Update/Le point

Diabetes in adults is now a Third World problem*

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Since 1988, WHO has been collecting standardized information on the prevalence of diabetes mellitus and impaired glucose tolerance (IGT) in adult communities worldwide. Within the age range 30–64 years, diabetes and IGT were found to be absent or rare in some traditional communities in Melanesia, East Africa and South America. In communities of European origin, the prevalences of diabetes and IGT were in the range of 3–10% and 3–15% respectively, but migrant Indian, Chinese and Hispanic American groups were at higher risk (15–20%). The highest risk was found in the Pima Indians of Arizona and in the urbanized Micronesians of Nauru, where up to one-half of the population in the age range 30–64 years had diabetes.

The prevalence of total glucose intolerance (diabetes and IGT combined) was greater than 10% in almost all populations, and was within the range 11–20% for European and U.S. white populations. However, the prevalence of total glucose intolerance reached almost 30% in Arab Omanis and in U.S. blacks and affected one-third of all adult Chinese Mauritians, migrant Indians, urban Micronesians and lower-income urban U.S. Hispanics. In Nauruans and Pima Indians, approximately two-thirds of all adults in the age range were affected.

These results lead to three important conclusions. (1) An apparent epidemic of diabetes has occurred—or is occurring—in adult people throughout the world. (2) This trend appears to be strongly related to life-style and socioeconomic change. (3) It is the populations in developing countries, and the minority or disadvantaged communities in the industralized countries who now face the greatest risk. Diabetes in adults should now be considered not only as a disease of industrialized countries, but also as a Third World problem. All countries should be encouraged to develop national policies and programmes for the prevention and control of this costly disease.

Introduction

For many years, diabetes mellitus in adults (in its noninsulin-dependent form) was considered a disease which afflicted the affluent and resulted from an overindulgent life-style. For this reason diabetes, as well as certain cardiovascular diseases, cancer and other noncommunicable diseases, were thought to be largely a problem of the industrialized nations.

In the past few years, several reports have been published indicating a high prevalence of diabetes in communities in the developing world, and in ethnic minorities in industrialized countries. These include

* A French translation of this article will appear in a later issue of the *Bulletin*.

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Reprint No. **5220**

such diverse groups as indigenous Americans (*1*), Pacific islanders (*2*), and migrant Asian Indians (*3*, *4*). A problem with the earliest reports was the fact that the criteria for the diagnosis and classification of diabetes were not uniform, resulting in a lack of comparability of such studies. It is only in the past 12 years that these aspects have been standardized, thanks to the efforts of the U.S. National Diabetes Data Group (*5*) and the World Health Organization (*6*, *7*).

Following these important developments in diabetes epidemiology, the published studies that conformed to current WHO criteria for classification and diagnosis were reviewed (*8*). Recently, the diabetes programme at WHO Headquarters, Geneva, has been collating data from many studies, both published and unpublished, in which the diagnosis of diabetes was based upon the current WHO diagnostic criteria (*7*). Between 1988 and 1991, all investigators who were considered to have examined diabetes prevalences in unbiased adult population samples, using the WHO diagnostic criteria for glucose intolerance (based on blood glucose measurements two hours after a 75 g oral glucose challenge), were encouraged to submit their data for inclusion in the study. Suitable material was obtained in this way for over 70 populations in over 30 countries worldwide, the total study sample being over 150 000 subjects.

In order to enhance comparability, the prevalence rates were standardized for age in a truncated age range of 30–64 years. The world population described by Segi (*9*) was taken as the standard. Full details of the standardization procedure and detailed results for all populations are published separately (*10*). The present article gives data from selected populations in all WHO regions on the global prevalences of diabetes and impaired glucose tolerance, and focuses on the pattern in the developing world.

Prevalence data

Diabetes mellitus

In African and Asian populations, diabetes was rarest (1%) among the Tanzanian rural Bantu (Table 1). Diabetes was also rare in Da Qing in China—despite the fact that this is an industrial city—and in rural India. Prevalence was close to 10% among Tunisian Arabs, 14% in Omanis, and was of the order of 10–20% among migrant Indian populations (in rural as well as urban locations.) The prevalence exceeded 10% among the Chinese Mauritians.

In American populations, prevalence was lowest (<1%) in the rural Mapuche Indians of Chile. In the USA, as compared with a prevalence of 5–7% among whites, the blacks had a higher risk (c. 10%); among U.S. Hispanics the prevalence was approximately 10–20%, and was inversely related to average income in the Hispanic residents of San Antonio. In the Pima Indians diabetes reached the extreme prevalence of 50% in this age range (30–64 years).

In European populations the prevalence was generally lower, ranging from 2–4% among Siberian Russians to 10% in Italy and Malta.

In Pacific populations the prevalence was highly variable. Diabetes was not recorded in a small highland population sample in Papua New Guinea and prevalence was low in rural Fijian Melanesians (unlike their Indian counterparts). Moderate rates were observed in urban Melanesians and in Polynesians. Rates were higher among urbanized Micronesians and in the Nauruans extremely high rates (>40%), close to those of the Pimas, were observed.

In Fig. 1, these populations are ranked according to increasing prevalence of diabetes, which can be seen to vary from 0% to 50% in this age range. One most interesting and important observation is that if ones takes an arbitrary cut-off point of 10%, above which diabetes in adults can be considered common, it is only among the populations of

Fig. 1. **Prevalence of diabetes in the age range 30–64 years in selected populations worldwide (age-standardized, sexes combined).** PNG, Papua New Guinea.

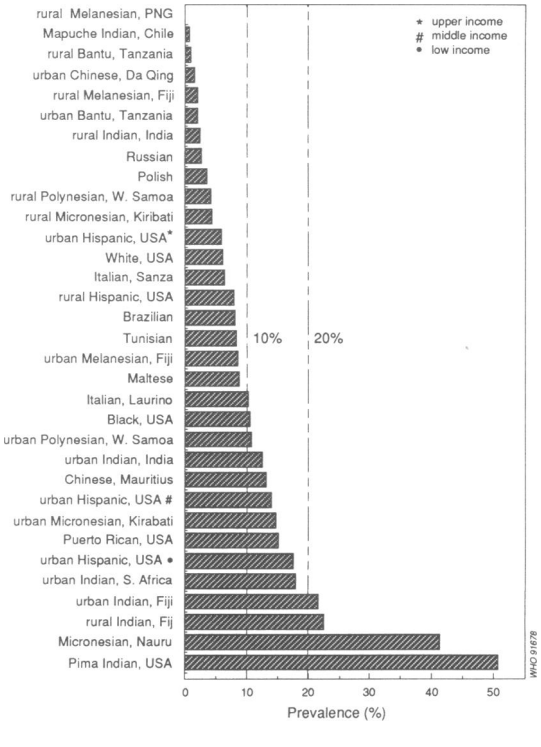


Table 1: **Percentage prevalences of diabetes mellitus and impaired glucose tolerance in the age range 30–64 years in selected populations[a]**

Region of origin, ethnicity, and location	Diabetes mellitus		Impaired glucose tolerance	
	Men	Women	Men	Women
Africa and Asia				
Arab:				
Tunisia	9	8	9	10
Oman	14	14	11	17
Bantu:				
Tanzania				
Dar-es-Salaam	3	1	9	16
Wachagga/Masai	1	1	8	10
Indian:				
S. India (Dravidian)				
Rural	4	2	9	7
Urban (Madras)	12	11	11	9
S. Africa (Durban)	14	21	12	7
Fiji				
Rural	23	16	10	12
Urban	23	20	12	17
Chinese:				
China (Da Qing)	2	2	1	1
Mauritius	16	10	17	22
Americas				
U.S. non-Hispanic:				
White	5	7	10	11
Black	9	12	14	17
U.S. Hispanic:				
Rural:				
San Luis Valley, Colorado	7	9	11	18
Urban:				
Puerto Rican (New York)	18	13	11	16
San Antonio, Texas				
Upper income	7	5	10	14
Middle income	16	12	16	17
Low income	15	19	13	18
American Indian:				
Mapuche (Chile)	0	1	1	1
Pima (Arizona, USA)	49	51	12	17
Brazilian:				
São Paulo	7	9	3	3
Europe				
Russian (Novosibirsk, Siberia)	2	4	6	10
Polish (Wroclaw)	4	4	2	3
Italian:				
Sanza	8	5	4	9
Laurino	11	10	3	8
Maltese	8	10	5	5
Pacific				
Melanesian:				
Papua New Guinea				
Rural	0	0	3	2
Fiji				
Rural	2	2	7	12
Urban	5	12	9	19
Polynesian:				
Western Samoa				
Rural	2	6	5	4
Urban	11	10	9	11
Micronesian:				
Kiribati				
Rural	4	5	14	17
Urban	16	13	28	19
Nauru	41	42	22	21

[a] Age-adjusted to standard world population.

developing countries, and migrant and minority communities in industralized countries, that this limit is exceeded.

Impaired glucose tolerance

The category of "impaired glucose tolerance" (IGT) describes individuals whose blood glucose after the oral glucose challenge is above the normal range, but is still lower than that used to define diabetes (*5–7*). Longitudinal studies suggest that approximately one-third of subjects with impaired glucose tolerance progress to diabetes, and that they are at increased risk of related complications such as cardiovascular disease (*11, 12*).

The prevalence of IGT was also highly variable in these study populations and the pattern differed somewhat from that observed for diabetes (Table 1).

In African and Asian populations, the only group in which IGT was rare (1%) was the Chinese in Da Qing. However, Chinese Mauritians had very high rates (c. 20%) and rates of approximately 10% were observed in the Bantu and Indians, even in the rural setting.

In American populations, IGT was rare in the Mapuche Indians (1%) and uncommon in São Paulo, Brazil (3%); in all other groups it was common (10–20%). In the USA, IGT was more common among blacks than whites, and among lower and middle than upper income Hispanics in San Antonio—a similar trend to that observed for diabetes. The figures for the Pimas (12% in men and 17% in women) were less than one-half of the corresponding figures for diabetes.

Like diabetes, IGT was generally less common

Fig. 2. **Prevalence of impaired glucose tolerance in the age range 30–64 years in selected populations worldwide (age-standardized, sexes combined).**

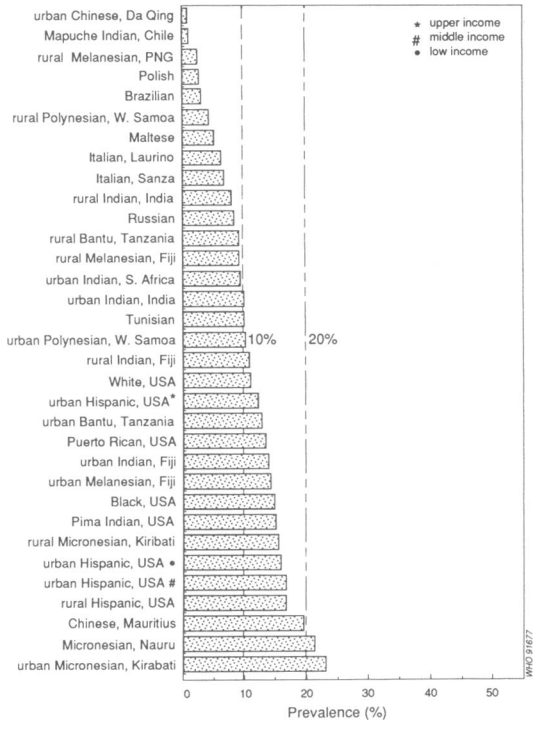
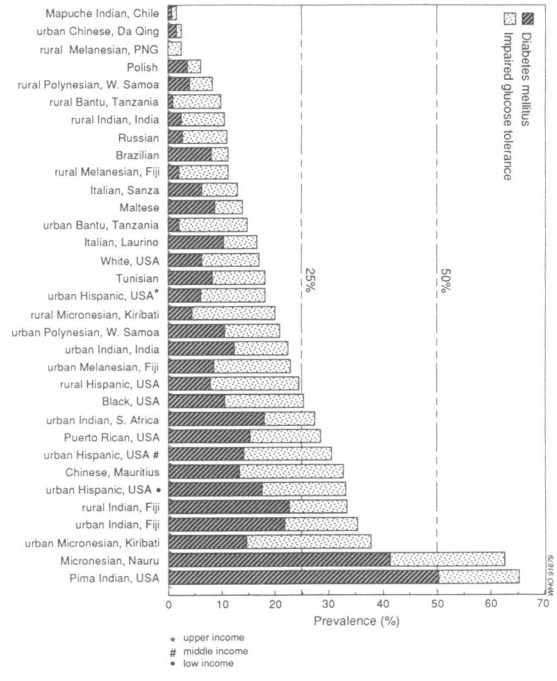


Fig. 3. **Prevalence of total glucose intolerance (diabetes and impaired glucose tolerance) in the age range 30–64 years in selected populations worldwide (age-standardized, sexes combined).**



among Europeans, being low in Poles (2–3%) and highest in Russians (6–10%). Prevalence was 5% for Maltese, which is lower than the corresponding figure for diabetes in this population.

As in the case of diabetes, the prevalence of IGT varied greatly in Pacific populations. Generally, it was lower in rural than in urban subjects. Micronesians had higher rates than Melanesian and Polynesian communities.

The rank ordering of the populations with respect to IGT is shown in Fig. 2. The overall range (1–24%), though substantial, was not as wide as for diabetes. Once again, all populations with a 10% or greater prevalence were from the developing countries, or were migrants or ethnic minorities in the industrialized countries. A greater number reached this high prevalence for IGT than for diabetes.

Total glucose intolerance

Since IGT indicates a high risk of subsequent diabetes and associated disorders such as cardiovascular disease, the combined prevalence of diabetes and IGT is a useful measure of the public health impact of glucose intolerance in a given population. The prevalence of total glucose intolerance for the populations mentioned in this article is shown in Fig. 3.

Apart from the Mapuche Indians, the Chinese in Da Qing, certain rural Pacific islanders, and the Poles, all communities demonstrate prevalences of total glucose intolerance in excess of 10%. Prevalence was within the range 11–20% for all other European populations, some rural populations in developing countries, and upper-income Hispanics in the USA.

However, prevalence reached almost 30% among Arab Omanis and blacks in the USA and reached, or exceeded, one third of the adult population in Chinese Mauritians, migrant Indians, urban Micronesians and lower-income urban Hispanics in the USA. For the Nauruans and Pima Indians, two-thirds of all adults in this age range displayed glucose intolerance.

Implications of the global data

The standardized information presented in this review demonstrates convincingly that diabetes is a global problem, and also that glucose intolerance reaches its greatest frequency in the developing countries, and among minority groups and the disadvantaged in the industrialized countries. Contrary to traditional belief, diabetes in adults should now be recognized as a particular threat to the public health of Third World communities—those living in the developing countries, as well as the disadvantaged minorities in industrialized nations.

The wide range in the prevalence of diabetes, from 0% to 50% in adults aged 30–64-years, is probably greater than that for any other chronic disease and is a strong indication of the importance of environmental factors in the etiology of noninsulin-dependent diabetes. The large difference in the prevalences of total glucose intolerance among the Chinese in Da Qing (3%) and the Chinese in Mauritius (33%) is most unlikely to be principally due to genetic factors.

Since environmental and behavioural factors may be amenable to change, the identification of risk factors for diabetes in all populations should be considered a priority. There is a consistent association between diabetes and urban living, and also an inverse relationship between glucose intolerance and income in the data from San Antonio, which suggest the presence of potentially avoidable life-style factors among the disadvantaged.

Inappropriate diet (high content of fat and refined carbohydrate), sedentary life-style, and obesity have often been incriminated as the principal environmental determinants of noninsulin-dependent diabetes. However, it is still not clear how such factors operate, and if their influence varies between populations (*13*). The distribution of risk factors within communities is also of some interest in defining strategies for prevention. If the risk factors cluster in certain individuals, a high-risk prevention strategy may be very effective; but if they are widely spread among the population, greater emphasis may be given to a population approach (*14*).

Recently, there has been speculation on the possible use of the IGT-to-diabetes ratio as a prognostic index of the epidemicity of diabetes in a given population (*15*). Since many subjects with IGT subsequently develop diabetes, a high prevalence of IGT in the presence of a low prevalence of diabetes (i.e., a high IGT/diabetes ratio) might be taken as an indication of the early stage of a diabetes epidemic. Such a situation can be seen in our data from the rural Bantu, Indian and Micronesian communities, and Siberian Russians. Some populations, such as the blacks and Hispanics in the USA, demonstrate a high prevalence of both diabetes and IGT. This may suggest that an already serious situation could deteriorate further in the future. Rarely, as in the Pima Indians and the Maltese, the prevalence of IGT was lower than that of diabetes, possibly implying that an epidemic of diabetes was on the wane. Alternatively, this might only reflect a situation in which most genetically susceptible persons already manifest the disease fully.

Diabetes is a very costly disorder, both to health agencies, in terms of provision of additional services, and also to diabetic individuals and their families, in terms of loss of productivity and reduced quality of life (*16*). However, it is thought that many of the complications of diabetes may be delayed or even prevented by prompt and effective treatment and education.

Although the survey data described here and in the full report (*10*) give a good impression of the global situation regarding diabetes in adults, gaps in our knowledge persist and the data also raise some interesting questions. For example, we still do not known if diabetes is rare *throughout* mainland China (and if so, why?) and information is surprisingly scarce for European communities. Further research is required to determine the extent to which heightened risk in migrant populations is related to environmental factors.

Global surveillance and programmes for primary, secondary and tertiary prevention are required. Aware of the modern threat of diabetes to global public health, the Forty-second World Health Assembly adopted a resolution on the prevention and control of diabetes in 1989 (*17*). It invited countries to assess the national importance of diabetes, to implement population-based measures for its prevention and control, and to share opportunities for training and further education.

WHO has prepared guidelines for the development of national programmes for diabetes to assist Member States in this process.[a] Recognizing diabetes as an important public health concern, the Ministry of Health of one developing country recently launched a comprehensive national diabetes programme (*18*). It is hoped that others will follow.

[a] **Reiber, G. E. & King, H.** *Guidelines for the development of national programmes for diabetes mellitus*. Unpublished WHO document WHO/DBO/DM/91.1, 1991.

References

1. **Knowler, W.C. et al.** Diabetes incidence and prevalence in Pima Indians: a 19-fold greater incidence than in Rochester, Minnesota. *Am. j. epidemiol.*, **108**: 497–505 (1978).
2. **Zimmet, P. et al.** The high prevalence of diabetes

mellitus, impaired glucose tolerance and diabetic retinopathy in Nauru—the 1982 survey. *Diabetes res.*, **1**: 13–18 (1984).

3. **Zimmet, P. et al.** Prevalence of diabetes and impaired glucose tolerance in the biracial (Melanesian and Indian) population of Fiji: a rural-urban comparison. *Am. j. epidemiol.*, **118**: 673–688 (1983).
4. **Dowse, D.G. et al.** High prevalence of NIDDM and impaired glucose tolerance in Indian, Creole and Chinese Mauritians. *Diabetes*, **39**: 390–396 (1990).
5. **National Diabetes Data Group.** Classification and diagnosis of diabetes mellitus and other categories of glucose intolerance. *Diabetes*, **28**: 1039–1057 (1979).
6. WHO Technical Report Series No. 646, 1980 (*WHO Expert Committee on Diabetes Mellitus*: second report).
7. WHO Technical Report Series, No. 727, 1985 (*Diabetes mellitus*: report of a WHO Study Group).
8. **King, H. & Zimmet, P.** Trends in the incidence and prevalence of diabetes: non-insulin-dependent diabetes mellitus. *World health statistics quarterly*, **41**: 190–196 (1988).
9. **Segi, M.** *Cancer mortality for selected sites in 24 countries (1950–57)*. Sendai, Tohuku University School of Medicine, 1960.
10. **WHO *Ad Hoc* Diabetes Reporting Group**. Global estimates for prevalence of diabetes and impaired glucose tolerance in adults. *Diabetes care* (in press).
11. **Fuller, J.H. et al.** Coronary-heart-disease risk and impaired glucose tolerance: the Whitehall study. *Lancet*, **1**: 1373–1376 (1980).
12. **Saad, M.F. et al.** The natural history of impaired glucose tolerance in the Pima Indians. *New Engl. j. med.*, **319**: 1500–1506 (1988).
13. **King, H.** Aetiology. In: Nattrass, M. & Hale, P.J., ed. *Noninsulin-dependent diabetes* (Bailliere's Clinical Endocrinology and Metabolism, Vol. 2). 1988, pp. 291–305.
14. **King, H. & Dowd, J. E.** Primary prevention of Type 2 (noninsulin-dependent) diabetes mellitus. *Diabetologia*, **33**: 3–8 (1990).
15. **Dowse, G.K. et al.** Relationship between prevalence of IGT and IDDM in a population—the "epidemicity" index. *Diabetes care* (in press).
16. **Huse, D.M. et al.** The economic cost of noninsulin-dependent diabetes mellitus. *J. Am. Med. Assoc.*, **262**: 2708–2713 (1989).
17. **World Health Organization.** World Health Assembly Resolution 42.36 (Prevention and control of diabetes mellitus). *Handbook of Resolutions, Vol. III, 2nd ed. (1985–1989)*. Geneva, 1990, p. 71.
18. **Asfour, M.G. et al.** Diabetes mellitus in the Sultanate of Oman. *Diabetic medicine*, **8**: 76–80 (1991).