

Available online at www.sciencedirect.com

SciVerse ScienceDirect

journal homepage: www.jfma-online.com

ORIGINAL ARTICLE

Incidence and prevalence rates of diabetes mellitus in Taiwan: Analysis of the 2000–2009 Nationwide Health Insurance database

Yi-Der Jiang^a, Chia-Hsuin Chang^{a,b}, Tong-Yuan Tai^c, Jung-Fu Chen^d,
Lee-Ming Chuang^{a,b,*}

^a Department of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan

^b Graduate Institute of Preventive Medicine, National Taiwan University School of Public Health, Taipei, Taiwan

^c Taipei Jen-Chi Relief Institute, Taiwan

^d Department of Internal Medicine, Chang Gung Memorial Hospital, Kaohsiung, Taiwan

Received 16 August 2012; received in revised form 4 September 2012; accepted 6 September 2012

KEYWORDS

diabetes mellitus;
incidence;
prevalence;
Taiwan National
Health Insurance

Background/Purpose: Formerly, Taiwan's diabetic population has been estimated by surveys conducted at irregular intervals and using different sampling methods. To obtain nationwide data on the incidence and prevalence of diabetes mellitus (DM) in Taiwan, we performed an analysis of the 2000–2009 claim data from the National Health Insurance (NHI) database.

Methods: One-third of the claims in the NHI database from 2000 to 2009 were randomly sampled. DM was defined by three or more outpatient visits with diagnostic codes (ICD-9-CM: 250 or A code: A181) within 1 year or by one inpatient discharge diagnosis of DM. Confirmation of type 1 diabetes mellitus was based on the issue of a catastrophic illness certificate with the same diagnostic codes. Age and/or gender distribution for DM were determined.

Results: In accordance with the global trend for DM, with a near constant standardized incidence rate, there was a more than 70% increase in the total diabetic population, or a 35% increase in the standardized prevalence rate, in Taiwan from 2000 to 2009. The incidence of diabetes was higher in men, especially in the 20–59-year-old age group, and the total number of men with diabetes exceeded the number of women with diabetes in 2005. However, the prevalence and incidence rates in women over the age of 60 years were higher than those in men. Type 1 DM was present in less than 1% of the diabetic population in Taiwan.

Conclusion: The incidence of diabetes, including type 1, remained stable over this 10-year period in Taiwan. However, the incidence rate in men aged 20–59 years was higher than that in age-matched women. With our nationwide database, subgroup analysis of DM incidence can

* Corresponding author. Department of Internal Medicine, National Taiwan University Hospital, 7 Chung-Shan South Road, Taipei, Taiwan.
E-mail address: leeming@ntu.edu.tw (L.-M. Chuang).

be performed to refine our health policies for the prevention, screening, and treatment of diabetes mellitus.

Copyright © 2012, Elsevier Taiwan LLC & Formosan Medical Association. All rights reserved.

Introduction

Diabetes mellitus (DM) is an epidemic disease worldwide. The International Diabetes Federation (IDF) has estimated that the global diabetic population was 151 million in 2000, 194 million in 2003, 246 million in 2006, 286 million in 2009, and 366 million in 2011, and this population is expected to be 552 million in 2030.¹ Given such rapid growth, DM is not only a medical or health issue, but also a social and financial problem for most governments. Consequently, World Diabetes Day was declared an official United Nations Day in 2007 with the passage of UN Resolution 61/225 in December 2006.²

On the first UN World Diabetes Day, November 14, 2007, a committee of Taiwan's diabetes societies announced the Taiwan Diabetes Declaration (TDD),³ which was sent to the IDF president at the United Nations Secretariat Building, New York City, USA. Several epidemiological surveys were performed in different areas of Taiwan between 1985 and 1996.^{4–12} The prevalence of DM varied according to sampling and inclusion criteria,¹³ and small sample sizes also limited the accuracy of the nationwide findings. In 2002, there was a nationwide survey for hyperglycemia, hypertension, and dyslipidemia (3 Highs) by the Bureau of Health Promotion that showed that the prevalence of DM was 8% in individuals older than 19 years of age.^{14,15} It is difficult to reproduce such a large survey at a regular intervals by using traditional field survey methods. We need to create a national representative survey that can be updated at short regular intervals.

Taiwan's National Health Insurance began in 1995 and covered 99.6% of Taiwan's residents by 2009. Such a high coverage rate made the NHI database the best national indicator of health issues and easier to update annually. An integrated program was started in 2010 to apply and analyze the data on various diseases included in this database, including the relevant incidence, prevalence, mortality rate, medications used, accountability, cost, complications, and comorbidities. On the basis of this detailed information,

outcomes and goals for diabetes care can be obtained for individuals in Taiwan.

Methods

Data source

A universal compulsory national health insurance (NHI) program was launched by the Taiwanese government in March 1995. It provided coverage for 96% of the total population of Taiwan (23 million) in 2000, 98% in 2005, and 99.6% in 2009. Extensive computerized administrative and claims data sets derived from this program have been maintained on an ongoing basis by the National Health Research Institute (NHRI) of Taiwan and are made available to investigators for research purposes after de-identifying individual health information.¹⁶ In this study, data sets from inpatient and outpatient claims from 2000 to 2009 were used. This study was approved by the institutional review board of National Taiwan University Hospital.

Case selection

We searched the Taiwan NHI database for the source population from 2000 to 2009 and identified any hospitalization with diabetes as one of the discharge or outpatient diagnostic codes (as per the *The International Classification of Diseases*, 9th Revision, Clinical Modification, ICD-9-CM code 250). The A code A181 was used before June 2000 for outpatients only. To protect personal privacy, NHRI only provided a random sampling of one-third of the patients identified as having a hospitalization or ambulatory visit for diabetes from 2000 to 2009. Patients were classified as diabetic and were included in our analysis if they had at least one admission code or three or more outpatient codes for diabetes within 365 calendar days.¹⁷ To avoid the inclusion of false-positive patients, we used the selection method used for diabetes for the data from each year.

Table 1 Diabetes population and prevalence rate in Taiwan from 2000 to 2009.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Residents (10 ⁴)	2228	2241	2252	2261	2269	2277	2288	2296	2304	2312
Residents in NHI (%)	96.1	96.6	97.1	97.3	97.6	98.0	98.3	99.3	99.5	99.6
Total DM (10 ⁴)	70.7	74.8	81.3	86.8	94.5	100.0	105.5	112.8	120.5	122.3*
Women (10 ⁴)	36.3	38.1	41.1	43.7	47.2	49.8	52.5	56.0	59.5	60.2*
Men (10 ⁴)	34.3	36.6	40.1	43.0	47.1	50.1	53.0	56.8	61.0	62.1*
Residents (10 ⁴) 20–79 y/o	1540	1565	1589	1610	1631	1649	1665	1681	1699	1715
Prevalence (%) 20–79 y/o	4.31	4.47	4.76	5.00	5.34	5.56	5.78	6.08	6.38	—
Standardized Prevalence (%)	3.15	3.24	3.42	3.55	3.74	3.84	3.92	4.07	4.22	—

* Underestimated due to incomplete follow-up in 2009.

Table 2 Diabetes prevalence rate by age and gender in Taiwan from 2000 to 2009.

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Women	0–19 years	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08%	0.08
	20–39 years	0.45	0.36	0.40	0.41	0.45	0.45	0.47	0.50	0.52	0.50
	40–59 years	4.63	4.65	4.81	4.91	5.13	5.24	5.35	5.55	5.70	5.47
	60–79 years	17.17	17.76	18.58	19.18	20.03	20.73	21.26	21.86	22.44	21.97
	≥80 years	14.72	15.49	16.62	17.58	19.32	20.32	20.97	22.39	23.63	23.97
	All Women	3.34	3.47	3.73	3.94	4.24	4.45	4.65	4.93	5.22	5.24
Men	0–19 years	0.06	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.07
	20–39 years	0.52	0.51	0.56	0.59	0.65	0.68	0.72	0.76	0.80	0.78
	40–59 years	4.97	5.21	5.60	5.89	6.36	6.64	6.90	7.27	7.64	7.56
	60–79 years	13.60	14.25	15.19	15.89	16.94	17.73	18.32	19.21	20.04	19.97
	≥80 years	11.66	12.32	13.27	14.19	15.18	16.19	16.92	18.25	19.67	20.07
	All Men	3.01	3.20	3.49	3.74	4.08	4.33	4.57	4.89	5.24	5.34

Data are expressed as (%).

* Underestimated due to incomplete follow-up in 2009.

Therefore, our analysis included only diabetic patients who had regular follow-up, rather than all diabetic patients.

Definition of type 1 diabetes

Type 1 diabetes is considered a catastrophic illness by the Taiwan NHI. Due to the fact that no co-payment is required for admission, emergency, or outpatient services, this certification is only applied when detailed and specific clinical data are met, e.g., a history of diabetic ketoacidosis, a positive glucagon test, and the presence of glutamic-acid-decarboxylase (GAD) antibodies. This system is a strict but reliable method for using a catastrophic illness certificate as the diagnostic criteria for type 1 diabetes. This data included all type 1 DM patients rather than only one-third.

Prevalence and incidence

For detailed analysis of the diabetic population in Taiwan, stratification by gender and age group (0–19, 20–39, 40–59, 60–79, and 80 years or older) was performed. For international comparison, age-standardization according to the 2000 World Health Organization population statistics (WHO 2000) was also shown. Because using the data of patients with incomplete follow-ups would result in misleading information and may underestimate the incidence and prevalence rates, these data were not shown in the 2009 data.

Results

Similar to the global trends in DM, the diabetic population in Taiwan also increased every year. As seen in Table 1, there was a nearly 80% increase in the total diabetic population, a 55% increase in the prevalence rate, and a 35% increase in the age-standardized prevalence rate in the analysis period.

Prevalence categorized by age group and gender is shown in Table 2. From 2000 to 2008, the increase in the prevalence rate was 33% for women under 19 years of age, 15% for women aged 20–39 years, 23% for women aged 40–59 years, 31% for women aged 60–79 years, and 61% for women aged 80 years and older. For men in the same age groups, the increases were 33%, 54%, 54%, 47%, and 69%, respectively. The overall increase in the prevalence from 2000 to 2008 was 56% for women and 74% for men.

Although a 25% increase in the overall diabetes incidence rate was observed (Table 3), the incidence rate for individuals aged 20–79 years, or the age-standardized incidence rate, was nearly constant from 2000–2009. Table 4 shows cases categorized according to age groups and gender. For children younger than age 19, the lowest diabetes incidence rate (about 20 new cases) was the same for both sexes. For the young and middle age groups (aged 20–59 years), there were more DM cases in men than in women. In the groups aged 60 years and older, more women than men had DM.

Before 2005, the diabetic population predominantly included women. However, men became predominant after

Table 3 Diabetes incidence rate in Taiwan from 2000 to 2009.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Residents (10 ⁴)	2228	2241	2252	2261	2269	2277	2288	2296	2304	2312
Total DM (10 ⁴)	70.7	74.8	81.3	86.8	94.5	100.0	105.5	112.8	120.5	122.3*
Incidence (%)	0.764	0.834	0.793	0.798	0.879	0.831	0.840	0.903	0.932	—
Incidence (%), 20–79	1.043	1.127	1.052	1.047	1.140	1.060	1.066	1.137	1.160	—
Standardized Incidence (%)	0.805	0.865	0.804	0.793	0.852	0.790	0.777	0.817	0.823	—

* Underestimated due to incomplete follow-up in 2009.

Table 4 Age and gender-specific incidence of new cases of diabetes in Taiwan from 2000 to 2009.

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Women	0–19 years	26	17	19	18	20	18	19	23	20	18
	20–39 years	241	157	166	154	177	160	168	173	179	149
	40–59 years	1242	1325	1181	1158	1236	1116	1122	1192	1193	970
	60–79 years	3430	3889	3480	3454	3633	3521	3424	3550	3554	2889
	≥80 years	3894	4302	4117	4113	4483	4407	4088	4289	4346	3897
	All Women	759	813	757	760	829	789	793	848	870	733
Men	0–19 years	27	17	18	16	23	23	22	22	21	20
	20–39 years	234	219	221	228	249	233	249	250	258	228
	40–59 years	1428	1593	1502	1492	1642	1497	1536	1643	1677	1449
	60–79 years	3119	3482	3280	3203	3506	3351	3224	3474	3522	3009
	≥80 years	3134	3357	3377	3407	3583	3559	3447	3646	3864	3417
	All Male	766	848	821	827	920	871	885	956	993	873

* Underestimated due to incomplete follow-up in 2009.

2005 (Table 1). The overall prevalence rate in men was higher than that in women after 2008. In the group younger than age 19 years, the incidence and prevalence rates were low for both genders. However, in the groups of age 20–39 and 40–59 years, the incidence and prevalence rates in men were 10% higher than those in women in 2000 and 40% higher in 2008 (Tables 2 and 4). In the 60–79 and 80 years or older age groups, the prevalence in women was still higher, whereas the incidence in men aged 60–79 was lower in 2000 but equal to that in age-matched women in 2008. Women aged over 80 years showed a higher incidence rate.

In Taiwan, a catastrophic illness certificate is issued under strict guidelines. The type 1 diabetic population accounted for less than 1% of the total diabetic population; this value may be an underestimate of the actual value but has remained constant (Table 5). The standardized incidence for type 1 DM seems to fluctuate around 3% but does not increase (Table 6).

Discussion

In this study, by using a more conservative method to avoid overestimation and the accumulation of false-positive cases, we reported the prevalence and incidence of diabetes in Taiwan from 2000 to 2009. Despite a steady increase in DM prevalence, the standardized incidence remained relatively stable for total DM and type 1 diabetes.

We also reported temporal changes in age- and gender-specific epidemiological features of DM in Taiwan over time. The increasing prevalence of DM might be due to better DM care and lower mortality in recent years.

The NHI was initiated in 1995. We discarded data before 2000 because of the following reasons: (1) NHI coverage increased to 96% in 2000 (Table 1); (2) a validation study was performed in 2000¹⁷; (3) for outpatients presenting before June 2000, both the ICD-9-CM and A codes were used (the A code is simpler, but not as accurate); and (4) the American Diabetes Association revised the DM diagnostic criteria in 1997 (fasting plasma glucose level, 126 mg/dL), and added hemoglobin A1c concentration as a criterion in 2009. Therefore, DM diagnostic criteria did not vary from 2000 to 2009 in Taiwan.

From 2000 to 2009, the age-standardized incidence of diabetes was constant and prevalence increased. However, the increment in men was higher than that in women. In our 1999–2004 study,¹⁸ we found the same phenomenon, especially in adults aged 20–39. In this study, the data for a longer period was available, and the overall incidence rate in men was higher than that in women from 2000 to 2009. There was only a small difference in 2000, but this difference increased and became increasingly larger over the years. Therefore, men accounted for the majority of the diabetic population since 2005, and the prevalence rate in men became higher since 2008. Why the incidence of diabetes increased at a higher rate in men than in women is

Table 5 Number of individuals with Type 1 diabetes in Taiwan from 2000 to 2009.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0–9 years	402	393	366	441	471	489	480	462	411	420
10–19 years	1233	1314	1446	1527	1581	1716	1824	1926	1992	1980
20–29 years	915	1143	1401	1614	1764	1935	2070	2151	2307	2439
30–39 years	714	771	849	1005	1053	1194	1269	1377	1518	1608
40–59 years	507	642	762	879	897	1020	1137	1191	1287	1449
≥60 years	168	186	195	207	144	126	132	129	138	147
Type 1 DM, total	3939	4449	5019	5673	5910	6480	6912	7236	7653	8043
Total DM (10 ⁴)	70.7	74.8	81.3	86.8	94.5	100.0	105.5	112.8	120.5	122.3*
T1DM/All DM (%)	0.56	0.59	0.62	0.65	0.63	0.65	0.66	0.64	0.64	0.66

* Underestimated due to incomplete follow-up in 2009.

Table 6 Incidence of type 1 DM in Taiwan from 2000 to 2009. Crude and standardized incidence (per 100,000) of type 1 diabetes were analyzed.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0–19 years	4.21	4.31	5.16	5.29	4.48	5.68	5.39	4.28	5.04	5.79
20–39 years	2.93	2.69	3.78	3.60	3.03	3.90	3.10	2.55	11.02	14.18
40–59 years	1.59	1.41	1.61	1.37	1.18	1.58	1.03	0.47	0.94	0.90
60–79 years	2.04	1.52	1.01	0.82	0.97	0.79	0.33	0.22	0.22	0.48
≥80 years	0.66	0.92	1.13	0.80	0.00	0.46	0.00	0.00	0.00	0.00
Crude incidence	2.79	2.63	3.22	3.09	2.60	3.27	2.70	2.05	2.32	2.64
Standardized Incidence	2.87	2.75	3.36	3.28	2.78	3.56	3.03	2.36	2.70	3.13

Data are expressed as (10^{-5}) .

a topic of interest. Although hepatitis C infection was related to metabolic syndrome in Taiwan, the diabetic incidence attributable to hepatitis C remained unclear.¹⁹

There have been several criteria proposed for type 1 diabetes. In our previous study, we excluded cases of potential type 1 DM ($n = 41,291$).¹⁸ Diabetic ketoacidosis is considered a clinical sign for children but is seldom applied to adults. Some type 2 or other specific types of DM may also present with ketoacidosis. Insulin injection was a common cause of β -cell exhaustion, and the length of the "honeymoon period" depended on the progression of β -cell destruction. These criteria were incomplete in the claims database. All relevant clinical data should be provided in order to apply for a catastrophic illness certificate, including type 1 DM. This is a stricter but more reliable way to define type 1 DM. Underestimation of values could be expected. Unlike most European countries that show a 3–4% increase in the type 1 diabetes incidence rate every year,²⁰ Taiwan showed a consistent incidence rate, partly influenced by the strict criteria policy for issuing catastrophic illness certificates.

The body mass index equivalent was 25 for Chinese and 30 for Caucasian individuals.²¹ In Taiwan, diabetes risk scores were developed,^{22,23} and free health check-ups for adults older than 40 years of age were started in 1995; early detection was found to be of great assistance.²⁴ A diagnostic protocol was also proposed using fasting plasma glucose and hemoglobin A1c levels as criteria.²⁵ Then a pay-for-performance reimbursement program that was based on the quality of diabetes care, rather than the traditional payment system based on the quantity of cases, was started in 2001.^{26,27} All these programs, such as screening, diagnosis, treatment, and screening for complications can detect DM at an earlier stage and improve diabetes outcomes when performed by a team of certified diabetes educators in Taiwan.

There are some study limitations. In contrast to our previous study, which used cumulative DM data, the patient was considered diabetic forever once he or she was diagnosed,¹⁸ in this study we chose a more conservative method to avoid overestimation and the accumulation of false positive cases over the observed 10 years. We analyzed only diabetic cases with regular NHI follow-up, rather than including all diabetic cases. Therefore, the prevalence was underestimated while the incidence was overestimated.

In conclusion, the present analyses reported the temporal changes in diabetes prevalence and incidence in

Taiwan during 2000–2009. The overall increase of prevalence of DM in Taiwan is not due to an increase in incidence, suggesting a possibility of better diabetes care and a resulting decrease in mortality rates of individuals with diabetes.

Acknowledgments

The authors thank Ms. Kang-Ning Hsu for her excellent help in data management. This work was supported by the Diabetes Association of the R.O.C.; the Collaboration Center of Health Information Application, Department of Health, Executive Yuan, Taiwan; and National Health Research Institute, Taiwan.

References

1. International Diabetes Federation. *Diabetes Atlas*. Brussels. Available at: <http://archive.diabetesatlas.org/content/previous-editions-idf-diabetes-atlas> [accessed 07.12].
2. United Nations. *United Nations 61/225 resolution on diabetes*. Available at: <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N06/507/87/PDF/N0650787.pdf?OpenElement>; Dec 2006 [accessed 07.12].
3. *The Taiwan declaration on diabetes*. Available at: http://www.diabetes.org.tw/wddte_wdd4.jsp; 2007 [accessed 07.12].
4. Tai TY, Yang CL, Chang CJ, Chang SM, Chen YH, Lin BJ, et al. Epidemiology of diabetes mellitus among adults in Taiwan, R.O.C. *J Med Assoc Thailand* 1987;**70**(Suppl. 2):42–8.
5. Chou P, Chen HH, Hsiao KJ. Community-based epidemiological study on diabetes in Pu-Li, Taiwan. *Diabetes Care* 1992;**15**: 81–9.
6. Lin JD, Shieh WB, Huang MJ, Huang HS. Diabetes mellitus and hypertension based on the family history and 2-h postprandial blood sugar in the Ann-Lo district (Northern Taiwan). *Diabetes Res Clin Pract* 1993;**20**:5–85.
7. Chou P, Li CL, Kuo HS, Hsiao KJ, Tsai ST. Comparison of the prevalence in two diabetes surveys in Pu-Li, Taiwan, 1987–1988 and 1991–1992. *Diabetes Res Clin Pract* 1997;**38**: 61–7.
8. Li CL, Tsai ST, Chou P. Comparison of the results between two diagnostic criteria by ADA and WHO among individuals with FPG 5.6–7.8 mmol/l in Kin-Hu and Kin-Chen, Kinmen, 1991–94. *Diabetes Res Clin Pract* 1999;**45**:51–9.
9. Wang SL, Pan WH, Hwu CM, Ho LT, Lo CH, Lin SL, et al. Incidence of NIDDM and the effects of gender, obesity and hyperinsulinaemia in Taiwan. *Diabetologia* 1997;**40**:1431–8.

10. Chen HD, Shaw CK, Tseng WP, Chen HI, Lee ML. Prevalence of diabetes mellitus and impaired glucose tolerance in Aborigines and Chinese in eastern Taiwan. *Diabetes Res Clin Pract* 1997; **38**:199–205.
11. Chen KT, Chen CJ, Gregg EW, Williamson DF, Narayan KMV. High prevalence of impaired fasting glucose and type 2 diabetes mellitus in Penghu Islets, Taiwan: evidence of a rapidly emerging epidemic? *Diabetes Res Clin Pract* 1999; **44**:59–69.
12. Lu FH, Yang YC, Wu JS, Wu CH, Chang CJ. A population-based study of the prevalence and associated factors of diabetes mellitus in southern Taiwan. *Diabetes Med* 1998; **15**:564–72.
13. Chou P, Li CL, Tsai ST. Epidemiology of type 2 diabetes in Taiwan. *Diabetes Res Clin Pract* 2001; **54**(Suppl. 1):S29–35.
14. Tseng CH, Chong CK, Chan TT, Bai CH, You SL, Chiou HY, et al. Optimal anthropometric factor cutoffs for hyperglycemia, hypertension and dyslipidemia for the Taiwanese population. *Atherosclerosis* 2010; **210**:585–9.
15. Bureau of Health Promotion. Survey for hyperglycemia, dyslipidemia and hypertension in Taiwan. Available at: <http://www.bhp.doh.gov.tw/health91/study-2.htm> [accessed 07.12].
16. Wen CP, Tsai SP, Chung WSI. A 10-year experience with universal health insurance in Taiwan: measuring changes in health and health disparity. *Ann Intern Med* 2008; **148**:258–67.
17. Lin CC, Lai MS, Syu CY, Chang SC, Tseng FY. Accuracy of diabetes diagnosis in health insurance claims data in Taiwan. *J Formos Med Assoc* 2005; **104**:157–63.
18. Chang CH, Shau WY, Jiang YD, Li HY, Chang TJ, Sheu WH, et al. Type 2 diabetes prevalence and incidence among adults in Taiwan during 1999–2004: a national health insurance data set study. *Diabetes Med* 2010; **27**:636–43.
19. Hsu CS, Kao JH. Hepatitis C infection and metabolic syndrome. *J Formos Med Assoc* 2010; **109**:403–7.
20. Patterson CC, Gyürüs E, Rosenbauer J, Cinek O, Neu A, Schober E, et al. Trends in childhood type 1 diabetes incidence in Europe during 1989–2008: evidence of non-uniformity over time in rates of increase. *Diabetologia* 2012; **55**:2142–7.
21. Chiu M, Austin PC, Manuel DG, Tu JV. Deriving ethnic-specific BMI cutoff points for assessing diabetes risk. *Diabetes Care* 2011; **34**:1741–8.
22. Lin JW, Chang YC, Li HY, Chien YF, Wu MY, Tsai RY, et al. Cross-sectional validation of diabetes risk scores for predicting diabetes, metabolic syndrome, and chronic kidney disease in Taiwanese. *Diabetes Care* 2009; **32**:2294–6.
23. Li HY, Chang YC, Wei JN, Chuang LM. Validation of diabetes risk scores for predicting diabetes diagnosed by oral glucose tolerance test. *Diabetes Care* 2010; **33**:e26.
24. Jiang YD, Shiu RS, Chuang LM, Lin BJ. Is the development of a diabetes care system important for quality care? An analysis in Taiwan. *J Diabetes Invest* 2011; **2**:79–80.
25. Li HY, Ma WY, Wei JN, Lin MS, Shih SR, Huang CS, et al. Hemoglobin A1c for the diagnosis of diabetes: to replace or to guide oral glucose tolerance tests? *J Diabetes Invest* 2012; **3**:259–65.
26. Lee TT, Cheng SH, Chen CC, Lai MS. A pay-for-performance program for diabetes care in Taiwan: a preliminary assessment. *Am J Manag Care* 2010; **16**:65–9.
27. Chen PC, Lee YC, Kuo RN. Differences in patient reports on the quality of care in a diabetes pay-for-performance program between 1 year enrolled and newly enrolled patients. *Int J Qual Health Care* 2012; **24**:189–96.