Validity of The Minimum Dietary Diversity for Women of Reproductive Age (MDD–W) in Rural Rwanda

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This study aimed to examine the validity of the Minimum Dietary Diversity for Women of Reproductive Age (MDD–W), which assesses the micronutrient adequacy of the participants by counting the number of food groups they consumed, in rural Rwanda. We used 54 one–day weighed food records collected from 41 women to calculate Spearman’s rank–order correlation coefficient between references of micronutrient adequacy and the MDD–W. Since only a few micronutrients’ references had a significant correlation with MDD–W scores (r= 0.294 to 0.392), we concluded the MDD–W could not work well in our study sites. That was due to these sites’ food consumption patterns; while micronutrient–dense foods such as meat and dark green leafy vegetables were eaten less (average daily intake was 25.8g and 46.2g, respectively) and they did not practically contribute to micronutrient supply, energy–dense foods such as starchy staple foods were consumed in a large amount (600.5g per day) and supplied a large part of micronutrient intake. Moreover, it was observed that references of many micronutrients increased in proportion to starchy staple foods’ consumption (r= 0.634). The MDD–W was not suitable for micronutrient assessment in our study sites’ conditions and quantity information should be taken into consideration where food variety is limited. (203 words / about 200 words)

**Key words**: dietary assessment, maternal health, dietary diversity, weighed food record, Rwanda

**INTRODUCTION**

Pregnant women are likely to be nutritionally vulnerable because of an increased need for nutrients¹. A lack of micronutrients before and during pregnancy may lead to adverse outcomes for both

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the mother and her fetus\(^2\). In poor-resource countries, people tend to have plant–based monotonous diets\(^3\), and many women of reproductive age (WRA: 15–49 years old) do not consume enough micronutrient–rich food. Rwanda, located in East Africa, also falls into that category. They rely on plant–based diet, and their micronutrient intakes do not meet the requirement because plant–based diet do not supply all required micronutrients. Commonly consumed starchy staple foods in Rwanda are plantains (green bananas), potatoes, sweet potatoes, and cassava\(^4\). They are boiled and eaten alone, or used as ingredients in stewed dishes. Cereals such as maize and sorghum are also frequently consumed. They are used to cook porridge, or other common Rwandan dishes. Vegetables and beans are also eaten in daily meals, although the amount and the frequency are much less than that of the starchy staple foods. Common animal–source foods are milk and meat, but they are mainly consumed by people living in urban area\(^5\). The percentage of WRA with anemia is 19% in Rwanda, and maternal mortality ratio is 210 deaths per 100,000 live births\(^6\). Effective assessment tools are needed to counter this problem.

Dietary diversity is an assessment method that has been advocated recently. It measures food consumption that reflects the adequacy of micronutrient intake. In 2016, the Food and Agriculture Organization of the United Nations (FAO) presented the Minimum Dietary Diversity for Women of Reproductive Age (MDD–W)\(^7\) as a new nutritional assessment tool. It can be used as a proxy to describe population–level micronutrient adequacy, summarized across 11 micronutrients; calcium, iron, zinc, vitamin C, thiamin, riboflavin, niacin, vitamin B\(_{12}\), folate, vitamin B\(_{12}\) and vitamin A. These are important micronutrients in maintaining the health of mothers and children, and their deficiency has been a big problem among developing countries\(^8\).

The MDD–W is calculated by counting how many food groups out of ten were consumed by WRA within a 24–hour period. For instance, if a woman consumed food from one group, she would get one point regardless of the consumption amount. By consuming foods from various groups, she would get a higher score. The score is easy to collect and suitable for large–scale surveys. The MDD–W was developed in order to meet the growing demand for a dichotomous indicator\(^9\), which is useful for program design or decision–making. Therefore, it has a cut–off point of five food groups to classify populations regarding their micronutrient status. Groups of WRA where a higher proportion consume food items from at least five out of the ten food groups are likely to have higher micronutrient adequacy\(^7\). The ten food groups of the MDD–W are as follows: 1) grains, white roots and tubers, and plantains, 2) pulses (beans, peas and lentils), 3) nuts and seeds, 4) dairy, 5) meat, poultry and fish, 6) eggs, 7) dark green leafy vegetables, 8) other vitamin A–rich fruits and vegetables, 9) other vegetables, and 10) other fruits.

The MDD–W is a relatively new method and there has been no validation study for it. In this paper, we investigated how correctly the MDD–W evaluated micronutrient intakes of WRA living in rural Rwanda. Many previous studies that examined the validity of other dietary diversity scales\(^9–11\) used 24–hour recall as a reference. However, lack of motivation to provide complete and accurate information is a source of errors, and differences between actual and recalled portion sizes are frequently observed in 24–hour recall method\(^12\). In this paper, we used weighed food record (WFR), the only method that weighs directly the amount of food consumption on the spot. We also depicted the dietary habits of WRA in rural Rwanda, and examined the accuracy of the MDD–W when it was applied there.
METHODS

Study sites

Rwanda has made impressive progress in economic and social development since the genocide in 1994. Its maternal health status also has been improving and maternal/child mortality rate has declined substantially over the past 10 years\textsuperscript{6}. However, 16.3\% of the population still lives in extreme poverty, and 39.1\% of them, mostly villagers, live below the national poverty line\textsuperscript{13}. Our study took place in two sectors of the Kayonza District, Eastern Province. These were rural areas, and most villagers depend on subsistence agriculture for food.

WFR

We conducted a second–analysis of the data collected in our previous research\textsuperscript{14}. The data collections were conducted four times: in March and August of 2013 and 2014. At the study sites, March and August are the rainy season and the dry season, respectively. Since MDD–W was developed for assessing WRA\textquotesingle s nutritional status, we selected WFRs of WRA from our data.

Researchers directly weighed and recorded the amount of participants\textquotesingle food consumption (direct–observed WFR). Since some women\textquotesingle s diets were recorded for two or three nonconsecutive days, the number of WFR was more than that of participants. Since MDD–W only requires food consumption data for the past 24 hours, we considered WFRs collected from the same woman on different days as independent. The number of participants was 41, and 30 of them were observed for a single day, six for two days, and five for three days. Thus, a total of 57 WFRs were used for nutrient calculation (Figure 1). Among them, 11 WFRs were collected in March (rainy season), and 43 WFRs in August (dry season). We excluded three WFRs since daily energy intakes calculated from them (383kcal, 420kcal, and 419kcal) were too low\textsuperscript{15} judging that they might be caused by measurement errors. As the result, the data of 54 WFRs in total was analyzed in this research.

Researchers attended to one family all day long and recorded their meals and snacks. The detailed procedure of the WFR was as follows: first, researchers weighed each raw ingredient before cooking. After cooking, they measured the whole weight of the dish, and calculated the percentages of each raw ingredient included in it (proportion coefficient). Second, they weighed not only the

![Figure 1](image-url)
served food but also the amount of leftovers and additionally served food in order to determine each participant’s portion size (consumption amount per meal). Then, they calculated the participants’ intake of each ingredient (in grams) by multiplying the ingredient’s proportion coefficient and portion size of the dish. Researchers conducted this procedure for every meal and snack, and summed them up to provide participant’s daily intake. For nutrient calculation, we used the food composition tables of Uganda, a neighboring country of Rwanda because those for Rwandans could not be found.

MDD-W scores
We counted participants’ MDD-W scores from their WFRs. We classified food items consumed by each participant into the MDD-W’s ten food groups, and the number of consumed food groups was regarded as the participant’s MDD-W score. The score range is from 0 to 10. The participant got a point even if her consumption from the food group was very small.

References
We used probability of adequacy (PA), and mean probability of adequacy (MPA) as references to examine the validity of the MDD-W scores. PA represents the probability that a given micronutrient intake is adequate for the individual. We followed the method by Foot et al., which used each micronutrients’ Estimated Average Requirement (EAR) and Standard Deviation to calculate PA, but adjusted some values to make them suitable for Rwandans. While Foot et al. used requirements from Institute of Medicine (IOM)’s Dietary Reference Intakes, which is developed for Americans, to calculate all 11 micronutrients’ PAs, we used WHO/FAO requirement distributions to some micronutrients. Where EAR is not provided by the WHO/FAO, we back-calculated an EAR from Recommended Nutrient Intakes using the coefficient of variance from the WHO/FAO, or otherwise we used IOM values. For iron, whose requirement distribution is known to be skewed for non-pregnant and non-lactating women, we used IOM tables. However, since its values are based on 18% bioavailability for Americans, we adjusted them into 10% bioavailability based on WHO’s requirements for Rwandans. MPA is the average of 11 micronutrients’ PAs and it represents participants’ overall adequacy of micronutrient intake.

Ethical consideration
This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Institutional Review Board of Ochanomizu University (approval number 2013-77) and the Ethics Committee of the Ministry of Health in Rwanda. Our native staff members were trained to obtain informed consent on behalf of Japanese researchers who do not speak the local language. Before the survey, our native staff members orally explained the details of the survey based on a document developed by the Japanese researchers. After the explanation, one of the family members, usually the head of the household, provided his/her signature or mark on the consent form. He/she represented all the family members who agreed to participate in the study. Japanese researchers were always present at the scene to answer questions from the participants, if any.

Statistical analyse
Spearman’s rank–order correlation coefficient was calculated to examine the association between the MDD–W scores and micronutrient references. We used SPSS ver.23 for all statistical analyses. Statistical significance was set at P<0.05.

RESULTS
Participants’ were 28.8±9.1 years old. The distribution of participants’ MDD–W scores is shown in Table 1. Below the frequency and its percentage,
the consumption prevalence of each food group (the percentage of women who consumed food from each food group) by MDD–W scores is shown. Some food groups such as vitamin A–rich vegetables and fruits and animal–source food were likely to be consumed by women with higher MDD–W scores rather than those with lower scores.

Table 1 shows the correlation coefficients between MDD–W scores and references. PAs of calcium, vitamin B_{12} and vitamin A had significant positive weak correlations with MDD–W scores.

Commonly cooked dishes consumed in the studied areas were agatogo, porridge, soup/sauce, and other starchy staple foods. Agatogo is a simmered dish with starchy staple foods such as green bananas or potatoes. People living in studied areas usually added complementary ingredients to it, such as beans, vegetables, nuts, meat, and fish. The ingredients varied from family to family. Forty–seven participants (87.0 %) had agatogo. Porridge is a simple dish made by mixing flour with liquid, common ly hot water. Forty women (74.1 %) had porridge. Soup/sauce is made with mainly vegetables, and in some instances meat/fish, beans, or nuts are added. Soup/sauce was eaten with starchy staple foods such as rice, Ubugari (made from cassava
flour), Umutsima (made from maize flour), boiled potatoes, or green bananas. It was eaten by 30 participants (55.6%). In terms of raw ingredients, 34 food items, which belong to the MDD–W’s 10 food groups, were observed in WFRs, and the result of classification is shown in Table 3. Food Group 6 (eggs) was not observed in any WFRs.

All participants consumed Food Group 1 (grain, white roots and tubers, and plantains), and this was the most widely consumed group (Table 4). Food Groups 9 and 2 followed Food Group 1 as a second and third widely consumed group, respectively. The average intake (in grams) of each food group is also shown in Table 4. The consumption of Food Group 1 was the largest among the ten food groups, and it was at least four times as much as

Table 3 Food items observed in weighed food records by ten food groups

| Food groups of the MDD–W<sup>a</sup> | The number of food items | Items consumed by the participants |
|--------------------------------------|--------------------------|-----------------------------------|
| 1 Grain, white roots and tubers, and plantains | 13 | maize flour, millet flour, sorghum, rice, wheat flour, cassava, cassava flour, Irish potato, yam, yam (aerial type), sweet potato (white), sweet potato (white, boiled), green banana |
| 2 Pulses (beans, peas, and lentils) | 2 | bean, soybean |
| 3 Nuts and Seeds | 2 | groundnut (peanut), sunflower seed |
| 4 Dairy | 1 | milk |
| 5 Meat, Poultry, and Fish | 5 | goat, beef, tilapia, silver fish (dried, row), silver fish (dried, boiled) |
| 6 Eggs | - | - |
| 7 Dark green leafy vegetables | 2 | onion leaves, other green leaves (dodo, isombe)<sup>b</sup> |
| 8 Other vitamin A-rich vegetables and fruits | 2 | carrot, sweet potato (yellow) |
| 9 Other vegetables | 4 | cabbage, eggplant, onion, tomato |
| 10 Other fruits | 3 | avocado, sweet banana, orange |

<sup>a</sup>Minimum Dietary Diversity for Women of Reproductive Age
<sup>b</sup>Unique plants in Rwanda. Since they were not found in food composition tables of Uganda, they were used in nutrient calculation as “other green leaves”

Table 4 Consumption prevalence and average intake by food groups

| Food groups | number of consumers (N) | consumption prevalence (%) | average intake by consumers (g)<sup>a</sup> | median intake by consumers (g) |
|-------------|-------------------------|----------------------------|--------------------------------|--------------------------------|
| 1 Grain, white roots and tubers, and plantains | 54 | 100.0 | 600.5 ± 260.1 | 590.9 |
| 2 Pulses (beans, peas and lentils) | 44 | 81.5 | 124.8 ± 64.3 | 106.6 |
| 3 Nuts and Seeds | 23 | 42.6 | 20.0 ± 9.5 | 16.6 |
| 4 Dairy | 13 | 24.1 | 163.8 ± 140.4 | 121.3 |
| 5 Meat, Poultry, and Fish | 13 | 24.1 | 25.8 ± 30.5 | 10.3 |
| 6 Eggs | 0 | 0.0 | - | - |
| 7 Dark green leafy vegetables | 24 | 44.4 | 46.2 ± 41.6 | 41.6 |
| 8 Other vitamin A-rich vegetables and fruits | 6 | 11.1 | 196.8 ± 211.4 | 145.3 |
| 9 Other vegetables | 47 | 87.0 | 56.7 ± 50.7 | 43.1 |
| 10 Other fruits | 8 | 14.8 | 79.1 ± 48.7 | 90.5 |

<sup>N</sup> = 54 weighed food records
<sup>a</sup>Mean ± standard deviation
that of any other groups.

The second largest consumed group was Food Group 8 (other vitamin A–rich vegetables and fruits), and the third one was Food Group 4 (dairy).

Figures 2 and 3 show each food group’s micronutrient content per same intake (100g) and per average intake that was observed in our study sites. The values above each bars in “per average intake” graph are percentages of each food group’s contribution to EAR (for iron, referring IOM’s table24). When comparing the same intake, the most contributing food group for nutrient supply differed from nutrient to nutrient. However, when comparing average intake, micronutrient contents of Food Group 1 and sometimes Food Group 2 tended to be greater than those of other groups, and these two groups provided a large amount of some micronutrients.

Table 5 shows the relation of each food group’s consumption amount with MDD–W scores and micronutrient references. MDD–W scores had significant negative correlations with Food Groups 1 and 2, while it had positive correlations with the rest of other groups. On the other hand, for individual micronutrient’s PA, the Food Group that had the most significant positive correlations was Food Group 1, and strengths of the coefficients were also high compared with those of other food groups. Moreover, considering overall micronutrient adequacy, Food Group 1 had the strongest correlation with MPA.

**DISCUSSION**

According to Table 2, a significant positive correlation between MDD–W scores and references was observed only for calcium, vitamin B₁₂ and vitamin A. MPA, which was assumed to be an indicator that could represent overall micronutrient status, did not have a significant correlation with MDD–W scores. Since the MDD–W was required to assess overall dietary intake of 11 micronutrients, it was judged to be not valid for the assessment in these areas. On the other hand, it was true that the percentage of participants who consumed nuts and seeds, animal–source foods, vitamin A–rich vegetables and fruits increased in proportion to MDD–W scores (Table 1).

The intakes of food groups aside from Food Groups 1 and 2 were relatively small compared with recommended amounts (Table 4). According to WHO recommendations, 400g of micronutrient–dense foods such as vegetables and fruits should be taken on a daily basis25). In another instance, MyPlate of America recommends to take 2 ½ cup equivalent of vegetables (equivalent to 2.5 cup of spinach), more than 1 ½ cup equivalent of fruits (equivalent to 1.5 large orange), and 5 ½ ounce equivalents of protein foods (equivalent to 1.5 small steak)26). Although MyPlate is not for Rwandans, the diet of the participants in this study was far below these recommendations. In the MDD–W’s guideline by FAO, it has been already mentioned that the MDD–W does not ensure micronutrient adequacy for the population whose micronutrient–dense foods’ consumption is too small7). Therefore, the observed inconsistency between MDD–W scores and PAs or MPA was due to the small consumption of micronutrient–dense foods among the participants.

According to Figures 2 and 3, other food groups’ micronutrient supplies of our study sites were likely to be lower than those from Food Group 1. From the results of comparison per 100g (blank bar), it could be said that consuming various food groups led to adequate micronutrient intake since the major contributor to a specific micronutrient is distributed across the food groups. However, from the results of average intake comparison (black bar), Food Group 1 and sometimes Food Group 2 pro-
a MDD-W's ten food groups
1 Grain, white roots and tubers, and plantains
2 Pulses (beans, peas, and lentils)
3 Nuts and Seeds
4 Dairy
5 Meat, Poultry, and Fish
6 Eggs
7 Dark green leafy vegetables
8 Other vitamin A-rich vegetables and fruits
9 Other vegetables
10 Other fruits

b As retinol activity equivalents (RAEs). 1 RAE = 1 µg retinol, 12 µg β-carotene, 24 µg α-carotene, or 24 µg β-cryptoxanthin.

* The values above bars in "per average intake" graph are percentages of each food group's contribution to EAR.

Figure 2 Minerals and other vitamins contents per 100g and per average intake of foods in each food group, and each group's contribution to EAR
Figure 3  B vitamins contents per 100g and per average intake of foods in each food group, and each group's contribution to EAR
provided a large supply for many micronutrients, and the various food consumptions that included micronutrient–dense food became inefficient unless their consumption amount is substantial. Figures of iron, zinc, vitamin C, thiamin, riboflavin, niacin, vitamin B₆ and folate indicates that Food Group 1 or 2 outperformed other food groups when considering the consumption amount. While consumption prevalence was high for Food Groups 1 and 2 and many participants took most part of micronutrient supply from them, consuming other food groups hardly made a difference in micronutrient intake. Therefore, it was not always true that participants’ micronutrient intake became large in proportion to MDD–W score since the consumptions of other food groups aside from Food Groups 1 and 2 had less influence on micronutrient intake.

According to Table 5, it can be also said that the quantity of Food Group 1 is important when assessing participants’ micronutrient intake. Table 5 shows the relation of micronutrient reference and food consumption amount. Seven micronutrients out of 11 had a significant positive correlation with the consumption amount of Food Group 1. Moreover, the correlations were relatively stronger than those with other food groups. Based on this idea, it might be said that participants who consumed large amount of Food Group 1 have adequate micronutrient intake. However, since participants with high scores tended to eat less foods from Food Group 1 (Tables 1 and 5), it could be that their micronutrient intake fell below that of low-score participants, who consumed less food groups including Food Group 1 but the consumption amounts were large. It is one of the reasons why MDD–W scores did not have any significant correlations with many micronutrients’ PAs.

Food Group 2 had large supply for some micronutrients in Figures 2 and 3, but its consumption amount was not correlated with MPA. According to Table 5, Food Group 2 tended to be eaten in a less amount when participants consumed other micronutrient–dense food groups. Although the same could be said for Food Group 1, Food Group 2 was

### Table 5  Spearman’s rank-order correlation coefficient⁴ between MDD-W scores / PA⁵ / MPA⁶ and each food group’s consumption amount

| Consumption amount (g) by food groups | 1     | 2     | 3     | 4     | 5     | 6*    | 7     | 8     | 9     | 10    |
|---------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| MDD-W⁵ scores                        | -0.326*| -0.475**| 0.394**| 0.402**| 0.340*| -0.551**| 0.447**| 0.327*| 0.398**|       |
| Calcium                              | -0.015 | -0.194 | 0.224 | 0.626**| -0.151 | -0.405**| 0.446**| 0.037 | -0.030 |       |
| Iron                                 | 0.628**| 0.375**| 0.092 | -0.999 | 0.100 | -0.076 | -0.235 | 0.130 | -0.182 |       |
| Zinc                                 | 0.195  | 0.137 | 0.288**| 0.103 | 0.217 | -0.096 | -0.226 |       | 0.282* | 0.099 |
| Vitamin C                            | 0.449**| -0.031 | 0.262 | 0.178 | 0.030 | -0.007 | -0.316*| 0.191 | 0.133  |       |
| Thiamin                              | 0.474**| 0.382**| 0.149 | -0.020 | 0.089 | -0.045 | -0.148 | 0.110 | -0.152 |       |
| Riboflavin                           | 0.537**| 0.074 | 0.202 | 0.369**| 0.051 | -0.120 | -0.090 | 0.142 | -0.031 |       |
| Niacin                               | 0.570**| 0.003 | 0.629**| 0.068 | 0.059 | -0.051 | -0.082 | 0.311*| 0.194  |       |
| Vitamin B₆                            | 0.440**| -0.105 | 0.169 | 0.144 | 0.057 | -0.089 | 0.011  | 0.006 | 0.197  |       |
| Folate                               | 0.648**| 0.738**| -0.136 | -0.160 | -0.340*| 0.044 | -0.331*| -0.036 | 0.024  |       |
| Vitamin B₁₂                           | -0.098 | -0.262 | 0.204 | 0.202 | 0.747**| -0.004 | -0.168 | 0.292*| -0.077 |       |
| Vitamin A                            | 0.205  | -0.225 | 0.244 | 0.199 | 0.043 | 0.382**| 0.274**| 0.348**| -0.114 |       |
| MPA⁶                                  | 0.634**| 0.133 | 0.355**| 0.210 | 0.186 | 0.012  | -0.178 | 0.270*| 0.018  |       |

⁴ Probability of adequacy
⁵ Mean probability of adequacy
⁶ Minimum Dietary Diversity for Women of Reproductive Age
⁷ Food Group 6 (eggs) was not observed in any WFRs.
assumed to be more likely to be affected by other food groups’ consumption. From WFRs, Food Group 2 seemed to be less consumed (less than 25 percentile of its intake) when participants consumed relatively large amount (more than 75 percentile of each intake) of foods from other Food Groups, in particular, Food Groups 3, 5 and 8 (data not shown).

Although the MDD–W could not ensure the overall micronutrient adequacy, some micronutrients’ PAs had a significant positive correlations with MDD–W scores. They were calcium, vitamin B12 and vitamin A. The similarities of these micronutrients are that their supplies from another food group was equally high or higher than that from Food Groups 1 and 2. For calcium, Food Group 4 was also one of the main contributors for its intake. The same could be said for Food Group 8 in the case of vitamin A. Since vitamin B12 is supplied only from animal–source food, its intake depends on whether a person consumed animal–source foods (foods from Food Group 4, 5 or 6) or not. According to Table 1, the consumption prevalence of Food Groups that significantly contribute to these micronutrients’ intake (Food Groups 4, 5, and 8) tended to increase in proportion to MDD–W scores. Therefore, the positive significant correlations were observed for these micronutrients.

The MDD–W score is determined by whether the participant ate a certain food or not. Even if the consumption amount is negligible, she could get one point. Conversely, even if participants consumed large amount of food from Food Group 1 or 2, it still only resulted in one point. Thus, for many micronutrients, the MDD–W underestimated the contributions of these influential groups such as Food Groups 1 and 2 in this case, and overestimated those of other food groups. This is the reason why the MDD–W should not be used in the area where the food variety is limited and the contributions of micronutrient–dense foods are too small. Not only this fact but also the characteristics of dietary patterns in study sites need to be considered. According to the results, no participant ate eggs and it is also reported that production of egg in Rwanda is much less than that of other animal–source foods10. This suggests that MDD–W’s Food Group 6 has small influence on counting MDD–W scores, and it might be better to reconsider the classification and subdivide food groups that are more important and more frequently consumed in the case of Rwanda. For instance, it might be better to integrate Food Group 5 (meat, poultry, and fish) and Food Group 6 (eggs) into one group, and subdivide Food Group 1 (grains, white roots and tubers, and plantains) into “grains” and “white roots, tubers, and plantains” (these two categories’ nutrient composition are different enough for dividing)10.

This study has several limitations that need to be considered. Firstly, direct–observed WFR, which was used in collecting dietary data of this study, provides exact and reliable quantitative data. However, it takes a long time and skills are required for researchers to deal with it. We collected only 54 person–day WFRs of WRA in this study due to the limited time and manpower, which was assumed not enough for validating MDD–W that is normally used in large–scale population surveys. Furthermore, such limited number of data was not enough to secure the representativeness of the dietary pattern among the studied areas. Therefore, larger–scaled research should be conducted to provide more accurate information.

Secondly, although data collection of this study was conducted in two different seasons in order to consider seasonal variation, each season’s sample size was significantly different (11 WFRs for rainy season and 43 WFRs for dry season). Generally, there is non–negligible seasonal food variation in
agricultural area where people mainly live on their own agricultural products, therefore it should have provided same sample size for each season and reduced its influence. Finally, to examine the validity of MDD–W in national level, the difference of wealth or food access between urban and rural areas should also be considered. Kayonza district, this study site, has middle-level food security among districts in Rwanda (the prevalence of food insecurity is 4 to 25%). Kigali, the capital of Rwanda has higher food security (under 3% of food insecurity), and western area of Rwanda has lower food security (16 to 49% of food insecurity) than Kayonza district. In urban areas, people often consume imported food and use restaurants, while there are few supermarkets and people make food on their own in rural areas. There is a large gap in food consumption among different areas. The same thing can be said about nutritional intake. Therefore, the conditions of each area needs to be surveyed and considered for validating MDD–W in national level.

CONCLUSION

Although the MDD–W could not be used for assessing overall micronutrient adequacy in this study, consumption prevalence of micronutrient–dense food increased as the MDD–W score became high. Furthermore, we found the cause of the MDD–W’s limitation that the large difference of each food group’s consumption amount resulted in the inconsistency of the MDD–W’s evaluation. In case there is a large difference of consumption amount among food groups, actual nutrient supply differed depending on their consumption amounts. However, the MDD–W does not take them into account and evaluates only by whether the participants consumed the food group or not. Thus, over- and underestimation of each food group’s nutritional contribution were caused. For countries or areas where the food variety is assumed to be limited and the consumption of micronutrient–dense food is small, it is important to clarify which food groups are most influential for micronutrient intake, and also its consumption amount should be considered, in addition to the variety of food groups.

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Validity of The Minimum Dietary Diversity for Women of Reproductive Age (MDD–W) in Rural Rwanda

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和文抄録

妊娠可能年齢の女性の栄養状態を評価する方法として、2016年にFAOからMinimum Dietary Diversity for Women（MDD–W）が発表された。これは24時間以内に摂取した食品群の数を数えることにより、11ある栄養素の摂取状態を団体レベルで評価するものである。本研究ではMDD–Wをルワンダ農村地域で用いる際の妥当性を調べた。41名の対象者から集めた54日分の直接栄養記録データを用い、観測された摂取量が必要量を満たしている確率（probability of adequacy; PA）とMDD–Wスコアの関連をスピアマンの順位相関係数を用いて評価した。各栄養素のPAとそれらを平均した総合的な栄養指標（Mean PA; MPA）のうち、MDD–Wと有意な正の相関を示したものは少なく、相関係数も0.294から0.392と小さかったことより、本研究地域におけるMDD–Wの妥当性は確認できないと判断した。本地域では栄養栄養素に富む食品の摂取量が少なく、食べていたとしてもそれらが全体的な栄養供給に貢献できていない例が多くみられた。食品群に含まれる栄養素量をその食品群の現地での平均摂取量当りに換算したところ、穀類の方が栄養栄養素に富む食品群よりも多くの栄養素を供給していた。しかしMDD–Wでは摂取の有無のみを基準に評価を行うため、少量しか摂取されず栄養供給への寄与が低い食品群も、摂取量の多さにより寄与が高くなっている食品群も、同じ1ポイントとして扱われててしまう。また、各食品群の摂取量とPA, MPAとの相関係数を算出したところ、穀類の摂取量とMPA有意な正の相関を示し、相関係数は0.634と相関の程度も強かった。一方で多様な食品を摂取しMDD–Wスコアが上がるほど穀類の摂取量は減るという逆相関がみられたことより、実際の栄養摂取状況とMDD–Wによる評価に不一致が生じていた。本地域でMDD–Wが正しく機能しなかったことは以上の理由によると考察するとともに、食品の多様性が限られている地域においては、現地の人々の栄養摂取に最も寄与している食品を見極め、その食品の人々の摂取量を把握することも重要であるという結論に達した。