)	0.1963 (1.16)	-0.5925 (0.43)	-0.9275 (0.42)
Third pattern Pacific island pattern (n=10)	1.1622 (0.60)	0.5351 (0.57)	1.1421 (0.70)	0.1589 (0.91)
ANOVA	F=45.046, P<0.001*	F=7.278, P=0.003*	F=38.111, P<0.001*	F=18.866, P<0.001*

[a]Body Mass Index ≥ 30 kg/m^2; [b]Systolic Blood Pressure ≥ 140mmHg or on medication;
[c]Fasting Blood Glucose ≥ 7.0 mmol/L or on medication; [d]Total Cholesterol ≥ 5.0 mmol/L.
* P < 0.05

Table 3　Multiple comparison for any two patterns by Sidak t-test

Multiple comparison groups			Obesity [a]		Raised blood pressure [b]		Raised blood glucose [c]		Raised blood cholesterol [d]	
I		J	Mean difference (I-J)	*P*	Mean difference (I-J)	*P*	Mean difference (I-J)	*P*	Mean difference (I-J)	*P*
Higher-income Asian pattern	*vs*	Lower-income Asian pattern	0.166	0.856	-1.111	0.027*	-0.095	0.974	1.888	<0.001*
Higher-income Asian pattern	*vs*	Pacific island pattern	-1.715	<0.001*	-1.449	0.003*	-1.829	<0.001*	0.802	0.048*
Lower-income Asian pattern	*vs*	Pacific island pattern	-1.882	<0.001*	-0.339	0.747	-1.735	<0.001*	-1.086	0.003*

[a]Body Mass Index ≥ 30 kg/m^2; [b]Systolic Blood Pressure ≥ 140mmHg or on medication;
[c]Fasting Blood Glucose ≥ 7.0 mmol/L or on medication; [d]Total Cholesterol ≥ 5.0 mmol/L.
* $P < 0.05$

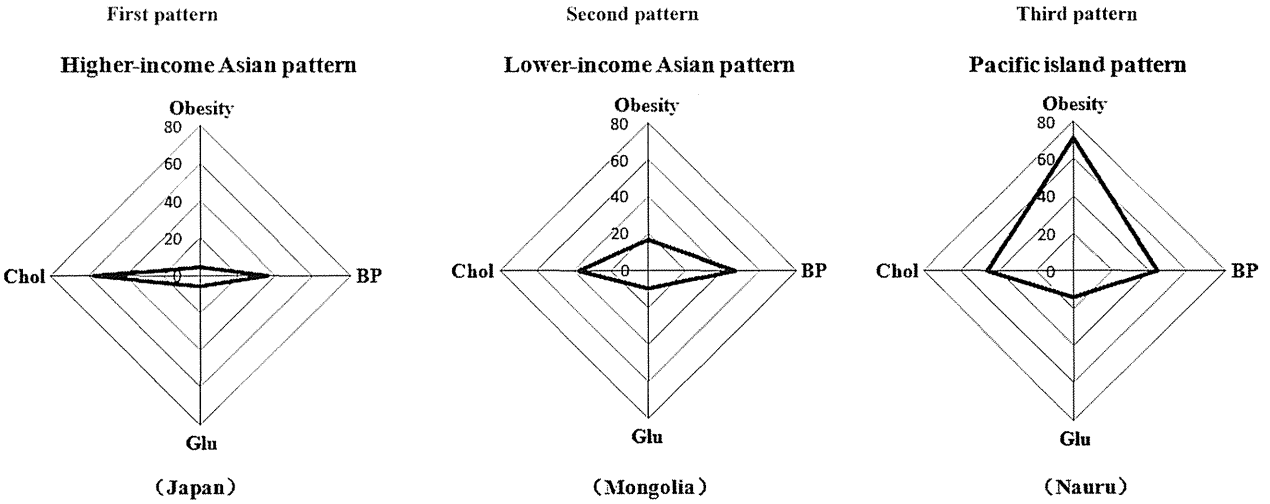

Figure 2.　Radar charts of the three patterns of metabolic risk factors

Typical countries of each pattern are shown. BP: raised blood pressure; Glu: raised blood glucose; Chol: raised blood cholesterol. The vertical and horizontal scales show the prevalence of each factor.

by step, until finally all individuals aggregate into the biggest cluster. Previous applications of cluster analysis were found in identifying patterns of behaviors[9, 10], dietary[12], or in genetic expressions[13]. These studies suggest that cluster analysis may be useful in characterizing large data into subgroups for identifying patterns with different features.

Our analysis revealed the three patterns of four major NCD metabolic risk factors among countries in East Asia, Southeast Asia and Oceania. We found that most countries in each pattern shared common economic and geographical characteristics, and therefore we propose to label the three patterns according to the income level and geographic characteristics of the majority of the countries categorized in each pattern. We propose to name the first pattern as Higher-income Asian pattern, the second pattern as Lower-income Asian pattern, and the third patter as Pacific island pattern. Higher-income Asian pattern presented relatively high prevalence of raised blood cholesterol, while prevalence of obesity, raised blood pressure and raised blood glucose remain relatively low. Countries which show this pattern are mostly high- and upper-middle-income countries in the regions. It is known that total blood cholesterol is an independent strong risk factor for ischemic heart disease[14, 15]. Some cause-specific mortality reports showed similar feature with our result. Many Higher-

income Asian pattern countries, such as Japan, Korea and Singapore, reported the increase in age-adjusted mortality for ischemic heart disease, in spite of the dramatically decline in stroke mortality[16]. Therefore, interventions to reduce blood cholesterol levels of the people should be a priority in these countries for preventing expected high morbidity and mortality from ischemic heart diseases. Possible interventions include promoting to take dietary fibers but not to take excess amount of saturated fats, screening blood cholesterol levels of people, and providing continuous medical treatment for hypercholesterolemia.

Lower-income Asian pattern presented relatively high prevalence of raised blood pressure, although prevalence of obesity, raised blood glucose, and raised blood cholesterol stayed relatively low. Most of low- and lower-middle-income countries in Asia are categorized in this pattern. Raised blood pressure is the most significant risk factor of stroke, which bears two thirds of the stroke burden globally[17]. National income was proved to be the strong predictor of stroke mortality, and low income countries have 3.5 times higher stroke mortality rates than those of middle- and high-income countries. For example, Mongolia, a Lower-income Asian pattern country, was reported to have about 5 times higher mortality rate of stroke than that of Australia or New Zealand, which were categorized as Higher-income Asian pattern countries[18]. It is urgently needed for those countries to control the blood pressure of people by reducing dietary salt intake through proper health and nutrition education, screening blood pressure regularly, and ensuring access to affordable lifelong antihypertensive treatment.

Pacific island pattern, observed uniquely among low- and middle-income insular countries in Oceania, exhibited high prevalence of obesity, relatively high prevalence of raised blood pressure and raised blood glucose. People in those countries are likely to suffer from high morbidities and mortalities from stroke and diabetes mellitus in the near future, unless effective control measures against obesity, raised blood pressure and raised blood glucose are taken. Integrated multi-sectoral interventions for improving diet habits and physical activities are urgently required. For example, it is needed for the people in these countries to increase intakes of vegetables and fruits and to reduce intakes of canned or processed meat with high fat and salt concentration. Therefore, not only school and community based nutritional education programs, but also interventions to the food production and marketing systems would be required simultaneously. In spite of the alarming situations of NCD problems, systematic studies on NCD mortalities and morbidities as well as detailed studies of lifestyle risk factors in low- and middle-income Pacific island countries were very limited. Further work is urgently needed to develop evidence-based NCD control strategies in these countries.

One of the interesting findings of this study was that two Pacific island countries, Vanuatu and Papua New Guinea, were categorized in Lower-income Asian pattern rather than Pacific island pattern. It means that the two countries might have relatively lower prevalence of obesity and raised blood glucose than the other Pacific islands countries. This phenomenon might be attributed to relatively high level of physical activities in Vanuatu[19] or genetic difference among Pacific islanders[20]. Since detailed NCDs related risk factor prevalence of those two countries and other Pacific islands countries were not available, the reasons why the two countries present different features require further studies.

Although we categorized countries in East Asia, Southeast Asia, and Oceania into three patterns of NCD metabolic risk factors, countries are unlikely to stay in the same pattern forever. People's lifestyles and nutritional status are changing along with the social and economic development, and so will the prevalence of NCD metabolic risk factors. Systematic public health interventions are also expected to bring dynamic changes in NCD metabolic risk factors.

For example, Japan is currently categorized in the Higher-income Asian pattern; however, it had high prevalence of hypertension and highest stroke mortality in the world in 1960s and 70s[6, 21], similar to the countries categorized in the Lower-income Asian pattern. Systolic blood pressures of Japanese people have been successfully lowered through systematic public health interventions, including health education and nutrition consultations for reducing salt intake, screening blood pressures in the local communities and workplaces, and providing affordable continuous anti-hypertensive treatment[6, 22]. This im-

plies that the proper interventions would make difference in the prevalence of NCD risk factors, and could reduce NCD mortalities and morbidities.

The changes in the pattern of NCD metabolic risk factor became apparent two to three decades after the period of rapid economic development in Japan. This suggests that low- and lower-middle-income countries in East Asia and Southeast Asia categorized in Lower-income Asian pattern may shift to be categorized in the Higher-income Asian pattern, 20 to 30 years after the ongoing dramatic economic growths. Therefore, unless systematic interventions for controlling hypertension are implemented immediately, these countries may suffer from dual burdens of high prevalence of raised blood pressures and raised blood cholesterol in the near future.

This study is the first step to highlight the features of NCD metabolic risk factors. Based on the estimated prevalence data obtained from the WHO database, we have identified three patterns of NCD metabolic risk factors. Categorizing into patterns could urge policy makers to develop appropriate joint or common strategies in the region based on the current risk factor status.

However, this study had several limitations. First, we chose single database to ensure the data comparability across countries and times[8], however, the data might not be representative of the whole population in each country. Sub-regional data within each county were not available from the database. For example, in China, NCD metabolic risk factors might be significantly different between residents in rich urban cities and poor farmers in remote areas. Second, other factors which might have relevant effects on establishing NCD pattern, such as diet, physical activity, and socio-economic factors, were not included in the analyses of this study, as the comparable data were unavailable or missing in significant number of the observed countries.

As a first step, we targeted only East Asia, Southeast Asia and Oceania regions. Next studies should cover larger Asian areas, where NCD metabolic risk factor feature is diverse. For example, obesity prevalence in Middle East and Central Asia is known to be much higher than that in East and Southeast Asia[8]; and comparing to that of East Asian, obesity for South Asians was reported to have different contribution to cardiovascular diseases[23], and cardiovascular disease mortality was also higher in South Asian countries[24]. It would also be useful to extend the analysis to other regions such as Africa and Latin America. Gender differences need to be investigated as well[25], although this study used estimated prevalence for both sexes to ensure comparability across countries.

V. Conclusion

Three patterns of the four major NCD metabolic risk factors were identified in our study. The patterns were labeled as: Higher-income Asian pattern, Lower-income Asian pattern and Pacific island pattern according to the income level and geographic characteristics of the countries categorized in each cluster. Countries categorized in each pattern should set priorities for effective NCD control strategies, taking into account of the features of the pattern. Possible pattern transition in the future should also be taken into consideration.

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国際開発学会

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発表論文集

Proceedings

2014 年 6 月 21 日（土）

同志社大学（新町キャンパス）

Saturday, June 21, 2014

Doshisha University (Shinmachi Campus)

オセアニア島嶼地域における
生活習慣病 (non-communicable diseases: NCD) とその危険因子
—低中所得国の保健医療分野における新たな開発課題—

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キーワード: non-communicable diseases (NCD); NCD 危険因子; 低中所得国;
オセアニア島嶼地域; パラオ

1. Non-communicable diseases (NCD) — 保健医療分野の新たな開発課題

低中所得国では、経済発展に伴う生活環境・栄養状態の変化や、母子保健・感染症対策などの進展に伴い、1990 年代以降、心血管疾患をはじめとする生活習慣病 (non-communicable diseases: NCD) の問題が顕在化してきた。虚血性心疾患は世界の成人死因第 1 位であり、推定死亡者 730 万人の 8 割は、低中所得国における死亡である。低中所得国における NCD 増加によって、全世界の NCD 疾病負荷は、現在の 43 %から 2020 年には 60 %まで増加すると予測されている。2011 年には、国連ハイレベル会合、WHO 閣僚会合において NCD が取り上げられ、その対策は国際的課題となっている。

また、ミレニアム開発目標に続く国際的な保健医療分野イニシアティブとして、国連、WHO は、ユニバーサル・ヘルス・カバレッジ (universal health coverage: UHC) を推進しており、日本政府もそれを支援している。低中所得国において UHC を達成するには、従来からの母子保健・感染症対策のみならず、主要死因であり長期的ケアが必要とされる NCD 対策を充実させる必要がある。

しかし、多くの低中所得国においては、NCD の実態すら十分把握されておらず、予防対策や長期的診療体制は整っていない。加えて、低中所得国においては、周産期・幼少期の栄養不良などが、成人期に糖尿病などの NCD 発症リスクを増加させることも指摘されている。世界各地における NCD 危険因子の実態を調査するため、WHO は、比較的簡便で標準化された NCD 危険因子疫学調査 [WHO STEPwise approach to surveillance (STEPS)] を開発し、各国での実施を進めている。

2. オセアニア島嶼地域・パラオにおける NCD に関する状況

オセアニア島嶼地域には、肥満者がきわめて多く、NCD は主要死因となっている。2000 年代以降、STEPS 調査がオセアニア諸国でも順次行われるようになった。2010 年、NCD 健康非常事態宣言 (State of Health Emergency on NCD) が、太平洋島嶼地域保健担当官連合により出され、ミクロネシア諸国の行政長官・大統領、太平洋島嶼地域議員連合、ミクロネシア伝統首長協議会、およびミクロネシア諸国の最高裁判所長官によって承認された。

パラオはオセアニア西部の島嶼国で、2011 年 1 人当り所得 6,510 米ドルの中所得国である。総人口約 2 万人、うち約 1 万 3 千人がコロール地域に集中している。国内唯一の国立病院では、二次レベルの医療サービスが提供されている。国内各地に保健センターが 6 ヵ

所あり、地域住民に一次医療サービスを提供している。他に、コロール地域には、民間クリニックが3ヵ所ある。三次医療が必要な場合は国外に紹介するが、そのような患者の83 %が NCD 関連である。予防的保健サービスは米国から支援を受けていて、治療サービスは保健省予算から支出しており、保健省の医療費の 55 %が NCD 関連である。

平均寿命は 72 歳、死因の 74 % が NCD 関連であり、NCD 関連死亡者の約 4 割は 60 歳未満である。保健省の推定では、成人の約 80 %が BMI 25 以上の過体重、約半数が BMI 30 以上の肥満であり、肥満が多いのはパラオ人の遺伝的形質にも関係しているとされている。保健省は、肥満・NCD を重要課題と捉えており、食生活の変化、すなわち、低カロリー低脂質であるタロ芋などの伝統的食品を家庭で調理しなくなり、脂質の多い肉類缶詰などを多食し、野菜・果物を摂らないようになったことや、運動不足が、その要因と考えられている。2011 年、NCD 増加は国家の緊急事態であるとする大統領令も発令されたが、NCD の実態調査に基づいた、科学的で有効な対策を実施するには至っていなかった。

3. パラオにおける NCD 疫学調査

保健省と WHO は、2011～2013 年、25～64 歳のパラオ住民から無作為抽出した 2,200 人を対象として、STEPS 調査を実施した。調査は、基本的に WHO の標準調査方法に従って以下の 3 ステップに沿って行われたが、パラオの状況に適合させ、例えばビンロウの使用に関する質問を追加するなど、一部変更を加えた。

[ステップ 1] 構造化質問票による面接調査：質問内容は、年齢、教育、結婚状況、世帯構造、収入、食事の状況、飲酒、タバコおよびビンロウの使用、身体活動など。

[ステップ 2] 身体計測：身長、体重、腹囲、腰囲、血圧。

[ステップ 3] 血液検査：ポータブル測定器による、空腹時血糖、血中総コレステロール、HDL コレステロール、中性脂肪の測定。

加えて、保健省と筆者らの研究チームが協力して、2013 年、18～24 歳の住民に対する同様の調査を行った。2012 年の簡易国勢調査によると、18～24 歳住民の人口は 1,681 人であり、パラオ唯一の高等教育機関であるパラオ・コミュニティ・カレッジ (PCC) に在籍する 18～24 歳の学生は 473 人であった。調査対象者は、調査に自主的に協力してくれた人としたが、PCC 学生を中心に社会人も含め 356 人が参加した。上記 25～64 歳を対象とした STEPS 調査方法に沿って実施したが、若年層を対象とするため、野菜果物の摂取量はじめやや詳しい食事内容や、違法薬物使用、メンタルヘルスなどに関する質問を追加した。

4. パラオにおける NCD とその危険因子の状況

WHO・STEPS (25～64 歳対象) 調査対象者 2,171 人のうち、男性は 1,040 人、女性は 1,131 人で、平均年齢は 45.4 歳であった。教育水準は、44 %が高等教育を受けていたのに対し、16 %が初等教育のみであった。全員が、[ステップ 1] 面接調査と[ステップ 2] 身体計測に参加したが、うち 13 名（3.7 %）は[ステップ 3] 血液検査に参加しなかった。空腹時血糖値測定のため、血液検査は翌日朝に行われており、勤務時間などの都合により 13 名が調査の全段階を完遂できなかったと考えられる。

表1に、調査結果を示した。25～64歳の平均BMIは、男性29.4kg/m^2、女性30.0 kg/m^2と男女とも極めて高く、肥満者 [BMI≥30 kg/m^2] は、男性40.6 %、女性45.8 %にのぼった。また、

高血圧 [収縮期血圧≥140 mmHg / 拡張期血圧≥90 mmHg または治療中] は、男性55.4 %、女性49.5 %と高く、45～64歳の中高年層では、男性65.6 %、女性63.5 %にのぼった。高血糖 [空腹時血糖値≥7.0 mmol/L (126 mg/dl)] の割合は、男性20.8 %、女性20.1 %と高く、また脂質異常症 [総コレステロール値≥5 mmol/L (193.4 mg/dl)] も、男性20.6 %、女性24.8 %と、極めて高かった。喫煙率は、男性24.5 %、女性9.6 %であったが、ビンロウを噛む習慣は、男性54.5 %、女性61.1 %と高く、そのうち、約85 %がビンロウとタバコを一緒に噛んでおり、その割合は、男性43.3 %、女性53.8 %に達していた。

18～24 歳を対象とした調査では、対象者の 48.9 % が肥満もしくは過体重 [BMI≥25 kg/m^2] であることが明らかになった。高血圧 [収縮期血圧≥140 mm Hg / 拡張期血圧≥90 mm Hg] は、対象者の 13.5 %、男性 21.2 %、女性 6.1 % であった。高血糖値 [空腹時血糖値≥126 mg/dl] を示した者は、3.5 % (12 名) であった。脂質異常症 [総コレステロール値≥200 mg/dL] は 20.9 % に認められ、7.6 %が高い中性脂肪値 [≥150 mg/dL]であった。喫煙率は 26.1 %で、周辺国と同等であったが、噛みタバコを含めたタバコ使用は 70.2 %と高かった。過去 30 日以内に飲酒した者は 51.1 %、野菜果物を殆ど摂取しない [<1 サービング/日] 者は 24.1 %であり、一日 5 サービング以上摂取している者は 9.2 %にすぎなかった。また、身体活動が殆どない者は 20 %に近いことがわかった。

表 1: パラオにおける NCD 危険因子疫学調査結果

	25～64 歳		18～24 歳	
	男性	女性	男性	女性
対象者数	1,040	1,131	174	182
BMI ≥ 25 kg/m2 (過体重・肥満)	75.6 %	76.3 %	46.7 %	50.8 %
BMI ≥ 30 kg/m2 (肥満)	40.6 %	45.8 %	20.1 %	22.9 %
収縮期血圧 ≥ 140 mmHg / 拡張期血圧 ≥ 90 mmHg	55.4 %	49.5 %	21.2 %	6.1 %
空腹時血糖値 ≥ 126 mg/dl (糖尿病域)	20.8 %	20.1 %	6.7 %	0.6 %
総コレステロール値 ≥ 5 mmol/L (193.4 mg/dl)	20.6 %	24.8 %		
総コレステロール値 ≥ 200 mg/dl			20.1 %	21.6 %
飲酒 (過去 30 日以内)	49.0 %	22.7 %	66.7 %	36.3 %
喫煙 (紙巻タバコなど)	24.5 %	9.6 %	40.8%	12.1 %
ビンロウ (ビンロウのみ、ビンロウ+タバコ)	54.5 %	61.1 %		
ビンロウ+タバコ	43.3 %	53.8 %	62.6 %	53.1 %
野菜･果物摂取量 <1 サービング/日			20.0 %	27.9 %
野菜摂取頻度	4.2 日/週	4.8 日/週		
果物摂取頻度	2.5 日/週	3.0 日/週		

5. パラオにおける NCD に関する社会的要因

パラオの人々のライフスタイルと社会的背景を調べ、NCD に関する社会的要因を明らかにするため、学識経験者・社会的リーダー8 名に対するキーインフォーマントインタビューと、グループインタビュー (8 グループ各 5 名) を実施した。グループインタビューは、コロール (都市) とアルコロン (村落) にて、地域、職業、宗教など偏らないよう参加者を

選び、年齢層別 (18～30 歳、31～45 歳、46～60 歳、61 歳以上) グループとした。健康・運動・食に関する伝統的価値観や実践、生活様式・食生活の変遷などについて、現地語で質的情報を収集し、英語に翻訳して解析した。

食生活面では、比較的高価な地元産の伝統的食品の利用が減り、より安価なコンビーフ缶詰などの輸入食品、酒類、ソーダ類などの嗜好品が、日常的な食事に多く消費されていた。また、伝統儀式では、量が多く脂肪分が多い食事が提供され、その食事を拒むことが難しいとわかった。缶詰や加工食品の多用はよくないと認識しているが、どのように対処すればよいかわからないとのことであった。

身体活動面では、かつては竹筏と竿を使った移動、漁労、農作業など身体的運動を伴う労働に従事していたが、現在は殆ど行っていないことが判明した。自動車をはじめとする先進技術の普及のほか、現金収入が増え、身体的運動を伴う作業に、主にフィリピン人・バングラデシュ人の外国人労働者を雇用するようになったためであった。

また、第二次世界大戦後の米国統治時代以降、伝統的リーダーが弱体化し、コミュニティ自体も結束力を弱め、コミュニティ成員が、自分や他人の子どもに対してかつてのように教育や躾をすることが難しくなっていることがわかった。

4. NCD 対策の課題・今後の展望

パラオでの疫学調査の結果、予想を超える NCD 危険因子の実態が明らかとなった。BMI 30 kg/m^2 以上の肥満は、成人で約半数、若年層で 2 割に及んでおり、高血圧は、成人で約半数、若年層で 14 %、糖尿病域の高血糖は、成人の 2 割、若年層の 4 %、高コレステロール血症は、2～3 割に達していた。また、ビンロウとタバコを一緒に噛む習慣があること、野菜果物をあまり摂取しないこと、身体活動が乏しいことなども明らかとなった。

質的調査では、安価で便利な缶詰などを多用していることや、身体活動が少ないといった問題点が明らかとなった。食生活に問題があると自覚していても対処方法がわからないことや、コミュニティの弱体化によって、健康に関する知識･情報の普及や実践が困難になっていることも示された。

NCDは保健医療の課題ではあるが、医療費増大のように経済的インパクトも大きい。NCD危険因子は、生活習慣や文化慣習と密接に関連しており、社会文化的に受け入れられる対策が必要とされる。今後は、保健省はじめパラオ政府や地域コミュニティと協力し、調査結果に基づいて、社会的文化的に適正で有効な戦略・対策を策定する必要がある。

まず、大統領、議員、政府職員、学校の教師、伝統的リーダーなど、指導的立場にある人々に、調査結果とその重大性を十分理解してもらう必要がある。米国の援助が大きいため輸入食品規制は容易でないであろうが、野菜の流通を増やしたり、街の構造を歩きやすくしたりするなどの政策を実施していくべきである。学校や地域では、NCD の重大さと NCD リスクを減らすための具体的実践方法を教育する必要がある。

生活習慣改善に一人で取り組むのは難しいので、地域コミュニティでグループを作り助け合いながら取り組むのが望ましい。以前より弱体化したとはいえ、パラオにはなお伝統とコミュニティの結束が強く残っている。生活習慣改善に協力して取り組むことにより、コミュニティの結束力を再び活性化させる効果も期待される。地域社会の文化を尊重する戦略は、他の低中所得国が NCD 対策を策定するときの参考になるであろう。

Profile of Non-communicable Disease (NCD) Risk Factors among Young People in Palau

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Running title: NCD Risk Factor Profile of Young People in Palau

Number of tables: 2, Number of figures: 0

Formatted for: Journal of Epidemiology

ABSTRACT

Background: Although non-communicable diseases (NCDs) have become the predominant health problems of Palauan society, there was no comprehensive data of NCD risk factors available to develop effective control strategies. The first Palauan national STEPwise approach to risk factor Surveillance (STEPS) was, therefore, completed in mid-2013 to provide information for its adult population aged 25 to 64 years. This study aims at obtaining the data from the younger adults aged 18 to 24 years, which remained yet to be surveyed.

Methods: We conducted an epidemiological study, targeting the 18-24 age group. A survey station and a mobile team were established to recruit voluntary participants dwelling in Koror. A slightly modified WHO STEPS instrument was used, including a structured questionnaire for behavioral risk factors, physical measurements and blood tests.

Results: A total of 356 young people had been recruited during the survey. In both sexes, nearly half of the participants were overweight/obesity. The prevalence of hypertension was higher in men than that in women (17.6% vs. 1.7%). Raised blood glucose and impaired fasting glucose were observed in 3.5% and 5.2% of the total participants, respectively. About 36% of the subjects were observed as raised levels of total cholesterol. More than 70% of the young people were current tobacco users in terms of all kinds of tobacco products.

Conclusions: The current survey, for the first time, revealed a high prevalence of NCD risk factors, especially of overweight/obesity and tobacco use among young people in Palau. It

indicates that swift measures against NCDs are required even from the young age group.

Key words: Non-communicable disease, WHO STEPS, obesity, tobacco use, Pacific islanders

INTRODUCTION

Over the past decade, the increasing burden of non-communicable diseases (NCDs) in Palau has been recognized as a serious public health threat. As early as the 1970s, notable shifts in dietary patterns and lifestyle changes often associated with NCDs were already reported.[1-3] In 2011, the national mortality data showed that four leading causes contributed to more than two thirds of all deaths, namely cardiovascular disease (24.3%), cancer (21.4%), chronic respiratory disease (12.7%) and diabetes (9.8%),[4] indicating that NCDs are the predominant health problems of the islanders.

Several population-based surveys for adult NCD risk factors have been conducted, *i.e.* the Palau Community Health Assessment (PCHA) completed in 2003, and the behavioral risk factor surveillance system (BRFSS) initially piloted in 2010, conducted in 2012, and presently adopted as an annual surveillance tool. Although information on various NCD related behavioral risk factors were collected from PCHA and BRFSS, physical and biochemical measurements were not included. Accordingly, the Palauan Ministry of Health collaborated with the World Health Organization (WHO) to launch the first comprehensive nationwide survey, *i.e.* STEPwise approach to risk factor Surveillance (STEPS), in late 2011 and completed the entire data collection in mid-2013.

The WHO STEPS approach has been developed as a simple and standardized method, which can be implemented in all countries to monitor NCD risk factors. Using the same standardized

42 questions and protocols to collect small amounts of useful information, makes it possible not
43 only to observe within-country trends but also to make comparisons across countries. Its
44 sufficiently flexible framework allows each country to expand on the core modules, and to
45 incorporate optional modules to meet local and regional interests. For low and middle income
46 countries, the WHO STEPS offers an entry point to begin NCD surveillance activities, and
47 helps them develop the capacity of their surveillance systems.[5-6]

48 In Palau, the national STEPS survey was targeted at all adult residents aged 25 to 64 years.
49 However, the younger adults aged 18 to 24 years were not its targeted population. This young
50 age group was also not included in various school health surveys conducted in Palau, and
51 therefore this study was carried out to investigate major NCD risk factors among the young
52 people of 18-24 years of age.

53

54 **METHODS**

55 The STEPS instrument includes three levels, or 'Steps', and within each level, risk factor
56 assessment is divided into core, expanded and optional items. The Palauan national STEPS
57 covered the core and expanded items of three Steps for eight major behavioral and biological
58 risk factors, *i.e.* tobacco use, harmful alcohol consumption, unhealthy diet, physical inactivity,
59 overweight and obesity, raised blood pressure, raised blood glucose, and abnormal blood lipids.
60 As given below, we slightly modified the STEPS instrument to fit the characteristics of the

young people population and other specific interests and needs in Palau for the current study.

Step 1: questionnaire-based assessment

In addition to basic socio-economic information and all standard modules for self-report behavioral measurements, extra questions were added to assess mental health, sleep habits and illicit drug use. Moreover, adaptations were made to the standard modules of the STEPS to address specific health priorities and concerns in Palau. For example, findings from PCHA 2003 showed that over half (58.4%) Palauan adults were betel nut chewers, and the majority of those individuals (84.3%) chewed with tobacco. Questions about betel nut use and betel nut with tobacco were added to the tobacco use module accordingly. The module of dietary behaviors for Palauan national STEPS merely included the consumption of fruits, vegetables, and fats and oils. In order to overview the nutritional status of the public, we posed questions about the consumption of meat, fish, dairy products, processed/canned foods, and sugar-sweetened beverages.

Step 2: physical measurements

This Step included measurements of weight and height, waist and hip circumferences, and blood pressure. The anthropometric examination was performed without shoes and any heavy clothing. Before measuring blood pressure, participants were asked to sit quietly for about 5

minutes and place their elbows on the table so that the cuff is the level with their hearts. Each participant's blood pressure measurement was taken three times in the upper arm by using automatic digital blood pressure monitors (Omron HEM-7200). The three readings of blood pressure were recorded, and the arithmetic mean of the second and third readings was used for the analysis.

Step 3: biochemical measurements

Capillary whole blood sample were drawn using the fingertip lancing technique, immediately followed by biochemical tests conducted on portable devices. We adopted ACCU-CHEK Aviva blood glucose meter (Roche Diagnostics K.K., Japan) for measuring fasting blood glucose levels, and POCket Lipid (Techno Medica Co., Ltd., Japan) for blood lipids. In addition to total cholesterol and fasting triglycerides, HDL-cholesterol was measured, and LDL-cholesterol was calculated via Friedwald Equation in the Step 3.

Study population and the setting

We referred to data from the Palau Mini-Census 2012 for the study design, because the latest population and housing censuses of Palau, carried out in 2005, might not be able to accurately reflect the current population composition. The national population between 18 and 24 years old was reported as 1,681 (793 females and 888 males), and more than 80% of this age group

99 reside in Koror, the most populated urban area in the country. Thus, we defined the study
100 population as adults 18-24 years living in Koror, and roughly half of the total population within
101 this age group, 600, was expected and considered as the feasible sample size for our study. We
102 established a survey station at Palau Community College (PCC), located in the center of Koror
103 to provide superior geographical access to all potential participants. In addition, PCC is the only
104 institution for college-level education in Palau, and the single organization which contains the
105 most members of the target age group (473 students). In order to reach as many potential
106 participants as possible, we had also dispatched a mobile survey team to a few local
107 communities and major employers in Koror.
108
109 *Staff training*
110 A total of 8 staff members of the Ministry of Health joined our study team. Six of them were
111 trained as interviewers for the Step 1 and the staff of physical measurements for the Step 2. As
112 well as role-playing interviews between staff members, we recruited a few voluntary students
113 from PCC as interviewees of the questionnaire pretest. According to the feedback from the staff
114 during the training, the questionnaire was revised a number of times. In the end of the training,
115 all of the staff members were confirmed to be able to confidently complete the questionnaire-
116 based interview in English within 35 minutes. For the biochemical measurements (Step 3), the
117 other two members, who have plenty of experience on blood tests with the Palauan national