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The Prevalence of Type 2 Diabetes Mellitus and Fasting Impaired Glucose（IFG）in Nepal：Ethnicity and Lifestyle Aspects of a Community–Based Cross–Sectional Tibetan Buddhist Monastery Study in 1990

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Abstract：To compare the prevalence of type 2 diabetes among Tibetan monks and Tibetan immigrants with different lifestyles in Nepal. A total of 202 male monks, ranging in age from 20 to 80（mean±SD；35±17 years）and Tibetan immigrants comprising 235 males participated in this study. The findings of our previous survey（1990）classified based on the 1997－American Diabetes Association revised criteria were reanalyzed, along with the newly analyzed data conducted in Tibetan Buddhist monasteries（Boudhnath）, were compared to the results of Tibetan immigrants in Jawalakhel who had the same genetic origins but quite different lifestyles. Diabetes and impaired fasting glucose（IFG）, respectively, were detected in only one（0.5%）and 9 subjects（4.5%）of the 202 Tibetan monks. Diabetes, IFG and obesity（body mass index ≧25 kg/m^2）were relatively similar to the prevalence rate between Tibetan monks and Tibetan immigrants in Nepal（0.5%, 4.5% and 15.8% vs 2.6%, 2.1% and 14.0%, respectively）. The recent concurrent dramatic increase in heterogeneous Nepalese data［Diabetic Med 20：170, 2003 & J Jap Diabetes Society 49（Suppl 1）：S93, 2006］appears to have been influenced by a more sedentary lifestyle and socioeconomic development more than ethnicity. Our new analysis of the data provide baseline feature for planning health care policy and medical priorities among Tibetan immigrants in Nepal.

Key words：Type 2 diabetes, Prevalence, Tibetan Buddhist Monastery, Environment, Ethnicity, Lifestyle, Nepal

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Introduction

The exact magnitude of diabetes in Nepal still remains uncertain. A recent short communication by Singh and Bhattarai[1)2)] on the high prevalence of diabetes mellitus and impaired fasting glucose/gycaemia in urban Nepal based on the first population study (1999–2001) was of great interest. Type 2 diabetes is recognized as a major global health problem and agency in Asian developed and developing countries and immigrants from Southern Asia.[3)–6)] The prevalence of Type 2 diabetes may vary considerably between countries, regions and ethnic groups.[3)–8)] Knowledge of the prevalence of diabetes in a community is very important in order to determine the magnitude of public health resources required to sufficiently treat this disease.[5)] In 1997 and 1998, respectively, the American Diabetes Association (ADA) and World Health Organization (WHO) proposed that diabetes should be defined based on the fasting plasma glucose (FPG) level.[9)10)] A new diagnostic entity, impaired fasting glucose/glycaemia (IFG) has been introduced for useful epidemiological field–work in developing countries where the oral glucose tolerance test (O–GTT) is difficult to perform.[11)] The realistic possibility of a rapid increase of diabetes in Nepal has recently been reported by Singh and Bhattarai,[1)2)] and others[12)13)] based on population/community–based and/or hospital–based surveys, respectively. Although the ethnic and/or region related differences in lifestyle factors may account for some predisposition to develop diabetes and body fat accumulation of various ethnic groups, genetic variations may play a more determinant role.[3)–5)7)8)] For comparison purposes, we re–analyzed the findings of our previous survey[14)] along with newly analyzed data conducted in Tibetan Buddhist Monasteries (Boudhnath),[17)18)] and compared them with the results of Tibetan immigrants in Jawalakhel (Tibetan Refugees Settlement;established in 1960 by the International Committee for Red Cross).[19)20)] At the time of the original study, no criteria for the field–based mass screening of type 2 diabetes had yet been established.[11)] Each community was a special area, and was quite different regarding lifestyles and the socio–cultural status, despite the fact that each community consisted of the same Tibetan immigrants in Nepal.[18)–20)] Our aim is to re–analyze whether or not the prevalence of diabetes among Tibetan immigrants in Nepal is greater than that among Tibetan monks, and if so, then elucidate whether this could be explained by differences in their acquired/environmental lifestyles.

Materials and methods

Buddhist monasteries in Boudhanath are located in a suburban area some 7 km northeast from the center of Kathmandu (Fig. 1). Studies were carried out inside the six abbeys of the monastery for one week in September 1990. A total of 202 men, ranging in age from 20 to 80, participated in this study. Most of the participants were Tibetan Buddhist male monks (95%) and some were of other ethnicities. Therefore, the subjects were relatively young and middle aged men(mean±SD ; 35.0 ±17 years old) who were undergoing religious training.[17)18)] In contrast, Tibetan refugees migrated to Nepal from the Tibet Autonomous Region of China after the Dalai Lama was granted asylum in India in 1959.[19)] Many Tibetans relo-

Table 1. The number and percentages of subjects with diabetes mellitus (DM) and impaired fasting glucose (IFG) by age among Tibetan monks and Tibetan immigrants in men studied in 1990

	Boudhanath (Tibetan monks)				Jawalakhel (Tibetan immigrants)				Total			
Age, Years	DM	IFG	Number	Obesity	DM	IFG	Number	Obesity	DM	IFG	Number	Obesity
20－29	0	2(1.7)	118	4(3.4)	0	1(1.5)	66	4(6.1)	0	3(1.6)	184	8(4.3)
30－39	1(3.8)	0	26	4(15.4)	0	0	53	6(11.3)	1(1.3)	0	79	10(12.7)
40－49	0	0	10	1(10.0)	0	1(3.6)	28	8(28.6)	0	1(2.6)	38	9(23.7)
50－59	0	2(11.8)	17	9(52.9)	1(1.8)	1(1.8)	57	12(21.1)	1(1.4)	3(4.1)	74	21(28.4)
≧60	0	5(16.1)	31	14(45.2)	5(16.1)	2(6.5)	31	3(9.7)	5(8.1)	7(11.3)	62	17(27.4)
Total	1(0.5)	9(4.5)	202	32(15.8)	6(2.6)	5(2.1)	235	33(14.0)	7(1.6)	14(3.2)	437	65(14.9)

Mean±SD, Obesity : BMI (kg/m^2) ≧25, Percentages in parentheses

cated to Jawalakhel (Fig. 1), which is situated in a suburban area of Patan city (Lalitpur), neighboring Kathmandu and easily accessible by public transportation, taxi and bike. The total Tibetan population of individuals 20 years of age and over was 813 at the time of the study (Sep. 1990). About 66.2% of the Tibetan immigrant population, 235 males and 303 females participated in this study. Over half of the participants were Tibetan carpet weavers (58%), while the remainder office workers (11%), merchants (10%) and others (21%).

The study protocol was approved by the Tribhuvan University Research Division and Ethic Committees. The best way to approach the subjects, explain the survey and obtain their consent for participation were carefully planned about one month beforehand with the help of local social organizations and the leaders of the each community. All sampling and examinations included a physical examination and the recording of each person's medical history which was designed in collaboration with well-trained Nepalese physicians of Tribhuvan University and Japanese special staff members.[14] All blood samples were centrifuged and the serum/plasma was kept frozen at −40℃ until a biochemical analysis was carried out in Japan after transportation by air within seven days. The blood chemistries included measurements of the fasting plasma glucose (FPG ; by glucose oxidase/peroxidase method), total cholesterol, high-density lipoprotein-cholesterol (HDL-C) and triglyceride (TG) were measured. The nutritional assessment included total energy intake, dietary composition (24-hour recall method by questionnaire using Nutrition Value of Indian Food[13)20)]), anthropometric variables(Body Mas Index;BMI 〔Body weight kg/Height m^2〕, percent fat and skinfold thickness;data not shown) and maximal oxygen uptake (VO_2 max ; by Margaria's indirect method.[22] Diabetes was diagnosed when the subjects FPG was ≧126 mg/dl. Impaired fasting glucose (IFG) was diagnosed when the FPG was 110-125 mg/dl based on the new criteria of the ADA -1997[9] and WHO-1998 without O-GTT.[10)11)] Obese subjects (BMI ≧25 kg/m^2) were evaluated based on the criteria of the Japan Society for Obesity Study published in 2002.[25] Details of these methodologies have been published elsewhere.[14)-15)] The Tibetan monks were all males and relatively young to middle age. As the sample size was small in the over 40-year-old group, and did not include any females, a statistical comparison for the data between the Tibetan monks (Boudhanth) and Tibetan immigrants (Jawalakhel) excluding females, was adjusted for all paticipating individuals ranging in age from 20-39, and the findings was estimated as shown in Table 2.

The statistical results are expressed as the mean ±SD analysis of the data, including between group comparisons using the Chi-square method, the unpaired Student's t-test, or the non-parametric test. P value of <0.05 was considered to be significant.

Results

Diabetes and IFG, respectively, were detected in only one subject (0.5%) and 9 subjects (4.5%) in Tibetan monks and six subjects (2.6%) and five subjects (2.1%) in Tibetan male immigrants as shown in Table 1. The prevalence rate of diabetes was

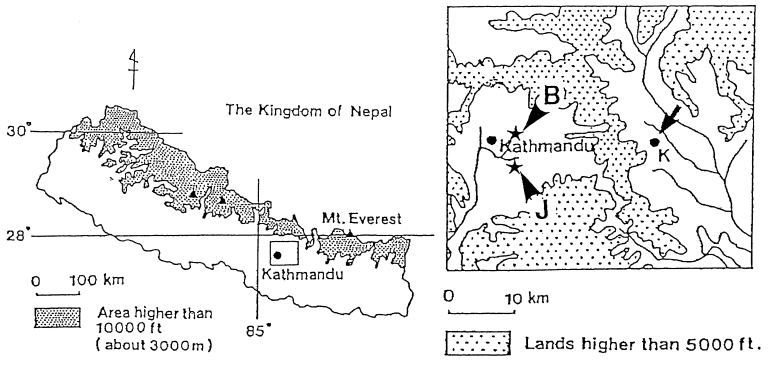

Fig. 1. Locations of Boudhnath (B), Jawalakhel (J) and Kotyang (K) in the Kingdom of Nepal

Table 2. Comparison of the body mass index (BMI), maximal oxygen uptake, daily energy intakes and biochemical variables in young－middle aged men (20–39 years) between Tibetan monks and Tibetan immigrants studied in 1990

Sites/Variables	Boudhanath (Tibetan Bhuddist monks)	Jawalakhel (Tibetan immigrants)
Number	144	119
DM/IFG	1/2 (2.1)	0/1 (0.8)
BMI (kg/m^2)	20.7±2.7	20.7±2.5
Ranges of BMI	16.5－28.0	15.8－29.0
Number of Obesity (BMI ≧25)	8 (5.6)	10 (8.4)
Maximal Oxygen Uptake (ml/kg/min)	43.5±7.7 (111)	43.5±8.6 (111)
Total Energy Intake (kcal/day)	1,594±529*	2,627±969
Total Protein (g/dl)	7.8±0.4	7.7±0.4
Albumin (g/dl)	4.6±0.2	4.5±0.2
Total Cholesterol (mg/dl)	143±29	149±33
HDL－Cholesterol (mg/dl)	37±7	42±10
Triglyceride (mg/dl)	91±37	103±42

Mean±SD, *$p < 0.01$ (vs Jawalakhel), DM：Type 2 diabetes, IFG：impaired fasting glucose, BMI：body mass index, Percent and/or number of participants in parentheses

similar in each community. We found the age and sex–adjusted 20–39 years prevalence of diabetes, including IFG, to be 3 subjects (2.1%) among Buddhist monks and only one subject (0.8%) among Tibetan immigrants of Jawalakhel, respectively. No subjects were found to have glycosuria among all participants. In both communities, a much higher prevalence of undiagnosed diabetes and IFG was found in older persons, but the number of participants in this age group was small. The daily nutritional status of Tibetan monks showed a significantly lower total energy intake than in those of Jawarakhel (Table 2). The animal protein intake was also relatively lower (Mean；23%), and the animal fat intake significantly higher than those of Jawarakehel (20%)(not shown in Table). One of the reasons for this low energy intake may be due to the ascetic and special religious training period at the time of study.[18] In addition, all apprentice monks ate together twice per day (morning and lunch only, without dinner) in the same dormitory room during the study period. Their main staple foods were basically noodles, Tibetan bread and Tibetan tea, which contains rock salt and butter and this diet was also similar to that regularly consumed by the Tibetan immigrants in Jawalakehel.[14][15] Their protein consumption depended basically on Tibetan tea. The number of obese subjects (BMI ≧25 kg/m^2) among the Tibetan monks was (15.8%) while that found among Tibetan immigrants was (14.9%), and the obese subjects tended to be older persons in both groups (Table 2).

Discussion

The prevalence of diabetes and/or obesity was relatively higher in both communities in comparison to those of native Nepalese in rural and suburban areas previously reported.[15] The prevalence of diabetes and impaired glucose regulation remained at a generally low rate in most regions of nearby Kathmandu without any ethnic difference until 1990；however, dramatically higher prevalence values have recently been reported by Singh and Bhattarai[1][2] and hospital–based heterogeneous Nepaleses by Karki and colleagues[12][13] and others.[16] Our findings, however, were consistent with the trend that diabetes generally occurs in older persons and it becomes increasingly more prevalent with advancing age.[25] No specific survey has been performed regarding the prevalence of diabetes among Tibetan immigrants in Nepal. As far as we know, and no available data have yet been reported regarding to the prevalence of diabetes in Tibet Autonomous Region of China. But our prevalence rate of diabetes (1990) was similar to that recently reported for a population–based study in Mongolia (crude；2.9%),[27] and in Bangladesh (diabetes and IFG；4.3% and 2.4%, respectively).[28] Religious high class elderly men[17][18] sometimes drank soft drinks such as "Coca–cola"

and/or milk tea since they offered such drinks to their foreign guests. However, the VO_2 max in monks was similar to those observed among the inhabitants in Jawalakehel. In addition, the young men in this community also occasionally played football (soccer) in their leisure time, while elderly individuals did not take part in such sports activities in their daily life. In contrast, most of the residents in Jawalakhel were mainly employed in sedentary jobs such as Tibetan carpet weaving, handcrafting (58%) and office work.[19] The socio-economic conditions, which include the literacy rate, education, distribution of income and economic conditions also differed somewhat, but these factors were difficult to estimate.[18)-20)] No objective data regarding the comparative differences in each community were available.[19)20)]

These studies clearly suggest that acquired and/or environmental factors closely associated with urbanization and globalization may play a significant role in the development of Type 2 diabetes in a growing number of individuals without any relation to ethnicity in urban Nepal. The socioeconomic conditions of metropolitan Kathmandu have changed rapidly due to urbanization and globalization.[29)30)]

In conclusion, taking the above results into consideration, the changes in lifestyle and socioeconomic development are considered to have played a strong role in the emergence of diabetes as a major health problem in Nepal. Reliable epidemiological studies are still scarce. Further follow-up studies are needed to clarify the heterogeneous and multifactorial determinant factors involved in these phenomena. Therefore, our new analysis of the data provide baseline features in order to design and establish health care policy and treatment priorities among Tibetan immigrants in Nepal.

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