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Prevalence and progression of impaired glucose homeostasis assessed by the different criteria for IFG in Japanese adults

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Abbreviations FPG: Fasting plasma glucose

To the Editor: Several studies have indicated that isolated IGT (that is, IGT with normal fasting plasma glucose) is more common than isolated IFG (that is, IFG with normal 2-h plasma glucose after OGTT). Based on current diagnostic thresholds, 30–60% of subjects with IGT have normal fasting plasma glucose (FPG) levels [1–3]. Furthermore, a recent longitudinal study on the natural history of type 2 diabetes has demonstrated that the threshold of 6.1 mmol/l (110 mg/dl) for normal FPG level does not create an equivalent category of glucose homeostasis to IGT for either the subsequent development of diabetes or in terms of coronary heart disease risk factors [4]. To reconcile these inconsistencies and to provide an equivalent predictive power to both categories, the American Diabetes Association most recently redefined IFG as FPG levels of at least 5.55 mmol/l (100 mg/dl) but below 7.0 mmol/l (126 mg/dl) [5]. To date, however, there is little information about differences in prevalence and progression of impaired glucose homeostasis (IFG and IGT) when different criteria for IFG are used. We assessed the feasibility of these criteria by comparing the proportion of categories for IFG and IGT with their progression to type 2 diabetes in Japanese adults. The study was approved by the institutional ethics committee. The subjects of the present study comprised the group of general health check-up examinees who enrolled between 1996 and 2003 and underwent a series of examinations at the Department of Health Care in our hos-

pital. Of 853 examinees, 46 already had diabetes and were eliminated, and the remaining 807 subjects (54.4±9.8 years [mean±SD], 81.2% men) underwent a standard 75-g OGTT after an overnight fast. A substantial number of individuals participated in this programme on several occasions over the study period. Their serial OGTTs were observed on occasions to convert to different diagnostic categories, for example NGT at one time point and IGT at a subsequent time point or vice versa. Therefore, we analysed all of them (1,406 OGTTs) separately to avoid selection bias. According to the modified criteria [5], NGT is defined as FPG below 5.55 mmol/l (100 mg/dl) and 2-h PG below 7.8 mmol/l (140 mg/dl), isolated IFG as FPG between 5.55 and 6.9 mmol/l (100–125 mg/dl) and 2-h PG below 7.8 mmol/l (140 mg/dl), isolated IGT as FPG below 5.55 mmol/l (100 mg/dl) and 2-h PG between 7.8 and 11.0 mmol/l (140–199 mg/dl), and combined IFG and IGT (IFG/IGT) as FPG between 5.55 and 6.9 mmol/l (100–125 mg/dl) and 2-h PG between 7.8 and 11.0 mmol/l (140–199 mg/dl).

At baseline, the prevalence of NGT was 58.4% (821 of 1,406 OGTTs) by the current criteria and was reassessed at 41.1% (578/1,406) by the modified criteria: IFG 4.9% at 22.2%, IGT 20.9% at 12.2%, and IFG/IGT 6.0% at 14.7%, respectively. The prevalence of diabetes was the same (9.7%) by both criteria as expected. Thus, based on the current criteria, isolated IFG was found only in 25% of isolated IGT (4.9 vs 20.9%), which was consistent with previous studies [1–3]. However, using the modified criteria, its prevalence increased approximately two-fold that of IGT (22.2 vs 12.2%). Among 137 diabetic OGTTs, only 20 OGTTs (14.6%) were diagnosed as diabetic by FPG criteria alone. In contrast, 64 OGTTs (46.7%) were diagnosed as diabetic by 2-h PG criteria alone and their FPG concentrations were normal in more than half of the cases (38 OGTTs). Thus, there is a serious flaw when as many as 46.7% of diabetic individuals could be left undiagnosed using the FPG criteria alone. We analysed the progression from NGT or impaired glucose homeostasis to each category for glucose tolerance on the subset of 95 subjects (51.2±9.0 years, 84

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Table 1 Distribution of glucose tolerance categories at baseline and at follow-up with a mean duration of 5.4 years assessed by the different criteria

Baseline	Current criteria (n=95)				Modified criteria (n=95)				Criteria by Meigs et al ^a (n=83)			
After follow-up	NGT (65)	IFG (7)	IGT (18)	IFG/IGT (5)	NGT (45)	IFG (27)	IGT (11)	IFG/IGT (12)	NGT (46)	IFG (19)	IGT (11)	IFG/IGT (7)
NGT	69.2	0	38.9	0	51.1	22.2	36.4	8.3	54.3	26.3	36.4	14.3
IFG	1.5	14.3	0	0	22.2	29.6	9.1	8.3	19.6	36.8	9.1	14.3
IGT	26.2	0	55.6	0	20.0	14.8	36.4	16.7	19.6	21.1	36.4	28.6
IFG/IGT	1.5	28.6	0	60.0	4.4	18.5	18.2	41.7	4.3	10.5	18.2	28.6
DM	1.5	57.1	5.6	40.0	2.2	14.8	0	25.0	2.2	5.3	0	14.3

^a‘Abnormal’ FPG as ≥ 5.55 mmol/l and ‘diabetic’ FPG as ≥ 6.1 mmol/l [4]

men) in whom at least two OGTTs were performed more than 4 years apart (mean duration, 5.4 ± 1.1 years), and a pair of OGTTs with the longest interval was used (Table 1). Based on the current criteria, a quarter of subjects with NGT progressed to IGT, but in contrast, about 40% of subjects with IGT reverted to NGT. None of the IFG subjects reverted to NGT. Forty percent of subjects with combined IFG and IGT progressed to diabetes. According to the modified criteria, about 20% of subjects with NGT progressed to each of IFG and IGT. A large majority of IGT subjects (72.7%) either remained unchanged or reverted to NGT. In contrast, a smaller portion of subjects with IFG (22.2%) reverted to NGT and 14.8% progressed to diabetes. Twenty-five percent of subjects with IFG/IGT progressed to diabetes. Interestingly enough, however, among eight subjects who progressed to diabetes, four subjects by the current criteria and five subjects by the modified criteria were diagnosed as having diabetes by 2-h PG criteria alone. In contrast, only one was diagnosed by FPG criteria alone. Thus, as indicated previously [4], progression to diabetes by FPG was a rare event that typically occurred in combination with progression by 2-h PG. In addition, using the ‘abnormal’ FPG of 5.55 mmol/l (100 mg/dl) or higher and the ‘diabetic’ FPG of 6.1 mmol/l (110 mg/dl) or higher proposed by Meigs et al [4], the prevalence of isolated IFG and IGT at baseline was roughly similar (IFG: 17.3% [243/1,406 OGTTs] and IGT: 12.2% [172/1,406 OGTTs]). The progression from NGT to either IFG or IGT was just the same in proportion (19.6%, 9/46), in agreement with similar progression rates of a long-term follow-up study [4]. After excluding 12 subjects with ‘diabetic’ OGTTs at baseline, only three progressed to ‘diabetes’, thus the number was too small to facilitate any

meaningful assessment. By any criteria, reversion to NGT occurred more often in subjects with IGT than in subjects with IFG.

In conclusion, these results suggest that the modified IFG appears to be too broad and the diabetic FPG threshold of 7.0 mmol/l (126 mg/dl) appears somewhat higher compared with the 2-h PG threshold of 11.1 mmol/l (200 mg/dl) in OGTTs for the diagnosis of type 2 diabetes in the Japanese population. We believe that these findings apply to the Japanese population but not necessarily to the general population.

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