

## Report (報告)

Analysis of the Nutrient Intake and the Nutritional and Health State of the people in a Nepalese Mountainous Village: *Dithal VDC*Hideaki NOMURA<sup>1)</sup>, Junichiro YANAGIDA<sup>1)</sup>, Rie UENO<sup>1)</sup>, Satoko IMURA<sup>1)</sup>, Kazuo ONO<sup>1)</sup>, Hiroko SAKAI<sup>2)</sup>, Kenji KIMURA<sup>3)</sup>, and Shiba Kumar RAI<sup>4)</sup>ネパール山間地方 (*Dithal*村) における摂取栄養と健康状態の解析野村 秀明<sup>1)</sup> 柳田潤一郎<sup>2)</sup> 上野 理恵<sup>3)</sup> 井村 聡子<sup>4)</sup> 小野 一男<sup>2)</sup>  
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## SUMMARY

The research team jointed with Kobe Tokiwa University, Kobe University, and Nepal Medical College has been organized to implement the fieldwork at Dithal Village in Nepalese mountainous area for JICA Kusanone Project. In the fieldwork, the nutritional and health state of 208 village inhabitants (5 to 82 years old : 82 of male and 126 of female) were investigated, and their daily dietary foods were analyzed intake of calories and nutrients. The state of hygiene was also studied including of checking the contamination of drinking water microbiologically.

The results showed that the high presence of over 50% of thinness, which is defined as less than 18.5 of BMI, was estimated in all age-groups, however among the age group under 12 years, the rate was much higher up to 75 ~ 80%. In body component analysis, the decreased fat and muscle volume and increased body water volume were manifested in children. Some of the children showed the distended abdomen, which is the typical sign of Kwashiorkor type malnutrition. The average calorie intake of daily diet was estimated about 800 ~ 1000kcal, and the content of it was 80% of carbohydrate, 10% each of fat and protein. The contaminations of Coliform bacilli and *E. coli* could be detected 80 to 100% of drinking water at 30 water places. The internal medical check revealed the prevalence of water-borne digestive diseases with abdominal pain, vomiting, and diarrhea.

The deteriorated nutritional and public health state in Nepalese mountainous area could be disclosed in this study, but these are the similar paths on which the advanced countries have gone through in their past. We are entrusted to give our hands to them.

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Key Words : underdeveloped country, malnutrition of Kwashiorkor type, carbohydrate, water-contamination

## 要 旨

【目的】世界辺境地区の一つであるネパール山間地方の住民の摂取栄養と健康状態について解析した。【方法】神戸常盤大学を中心に共同調査プロジェクト（JICA 草の根事業）を編成し、ネパールデータル村でのフィールドワークを行った。住民208名（年齢5～82歳、男女比82：126）の健康調査を施行し、身体計測とBIA法を用いた体構成成分測定、および血液検査（TP、Albumin、GPT、BUN、Ca）を行った。また住民の内科診療を行い、下痢などの消化管疾患の有無を調査した。さらに、一般家庭における日々の食事内容をデジタルカメラに撮影し、摂取熱量、摂取栄養素を計測すると同時に、村の採水所30カ所での飲水を含めた生活用水の細菌学的検査を行った。【結果】身体計測上、BMI<18.5の比率が50%を超え、12歳以下の子供では80%近くに及んだ。体構成成分測定では、特に子供で体内脂肪、筋肉量の減少と、体内水分量の増加が見られた。また一見肥満体系であっても、栄養障害による浮腫や、筋肉量の減少による下腹部の突出（クワシオルコル）を示す症例も、12歳以下の子供で見られた。血液検査は、血清総タンパク、アルブミンの低下以外は、ほぼ正常値内であった。食事は、ネパール特有のダル・パート・タルカリという炭水化物が中心の料理で、摂取栄養素の80%を占めた。1日2食が標準である現地人の平均摂取熱量は800～1000kcal程度と推計された。飲料水の細菌学的検査では、大腸菌、及び大腸菌群が80～100%の頻度で検出された。【結論】未だカースト制度の現存するネパールの山間地方における栄養状態と衛生環境は劣悪であったが、これは過去に先進国が経た道であり、自らの事として手を差しのべる必要があると考えられた。

キーワード： 開発途上国、クワシオルコル型栄養不良、炭水化物、水質汚染

## Introduction

Nepal, officially the Federal Democratic Republic of Nepal, whose capital is Kathmandu, is a landlocked country located in South Asia. The population is reported as 29,331,000 in 2013, and the land area is 147,181 km<sup>2</sup>, which is about 2 times larger than that of Hokkaido. The north of Nepal has eight of world's tallest mountains including the famous Mount Everest. Most of their religion are Nepalese Buddhism and Hinduism, and most of Hindu were migrated from India with a traditional social custom "caste system". Basically, caste system determines their way of life, and has some important role in social stratification in Nepal. The high caste people like the *Brahmins* and *Kshatriya* live in

center of the cities, on the other hand, most of the lower caste people are expelled into peripheral areas from the cities, such as mountainous area or valleys.

The public health statistic data depict the present state of Nepalese health condition. Based on the data of 2013 World Health Organization (WHO)<sup>1</sup>, life expectancy of Nepal are 66.2 years (male ; 64.9 years, female ; 67.4 years), and their birth and death rate is 22.1/1,000 and 6.8/1,000, respectively. Their infant death rate is 44.5/1,000 births, which is the worst in Asia.

Under the JICA (Japan International Cooperation Association) "Kusanone Project", Kobe Tokiwa University organized a collaboration team with Kobe University and Nepal Medical College as a

counterpart of Nepal. The aim of this project is to investigate and to analyze the nutritional and health, and the hygiene state in the Nepalese mountainous village where the lower caste people live. Our final goal is to introduce the new water purification system with sand-filtration in this village for improving their water sanitation.

### Subjects and Methods

The north eastern mountainous area, *Dithal* VDC (Village Development Committee) in *Kaski* District, was selected as the subject of the investigation. The population of this village is around 1200, most of them are in the lowest caste people, the *Daritt*.

Total 208 inhabitants were entered in this study. The age range of the subjects is between 5 and 82 years old, the number of gender ; 82 males and 126 females. They received the internal medical examination by Japanese and Nepalese doctors for checking up the presence of cardiac, pulmonary and digestive problems.

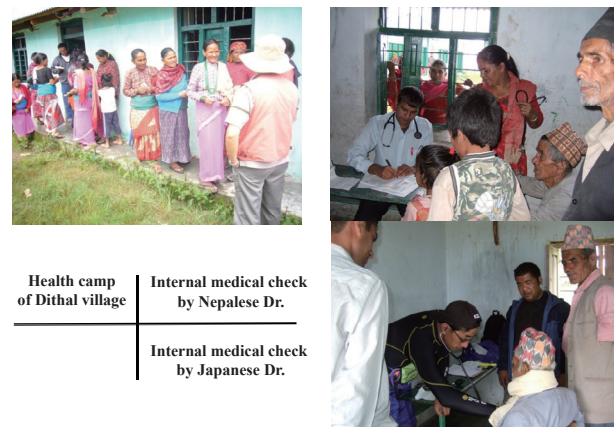
Body anthropometric measurement of height, body weight, arm circumference (AC), arm triceps skinfold thickness (TSF) were done individually. Body component analysis was carried out with Biological Impedance Analysis (BIA) scanning machine which was brought into Nepal from Japan. The BIA measurement could be completed in 64 people, but not more because of the electric problem (power failure), as is often seen in Nepal. A small quantity of blood samples were taken for measurement of serum total protein (TP), albumin (Alb), total cholesterol (TC), glutamate pyruvate transaminase (GPT), blood urea nitrogen (BUN), triglyceride (TG), uric acid (UA), and calcium (Ca).

Picture 1 and 2 are the snapshots of health

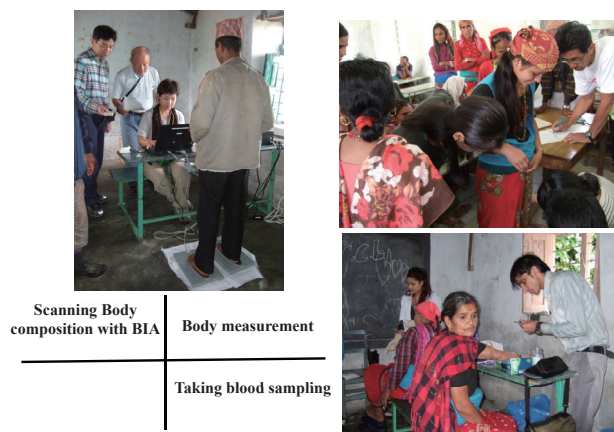
camp in *Dithal* village. About one sixth of the village inhabitants were gathered and made the long line for waiting to receive the medical check (Picture 1). Body anthropometric measurements including BIA scanning, and blood sampling were shown in Picture 2.

Moreover, the daily meals were inquired and taken in picture for analyzing intake calorie and nutrients (Picture 3).

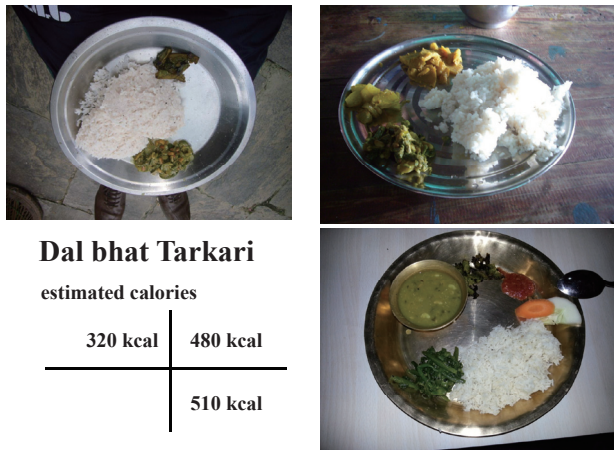
The microbiological examinations were applied to the drinking water at thirty water places (Picture 4). Coliform bacilli and E. Coli were detected by the method of colilate with luminescent coloring for qualitative analysis and by the method of petrifilm for quantitation.



Picture 1 Health camp (gathering villagers, internal medical check-up)



Picture 2 Health camp (BIA and body measurement, blood sampling)



Picture 3 Typical Nepalese food (*Dal bhat Tarkari*)



Picture 4 A girl fetching water and water places

## Results

### I Body anthropometry

The distribution of their BMI which is calculated with their height and body weight were indicated graphically in Figure 1. According to BMI value, their physique were classified into three categories; the thinness lower than 18.5, the moderate from 18.6 to 24.9, and the obese over 25. Each number of them is expressed in three different colored columns. Almost all villagers are categorized in thinness or in moderate. Obese people could be observed only 8% in male, and 15% in female of the adults. On the other hand, 70 to 80% of all children, both boys and girls, are classified in thinness.

The anthropometric measurement of the arm is shown in Table 1. Total 208 of inhabitants' age

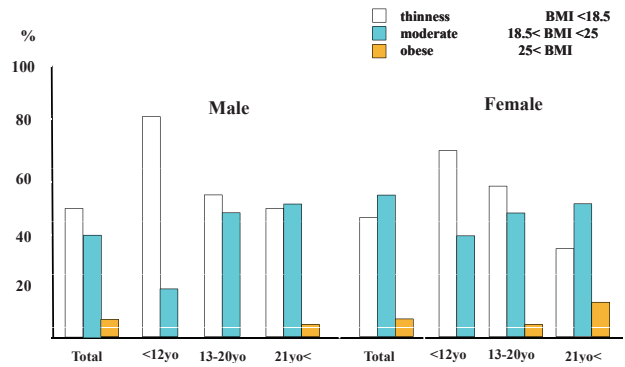


Figure 1 Distribution of Body Mass Index (BMI)

Table 1 Anthropometric measurement of AC and TSF

Age range	mean ± SD (n=208)		
	< 12 yo	13-20yo	21yo <
AC (arm circumference)			
Male	13.3 ± 1.0	21.3 ± 2.1	23.5 ± 2.2
Female	11.3 ± 1.1	19.8 ± 2.4	21.7 ± 2.0
TSF (triceps skinfold)			
Male	0.9 ± 0.4	1.8 ± 0.6	2.8 ± 0.2
Female	0.8 ± 0.5	1.6 ± 0.5	2.2 ± 0.3

unit:cm in AC and TSF

range was divided into three group, children under twelve, young from thirteen to twenty, and adults over twenty one years old. Arm circumference (AC) and arm Triceps Skin Fold (TSF) are convenient to assess as a indices of systemic muscle and fat volume, respectively. As shown in table 1, children's AC and TSF are quite low, which are rather low compared with the international standard value<sup>2)</sup>, which means their muscle and fat volume are remarkably lower far below than those of the standard.

By using Body Impedance Analysis (BIA) machine, the body component volume of fat, muscle, and intra- and extra-cellular water were calculated with the formula using electrical impedance value. Totally 64 villagers' data were obtained and shown in Table 2. The decreased fat, muscle volume and lean body mass which is body weight subtracted of fat mass, and increased body water volume could be noted remarkably in children compared with the international standard.



Table 2 Body composition analysis (BIA)

		mean (n=64)		
		<12yo	13-20yo	21yo<
Body fat ratio (%)	Male	16.3%	19.2	23.4
	Female	18.2%	20.4	24.6
Muscular mass (kg)	Male	17.9kg	29.8	27.5
	Female	16.2kg	23.3	25.6
Body water volume (l)	Male	24.8 l	28.3	25.3
	Female	22.4 l	26.9	23.2
Lean body mass (kg)	Male	19.4kg	37.3	39.3
	Female	20.2kg	33.2	33.7

II Blood Sampling Data

Serum hematological and biochemical data of 208 villagers were listed in Table 2. Almost all data in the young and the adults are within normal range except a slightly lower total protein and albumin. In the children, the low value in total protein and albumin were markedly noted. Total frequency of low proteinemia, which is defined as lower than 5.9mg/dl of total protein and lower than 2.9mg/dl of albumin, is observed up to 30 ~ 40 % of all the inhabitants shown in Fig 2.

III Intake Food Calorie and Ingredient

We also inquired their daily diets in ordinal living and analyzed the calorie and its nutrient components. In Pictures 2, three kinds of the typical Nepalese food, which is named “*Dal bhat tarkari*” are shown. *Dal* is a spicy lentil soup, served over *bhat* (boiled rice), with *tarkari* (curried vegetables), sometime together with *achr*

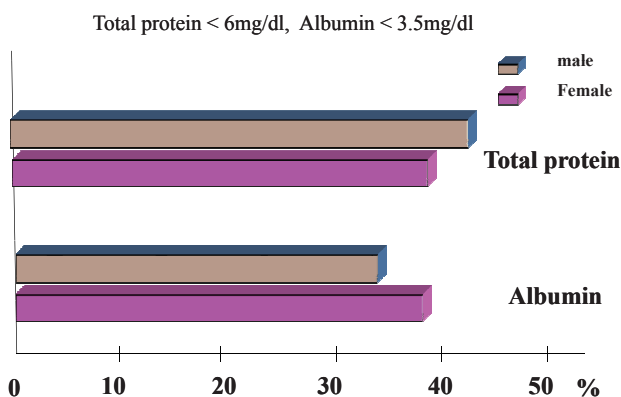


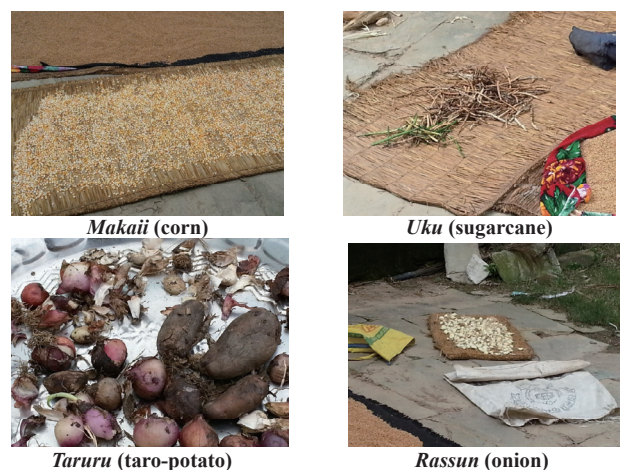
Figure 2 Frequency of low proteinemia

Table 3 Blood serum biochemical data

		mean ± SD (n=208)		
		<12yo	13-20yo	21yo<
T-protein (g/dl)	Male	6.22 ± 0.63	6.52 ± 1.05	6.63 ± 1.47
	Female	6.20 ± 0.99	6.54 ± 0.79	6.48 ± 0.87
Albumin (g/dl)	Male	3.42 ± 0.77	4.16 ± 0.92	4.00 ± 0.69
	Female	3.10 ± 0.57	4.00 ± 0.95	3.94 ± 0.64
Cholesterol (mg/dl)	Male	150.0 ± 49.5	139.5 ± 27.7	131.0 ± 22.2
	Female	112.0 ± 10.6	138.3 ± 37.4	141.9 ± 26.6
Triglyceride (mg/dl)	Male	156.4 ± 82.3	133.4 ± 66.3	153.4 ± 63.0
	Female	171.0 ± 67.4	139.3 ± 74.5	153.8 ± 79.1
GPT (IU/l)	Male	16.08 ± 8.18	13.37 ± 6.53	21.34 ± 6.44
	Female	16.50 ± 12.0	15.40 ± 7.61	19.96 ± 7.67
serum Ca (mg/dl)	Male	8.64 ± 0.86	8.22 ± 0.68	9.13 ± 1.16
	Female	9.45 ± 0.64	8.97 ± 1.40	8.95 ± 0.50

(pickles). The estimated calorie of them by a Japanese authorized clinical dietician was 320kcal, 480kcal, and 510kcal, respectively. They have the daily habit of two times of meal a day, it is breakfast and dinner, and no lunch. Consequently, the total intake calories a day is less than 1000kcal. The calculated nutrient component consists of 75~80 % of carbohydrate, and the rest of fat and protein in 10% each.

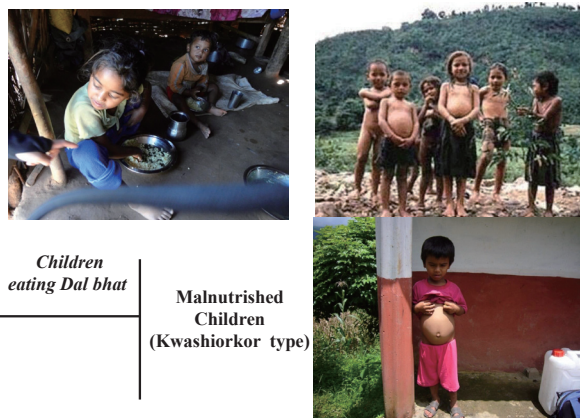
They cultivate various kinds of products in the mountainous field. These are the pictures of their products of corn, sugarcane, onion, and taro-potatoes (Picture 5). They eat cooked vegetables with rice in *Dal bhat tarkari*, but have little chance of eating meat (beef or pork). Only chickens and eggs are served as their best feast



Picture 5 Cultivated products in Nepal

for special days of festivals or ceremonial occasions. Mustard oil and a variety of spices, such as cumin, coriander, black pepper, sesame seeds, garlic, ginger, cinnamon, and chilies are often used for flavoring.

You can see the small children more often in peripheral country (Picture 6). Two children were eating *Dal bhat tarkari* on the floor in their house. They usually eat with their hand, without spoon or fork. These are the snapshots of the children in the neighborhood, most of whom are skinny with the distended abdomen. It does not come from obese, but malnutrition. The distended abdomen is manifested as a typical sign of malnutrition of Kwashiorkor type, which is caused by the lack of abdominal muscle due to protein deficiency and excessive body water of edema.



Picture 6 Children in *Dithal* village

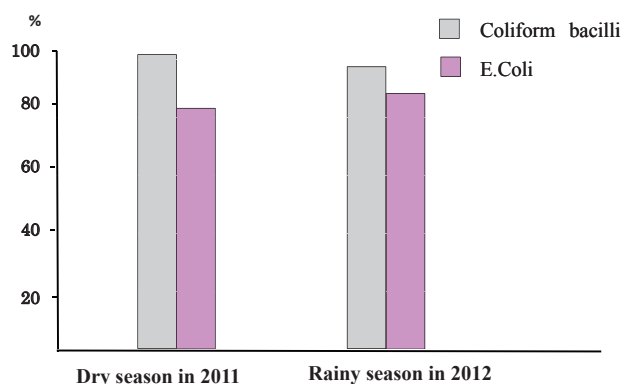


Figure 3 Bacterial contamination of drinking water

#### IV Water Contamination

Fig 3 showed the ratio of bacterial contamination of drinking water. Thirty water places of piped spring water and water storage tanks were examined. Coliform bacilli and E. Coli were detected in the samples in 100% and 80%, respectively. The rates of them were almost the same regardless of in dry or in rainy season.

### Discussion

Nepal's economic growth is to be continued in spite of her political uncertainty. The gross domestic product (GDP) of Nepal for 2012 was estimated at over \$ 17.921 billion, which is No.169<sup>th</sup> out of all 188 countries in the world<sup>3)</sup>. The proportion of the poor has declined substantially in recent years. It is reported that the percentage of people living below the international poverty line, which is defined as earning less than US\$1.25 a day, has halved in past several years<sup>3)</sup>. Unfortunately, however, there has been also emerged a big stratified society, which would be most partly attributed to "caste system"<sup>4)</sup>. It could not be discussed about Nepal without referring to their caste system, which is complex and continues to exist the traditional system of social feudalistic structure of Nepal.

The aim of our study is to clarify the present health and nutritional state of the lower caste people. That is the major reason why we did not choose the people living in the cities but the population living in the mountainous place where the lowest caste *Daritt* live, as a subject of our study.

This study clarified that the poor nutritional and health conditions have even now been existed in Nepalese mountainous area. There are three

big causes to lead into the difficult situations in rural Nepal.

It is obvious that the first cause is the problem of malnutrition. In Nepal, it is reported that recent children’s malnutrition is reported that about 47% of children under 5 are stunted, 15% wasted, and 36% underweight, although there has been a declining trend for these rates, they still remain alarmingly high<sup>5)</sup>. These figures are comparable with those of our data. It is apparent that the deficient calorie intake is to be ascribed to the poverty, and the lack of foodstuffs. In shortage of domestic animals for livestock is one of the problems. We can see many stray cows strolling around everywhere, but the cow are prohibited to eat on the religious belief. They can eat only the chickens but seldom, if ever.

Nutrient intake unbalances is mentioned as the second cause. It could be seen that not only the deficiency of the food calorie but the deviations of the nutrients intake to carbohydrate. They have no choice but the bad-balanced diet, which is often occurred in underdeveloped poor countries like countries in Africa. Excessively carbohydrate is by the economic destitution. The price of carbohydrate is much cheaper than that of food which is rich in the fat and protein. Fig 4 elucidates the comparison of chronological changes in proportion of daily intake nutrients

in Nepal, Japan, and USA. The proportion of daily nutrients intake in Nepal is very similar to that of Japanese in 1950’s. The state of Nepal is just like what Japan was in post-World War II of 70 years ago.

The unbalanced nutrients do more harm to the children who are in growing stage in life, in the highest demand of well-balanced nutrients, especially of protein and fat. That is the reason why the malnutrition could be manifested more remarkably than in other aged people.

Bacterial contamination of water is the third problem. In rural area in Nepal, more than one third (38.2%) of the total households do not have toilet at the house, and Tube well/hand pump are the main source of drinking water for about 35% of the total households, while spout, uncovered and covered well are the main source for 5.8%, 4.7%, and 2.5%, respectively<sup>6)</sup>. Tap/piped water for the source of drinking water have never been equipped in rural area.

Not only the food but the secured water are the urgent task for improving the public health. JICA<sup>7)</sup> has implemented some other supporting projects. Kusanone Project of JICA is one of them and has another mission to introduce the water purification system for supplying safety water. The project has been now ongoing to construct the infrastructure of setting up the water-filtration system. The outcome of this Kusanone activities will be reported for next papers.

## Conclusion

The prevalence of disease and malnutrition is higher in rural mountainous area in Nepal than it is in the other South Asian countries, especially. Nepal as well as other underdeveloped countries

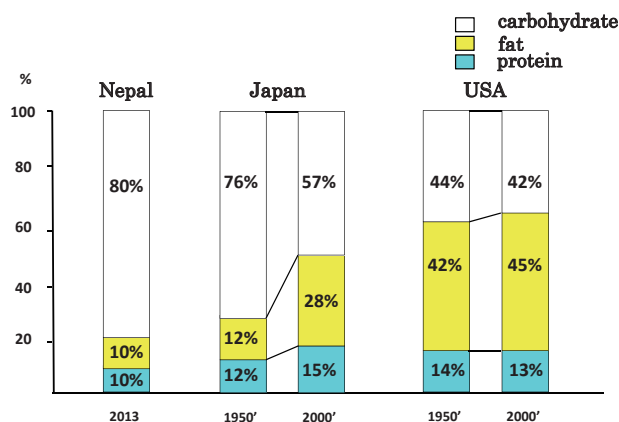


Figure 4 Proportion of daily intake nutrients

are trying to overcome their facing difficulties. They are now may trace the path on which the advanced countries have gone through in several decades. The advanced countries are expected to be ready for giving more hands to them<sup>8)</sup>.

People living in advanced countries should bear in mind the following words, stated by Mother Teresa (1910-1997), on whom was bestowed Nobel Prize in 1979.

“The opposite of love is not hate, but indifference.”

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