

Research Article

Possible Association of High Urinary Magnesium and Taurine to Creatinine Ratios with Metabolic Syndrome Risk Reduction in Australian Aboriginals

Atsumi Hamada,¹ Takashi Taguchi,¹ Hideki Mori,¹ Marjorie Thorpe,^{2,3}
Yukio Yamori,¹ and Mari Mori¹

¹Institute for World Health Development, Mukogawa Women's University, Nishinomiya, Hyogo 663 8143, Japan

²Department of Sustainability and Environment, East Melbourne, VIC 3002, Australia

³Kirrae Health Service, Purim, VIC 3278, Australia

Correspondence should be addressed to Atsumi Hamada, a.hamada@mukogawa-u.ac.jp

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Background. Because of the epidemic of metabolic syndrome (MS) in Australian Aboriginals known for their higher cardiovascular mortality and shorter life expectancy, we analyzed the possible relationship of their MS risks with the current dietary custom. **Methods.** The subjects were 84 people aged 16–79 years. The health examination was conducted according to the basic protocol of WHO-CARDIAC (Cardiovascular Diseases and Alimentary Comparison) Study. **Results.** The highest prevalence among MS risks was abdominal obesity (over 60%). After controlling for age and sex, the odds of obesity decreased significantly with high level of urinary magnesium/creatinine ratio (Mg/cre) (OR, 0.11; 95% CI, 0.02–0.57; $P < .05$). The significant inverse associations of fat intake with Mg/cre and of fast food intake with urinary taurine/creatinine ratio were revealed. **Conclusions.** The high prevalence of obesity in the Aboriginal people of this area may partly be due to the reduction of beneficial nutrients intake including Mg and taurine.

1. Introduction

The metabolic syndrome (MS) is composed of cardiovascular risk factors including abdominal obesity, high blood pressure (BP), dyslipidaemia and disturbed glucose metabolism. The people with MS would be more likely to have cardiovascular events and have a higher risk of mortality [1, 2]. An increased rate of MS in indigenous people than in nonindigenous people is becoming a serious problem [3]. Australian Aboriginals have the worse health status and life expectancy than nonindigenous people. Thompson et al. reported that a high proportion of urban Aboriginals revealed to be smokers, hypertensive, dyslipidaemic, overweight, obese or diabetes [4]. It was reported that the percentage of overweight in indigenous Australians was 5.5 times more than that in nonindigenous Australians. The prevalence of burden of cardiovascular diseases and diabetes

were 4.6 and 5.4 times higher in indigenous people than in nonindigenous people in 2003 [5]. Both avoidable mortality and unavoidable mortality in indigenous people were much higher than those in nonindigenous people in Australia.

The high rate of cardiovascular diseases and obesity among Aboriginal people is thought to be caused by the combination of several factors including diet change, less activity, genetic susceptibility, and low level of living standard [5]. They hunted, fished, and gathered their food depending on local supply, before the introduction of western-style diets, high in fat and sugar and low in carbohydrate and nutrients [6]. They are not seemingly adaptable to the rapid dietary and lifestyle changes by adjusting their own homeostatic mechanisms, thus resulting in the development of MS.

Our objective in this survey including urine collection for Australian Aboriginals was to assess the prevalence of MS risks and their relationship with lifestyle factors especially

eating habit. Urinary biomarkers such as sodium (Na), potassium (K), magnesium (Mg), and taurine (Tau) would reflect their eating habit related to health and MS risks, however, there is few reports about them. We also expected to reveal possible triggers in their diets, if any, for the MS risks.

2. Method

2.1. Subjects. We carried out a health survey in an Aboriginal community located in Victoria, Australia. Participants were 84 people aged 16 to 79 years who were informed of the purpose and procedures about the study and signed an informed consent form. The study included BP and anthropometrical measurements, blood and spot urine collections and lifestyle questionnaires. This study was ethically approved by Mukogawa Women's University and supported by Framlingham Aboriginal Trust committees.

2.2. Data Collection. All measurements and blood sampling were performed by an experienced physician and a nurse at a local community healthcare centre or hospital. Body weight and height were checked for the subjects standing and wearing light clothes. From these results, body mass index (BMI; weight (kg)/height (m)²) was calculated. Waist circumference (WC) was measured using a flexible steel measuring tape. BP and heart rates (HR) were measured after a 5- to 10-minute rest using an automatic digital BP measurement system (Omron Digital HEM-907, Tokyo, Japan). The mean of 2 readings was used in this analysis.

Blood analyses including serum total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), fasting blood glucose, and haemoglobin A1c (HbA1c) were assessed at Gribbles Pathology (Victoria, Australia). Enzymatic methods for TC, HDL-C, LDL-C, and TG were performed. Spot urine was collected using a plastic cup and creatinine, Na, K, Mg and Tau were analyzed. Na and K were determined by electrode methods and creatinine was analyzed by enzymatic method. Mg was analyzed by spectrophotometric method. Tau was assessed using high performance liquid chromatography system with fluorescence detection consisted of two pumps (GL-7410, GL science, Tokyo, Japan), autosampler (GL-7420), and fluorescence detector (GL-7453A). O-phthalaldehyde solution (containing 5.96 mM O-phthalaldehyde and 0.1% 2-mercaptoethanol in borate buffer) was delivered at 0.5 ml/min and filtered urine samples were injected onto a Hitachi #2619-PH column (4.0 mm i.d. × 150 mm, Hitachi, Tokyo, Japan). Tau was monitored using an excitation wavelength of 360 nm and an emission wavelength of 450 nm. Sodium-potassium ratio (Na/K, (mmol/mmol)), sodium-creatinine ratio (Na/cre, (mmol/g)), potassium-creatinine ratio (K/cre, (mmol/g)), magnesium-creatinine ratio (Mg/cre, (mg/g)), and taurine-creatinine ratio (Tau/cre, (μmol/g)) were calculated by the measured values.

MS risks were defined according to the International Diabetes Federation (IDF) definition of the following: abdominal obesity (≥94 cm for men or ≥80 cm for women); high TG (≥1.7 mmol/L (150 mg/dL)); low HDL-C (<1.03 mmol/L

(40 mg/dL) for men or <1.29 mmol/L (50 mg/dL) for women); increased BP (≥130 mmHg for systolic or ≥85 mmHg for diastolic). In this survey, high HbA1c (≥5.8%) was used as a definition of disturbed glucose metabolism instead of fasting glucose criteria because it remained possible that some participants drank soft drinks containing sugar before starting examination. Dyslipidaemia was defined as elevated TG and/or low HDL-C. BMI was categorized into 3 groups; under 25 as normal, 25 or more to under 30 as overweight, and equal to or over 30 as obesity.

For each participant, eating frequency was assessed using a food frequency questionnaire about 18 food items categorized into 4 or 5 levels: meat, fat, fish, milk, cheese, egg, fast food, bread, rice/pasta/noodles, legumes, soy products, fruits, vegetables, salt, coffee, tea, water, and soft drinks. Furthermore, information regarding employment, education, alcohol intake, smoking, medical history and physical activity were recorded.

2.3. Data Analysis. Differences between men and women were investigated using Student's *t*-tests. Prevalence rates of MS risks and intake frequency were compared using chi-square tests by age divided into 3 categories: young; under 30 years, middle-aged; 30 to 49 years and old; at least 50 years. Intake frequency was classified into two, high (once or more a week) and low (1, 2 times or less a month), which was applied to meat, fish, vegetables, and fast food. The intake frequency of soft drinks was classified into two, high (3 glasses or more a day) and low (2 glasses or less a day). The fat intake was categorized to two, "Yes" (eat fat or taken off after cooking) and "No" (taken off before cooking or eat no fat).

To compare urine Na/cre, K/cre, Mg/cre, Tau/cre and Na/K among three age groups, analyses of one-way variance was used. Multivariate logistic regression analysis was used to estimate the odds ratios (ORs) adjusted by age and sex on MS risks of the level of Na/cre, K/cre, Mg/cre, Tau/cre and Na/K in urine, which were divided into two groups, high and low, at the mean value. Differences in MS risks were investigated using Student's *t*-tests between high and low of urine Mg/cre and Tau/cre. The association of intake frequency to Mg/cre and Tau/cre was examined by a logistic regression adjusted with age and sex.

All statistical analyses were undertaken using the SPSS for windows package version 15 (SPSS Inc, Chicago, IL). Results are presented as means ± standard deviations. A *P*-value of .05 was set as the level of significance.

3. Results

3.1. Characteristics of the Study Population. Fifty percent of the total study subjects (*n* = 84) were men. Two men were excluded from all analyses because of the lack in blood and urine sampling. Urinary data of a man who did not provide adequate results was also eliminated. Baseline characteristics of study subjects are shown in Table 1. The mean age was 42 years for men (range, 16–77 years) and 37 years for women (range, 16–79 years). Men showed significantly higher levels in TC, LDL-C and SBP than women. The Na/Cre, K/Cre,

TABLE 1: Characteristics of study subjects.

	All	Men	Women	P-value
Biological variables	(n = 82)	(n = 40)	(n = 42)	
Age (year)	39.6 ± 17.6	42.0 ± 18.2	37.4 ± 17.0	.23
BMI (kg/m ²)	28.2 ± 6.1	27.4 ± 4.7	28.9 ± 7.1	.27
WC (cm)	96.6 ± 14.5	94.5 ± 12.5	98.6 ± 16.0	.20
SBP (mmHg)	130.4 ± 16.4	135.3 ± 17.0	125.7 ± 14.5	<.01
DBP (mmHg)	73.9 ± 11.9	76.0 ± 12.4	72.0 ± 11.2	.12
HR (bpm)	75.8 ± 15.4	75.0 ± 16.6	76.6 ± 14.3	.65
TC (mmol/L)	4.6 ± 1.1	4.9 ± 1.2	4.3 ± 1.0	<.05
HDL-C (mmol/L)	1.2 ± 0.2	1.2 ± 0.2	1.2 ± 0.3	.60
LDL-C (mmol/L)	2.8 ± 1.0	3.1 ± 1.0	2.5 ± 0.9	<.01
TG (mmol/L)	1.5 ± 0.9	1.4 ± 0.7	1.5 ± 1.0	.69
HbA1c (%)	5.9 ± 0.9	5.8 ± 0.5	6.1 ± 1.2	.11
Ratios in urine	(n = 79)	(n = 38)	(n = 41)	
Na/cre (mmol/g)	94.5 ± 60.2	86.0 ± 56.7	102.3 ± 62.9	.23
K/cre (mmol/g)	55.7 ± 28.4	53.7 ± 28.6	57.6 ± 28.4	.54
Mg/cre (mg/g)	44.9 ± 23.1	42.1 ± 25.3	47.6 ± 20.9	.30
Tau/cre (μmol/g)	1122.8 ± 2674.9	1590.3 ± 3770.8	689.5 ± 631.9	.14
Na/K (mol/mol)	1.97 ± 1.65	1.89 ± 1.55	2.04 ± 1.76	.69

Data are mean ± SD.

Mg/Cre, Tau/cre and Na/K ratios did not differ between the sex groups.

3.2. Age-Specific Prevalence. The frequency of MS risks and eating habit profiles among three age groups are presented in Figure 1 and Table 2. The highest percentage of obesity was shown in the old (young; 23.3%, middle-aged; 21.4%, old; 37.5%) and quite high frequency of abdominal obesity was shown at any age group (young; 66.7%, middle-aged; 67.9%, old; 66.7%). The prevalence of increased BP rose with age, from 60% of the young to 75% of the old, as well as high HbA1c, from 20% of the young to 62.5% of the old. On the other hand, the percentages of low HDL-C (41.7%) and high TG (25.0%) in the old were lowest of all, which resulted in the lowest percentage of dyslipidaemia (young; 66.7%, middle-aged; 67.9%, old; 50%, data not shown). Table 2 shows the dietary pattern of participants among age groups. The intake frequency of vegetables in the young was lower and that of soft drinks was higher than other age groups ($P < .01$ for both). On the other hand, the intake frequencies of meat and fast food in the old were significantly lower than those in younger groups ($P < .05$ and $P < .001$, resp.).

3.3. Urine Analyses. Table 3 shows logistic regression results of obesity and dyslipidaemia with urinary biomarkers adjusted with age and sex. High level of urine Mg/cre was associated with a much lower likelihood of obesity (OR, 0.11; 95% CI, 0.02–0.57; $P < .05$). Logistic regression results adjusted with age and sex on subjects with dyslipidaemia showed a significantly lower OR in the high level of urine Tau/cre (OR, 0.22; 95% CI, 0.07–0.73). High Tau/cre was

associated with low TG ($P < .05$) and showed a tendency to be related with low WC and BMI ($P = .06$ and $.09$, resp.; Table 4). Table 5 shows the relationship of urine Mg/cre and Tau/cre with eating habits by logistic regression adjusted with age and sex. Compared to subjects who eat no fat, those who eat fat had a significantly lower likelihood of high Mg/cre level (OR, 0.12; 95% CI, 0.02–0.59) and a similar relationship was shown between intake frequency of fast food and Tau/cre level (OR, 0.11; 95% CI, 0.02–0.69).

4. Discussion

This study is the first to report on the relationship of MS risks with eating habit by spot urine analysis of nutritional biomarkers including Mg and Tau in Australian Aborigines. It revealed a high prevalence of MS including abdominal obesity, increased BP and low HDL-C even at young age, and a quite high prevalence of high HbA1c in the old. The study confirms that an increased level of Mg/cre in spot urine is associated with a decreased likelihood of obesity, supported by lower BMI and WC in people with a higher level of Mg/cre. Restriction of magnesium intake decreased urinary loss [7] and a good correlation was observed between Mg/cre in spot urine and total 24-hour urine excretion ($R = 0.80$, $P < .05$) [8]. Considering both, low level of Mg/cre in spot urine would be caused by insufficient Mg intake and our finding is consistent to the previous studies that higher intake of Mg was associated with a marked reduction in the prevalence of obesity (OR, 0.78; 95% CI, 0.72–0.85), abdominal obesity (OR, 0.80; 95% CI, 0.76–0.85), and MS (OR, 0.83; 95% CI, 0.72–0.96) in the US people [9]. As it is

TABLE 2: Eating frequency by age groups.

Age (Men/Women)	Young <i>n</i> = 30 (13/17)	Middle-aged <i>n</i> = 28 (13/15)	Old <i>n</i> = 24 (14/10)	<i>P</i> -value
Meat				<.05
Low	30.0 (9)	28.0 (7)	58.3 (14)	
High	70.0 (21)	72.0 (18)	41.7 (10)	
Fat				.56
No	36.0 (18)	30.0 (15)	34.0 (17)	
Yes	35.7 (10)	39.3 (11)	25.0 (7)	
Fish				.53
Low	46.7 (14)	32.0 (8)	37.5 (9)	
High	53.3 (16)	68.0 (17)	62.5 (15)	
Vegetables				<.01
Low	93.3 (28)	76.0 (19)	56.5 (13)	
High	6.7 (2)	24.0 (6)	43.5 (10)	
Fruits				.74
Low	20.0 (6)	16.0 (4)	25.0 (6)	
High	80.0 (24)	84.0 (21)	75.0 (18)	
Fast food				<.001
Low	20.0 (6)	28.0 (7)	70.8 (17)	
High	80.0 (24)	72.0 (18)	29.2 (7)	
Soft drinks				<.01
Low	36.0 (9)	68.4 (13)	80.0 (16)	
High	64.0 (16)	31.6 (6)	20.0 (4)	

Data are percentage (*n*). Young; under 30 years, Middle-aged; 30 to 49 years, Old; 50 years and older.

TABLE 3: Adjusted odds ratios of obesity and dyslipidaemia according to urinary biomarkers.

		Obesity		Dyslipidaemia	
		OR (95% CI)	<i>P</i> -value	OR (95% CI)	<i>P</i> -value
Na/cre	Low	1		1	
	High	0.31 (0.08–2.26)	.31	0.75 (0.19–3.02)	.69
K/cre	Low	1		1	
	High	1.81 (0.39–8.40)	.45	0.56 (0.15–2.04)	.38
Mg/cre	Low	1		1	
	High	0.11 (0.02–0.57)	<.05	0.82 (0.27–2.48)	.73
Na/K	Low	1		1	
	High	5.68 (1.00–32.33)	.05	1.02 (0.25–4.20)	.98
Tau/cre	Low	1		1	
	High	0.36 (0.08–1.71)	.20	0.22 (0.07–0.73)	<.05

Data are adjusted by age and sex.

known, Mg is essential to many enzymatic reactions across the metabolic pathway of carbohydrate, lipid and electrolytes as a cofactor [10], and obesity is strongly inversely related to magnesium deficiency [11]. This may be partly due to the eating habit of obese people and the low consumption of rich

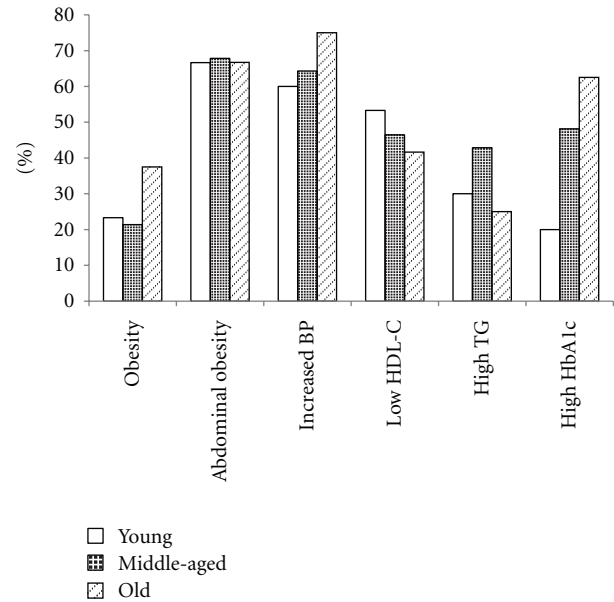


FIGURE 1: Prevalence of MS risks by age groups. young: under 30 years, middle-aged: 30 to 49 years, Old: 50 years and older. Obesity: BMI ≥ 30 , abdominal obesity: ≥ 94 cm for men or ≥ 80 cm for women, Increased BP: ≥ 130 mmHg for systolic or ≥ 85 mmHg for diastolic, low HDL-C: <1.03 mmol/L, high TG: ≥ 1.7 mmol/L, high HbA1c: $\geq 5.8\%$.

in Mg foods such as whole grains, vegetables and seafood. The renal loss may be another mechanism contributing to Mg deficiency in obese people. Insulin plays a role in inducing Mg excretion [12]. Insulin resistance is the most common and could increase Mg excretion in people with MS risks [13].

In this study, urine Mg/cre was inversely associated with fat intake. It is reported that saturated fatty acids can cause a lipid-created plasma membrane abnormality because of incorporation into the cell membrane and the transition of Mg into cell may be reduced [14]. An accumulation of saturated fatty acids by diet may cause depletion of intracellular Mg, which might lead to diabetes [15]. Previous studies revealed that Mg deficiency was correlated with diabetes in indigenous Australians and US women [16, 17]. However, our study showed no significant association between urine Mg/cre and HbA1c. A possible reason is that HbA1c is a long-term indicator of hyperglycaemia, whereas, urine Mg/cre is a short-term indicator of diet.

Urine Tau/cre was associated with a decreased likelihood of dyslipidaemia. Fish is abundant source of Tau [18, 19] and omega-3 fatty acid. It was reported that the frequency of fish intake was positively correlated with the percent composition of omega-3 fatty acid in plasma phospholipids and negatively correlated with TC and LDL-C [20]. Fish oil such as eicosapentaenoic acid and docosahexaenoic acid are well known to lower the TG level [21]. The beneficial effects of Tau on lipid metabolism, such as hypocholesterolaemic and hypotriglyceridaemic activities, were observed both in rats and in humans [22, 23]. There was no significant

TABLE 4: MS risks according to urine levels of Mg/cre and Tau/cre.

	Mg/cre			Tau/cre		
	Low	High	<i>P</i> -value	Low	High	<i>P</i> -value
BMI (kg/m ²)	29.4 ± 6.3	26.1 ± 4.6	<.05	28.9 ± 6.1	26.4 ± 5.0	.09
WC (cm)	99.1 ± 14.6	91.8 ± 11.9	<.05	98.4 ± 14.3	91.8 ± 12.3	.06
SBP (mmHg)	128.1 ± 15.4	134.4 ± 18.0	.10	131.7 ± 17.7	128.3 ± 14.2	.41
DBP (mmHg)	74.1 ± 13.4	73.1 ± 9.7	.73	74.3 ± 11.8	72.4 ± 12.8	.53
HR (bpm)	75.9 ± 14.5	75.7 ± 16.4	.95	74.5 ± 11.0	79.5 ± 11.0	.19
TC (mmol/L)	4.5 ± 1.2	4.8 ± 0.9	.40	4.7 ± 1.1	4.4 ± 1.1	.29
HDL-C (mmol/L)	1.2 ± 0.3	1.2 ± 0.2	.65	1.2 ± 0.3	1.2 ± 0.2	.55
LDL-C (mmol/L)	2.7 ± 1.1	2.9 ± 0.8	.57	2.8 ± 1.0	2.7 ± 1.0	.52
TG (mmol/L)	1.4 ± 0.7	1.6 ± 1.0	.19	1.6 ± 0.9	1.2 ± 0.6	<.05
HbA1c (%)	6.0 ± 1.1	5.8 ± 0.6	.51	6.0 ± 1.1	5.7 ± 0.3	.15

Data are mean ± SD.

TABLE 5: Adjusted odds ratios of urine Mg/cre and Tau/cre according to eating habit.

		High Mg/cre		High Tau/cre	
		OR (95% CI)	<i>P</i> -value	OR (95% CI)	<i>P</i> -value
Meat	Low	1		1	
	High	1.07 (0.19–6.05)	.94	2.06 (0.33–12.82)	.44
Fat	No	1		1	
	Yes	0.12 (0.02–0.59)	<.01	0.24 (0.04–1.30)	.10
Fish	Low	1		1	
	High	1.69 (0.42–6.83)	.46	3.17 (0.63–16.08)	.16
Vegetables	Low	1		1	
	High	1.87 (0.37–9.51)	.45	1.27 (0.20–8.06)	.80
Fruits	Low	1		1	
	High	1.18 (0.20–6.77)	.86	0.31 (0.05–2.15)	.24
Fast food	Low	1		1	
	High	0.80 (0.17–3.90)	.78	0.11 (0.02–0.69)	<.05
Soft drinks	Low	1		1	
	High	1.16 (0.29–4.71)	.83	0.93 (0.20–4.38)	.92

Data are adjusted by age and sex.

association between elevated urine Tau/cre and obesity in this study. However, the subjects with high Tau/cre showed a weak tendency to be low BMI and WC, which is supported by the previous study showing that Tau prevented obesity in high-fat-induced and/or genetically obese mice [24].

Contrary to our expectation, no association was detected between the intake frequency of fish and Tau/cre. It may be due to out of consideration to the volume of fish consumption and the lack of question about seafood other than fish, especially to shellfish, the most abundant source of Tau. Furthermore, no association was detected between Tau/cre and HbA1c in this study. Our previous report revealed that the excretion volume of Tau in 24-hour urine was inversely associated with fasting blood glucose in African

men [25]. A population-based prospective cohort study in England also showed that fish consumption would be effective in reducing risk of diabetes [26]. The same reason for the lack of relationship between Mg/cre and HbA1c in this study is supposed to be applicable to between Tau/cre and HbA1c again.

Aboriginal people used to eat Mg rich food, such as nuts, vegetables, and unrefined cereals. These plant foods also contain other minerals, vitamins, fibre, and omega-3 fatty acids [27]. Their modern diet, however, includes foods that are rich in fat and sugar, which may result in excessive energy intake and unhealthy condition. This study revealed Aboriginal people in this area were at extremely high risks of abdominal obesity, consistent with health report in

Australian Aboriginals [5]. Our data also confirmed previous findings from the DRUID (Diabetes and Related conditions in Urban Indigenous people in the Darwin region) study that the percentages of increased BP and TC in men were higher than in women and that the prevalence of diabetes and the mean of HbA1c rose strongly with age [28]. Aboriginals also used to have eating habit of fish and shellfish [6]. However, this study showed that the fish intake frequency in nearly the half of the subjects was less than once a week. The inverse relationship between Tau/cre and the intake frequency of fast food, as well as between Mg/cre and fat intake, would demonstrate that Western eating habit have caught on in this area. The percentage of high TG showed no association with age, which may be accounted for by lower eating frequencies of meat and fast food and a higher eating frequency of vegetables in the old than in both the young and middle aged. These results from eating frequency revealed increasing westernization of diet in the young and middle-aged, indicating the increase of diabetes in future.

Recently, Yamori et al. reported that Mg and Tau showed a synergistic effect on preventing cardiovascular risks [29]. Tau is an abundant and semiessential free amino acid in human and has beneficial effects on MS risks such as hypertension, dyslipidaemia, and diabetes [30]. Previous reports showed Mg intake was inversely associated with the incidence of ischemic stroke [31]. Beneficial effects on endothelial function of Mg, and Tau were also reported [32, 33]. To prevent MS risks, it would be recommended to promote diet rich in Mg and Tau to Australian Aboriginals.

There are some limitations in this study. First, the number of the participants was small and age showed wide variance, yet the number and mean age of each sex was nearly equal. Secondly, it was impossible to analyze the excretion volume of Na, K, Mg and Tau a day because the number of participants successful in a collection of 24-hour urine was inadequate. Consequently, we analyzed those excretion levels of spot urine instead of 24-hour urine, because the good correlation between creatinine ratio of Tau in spot urine and the total volume in 24-hour urine was detected in previous study [34] as well as Mg [8]. We supposed that Mg/cre and Tau/cre in spot urine could be useful for alternative markers of one-day excretion volume of Mg and Tau respectively and that could be available for evaluating risks of coronary heart diseases and diabetes.

The main implication of our results is that low urinary Mg and Tau levels predict increased MS risks in Australian Aboriginals. Mg deficiency would lead less activity of enzymes and insulin resistance. Tau has beneficial effects for lipid metabolisms. In addition, both Mg and Tau have cardioprotective and antihypertensive effects. These data support the hypothesis that diet rich in Mg and Tau may help to prevent MS risks. It is needed to confirm the association of Mg and Tau with MS risks in additional large prospective studies.

5. Conclusion

In conclusion, low urine Mg/cre and/or Tau/cre could be associated with MS prevalence in Australian Aboriginals, in part, via the effects on obesity and dyslipidaemia.

Abbreviations

BMI:	Body mass index
BP:	Blood pressure
CARDIAC Study:	Cardiovascular Diseases Alimentary Comparison Study
CI:	Confidence interval
DBP:	Diastolic blood pressure
K/cre:	Potassium-creatinine ratio
HbA1c:	Haemoglobin A1c
HDL-C:	High-density lipoprotein cholesterol
HR:	Heart rate
IDF:	The International Diabetes Federation
LDL-C:	Low-density lipoprotein cholesterol
Mg/cre:	Magnesium-creatinine ratio
MS:	Metabolic syndrome
Na/cre:	Sodium-creatinine ratio
Na/K:	Sodium-potassium ratio
OR:	Odds ratio
SBP:	Systolic blood pressure
Tau:	Taurine
Tau/cre:	Taurine-creatinine ratio
TC:	Total cholesterol
TG:	Triglycerides
WC:	Waist circumference.

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