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The cost of diabetes in adults in Australia

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ABSTRACT

Aims: To assess and compare costs associated with diabetes and lesser degrees of glucose intolerance in Australia.

Methods: The Australian Diabetes, Obesity and Lifestyle study collected data on the use of health services and health related expenditure in 2004–2005. Complications data were collected through physical examination and biochemical tests or questionnaire. Data were available on 6101 participants. Age- and sex-adjusted direct healthcare costs, direct non-healthcare costs and government subsidies were estimated according to glucose tolerance status.

Results: Annual direct per person costs were A$1898 for those with normal glucose tolerance to A$4390 for those with known diabetes. Costs were substantially higher in people with diabetes and both micro- and macrovascular complications. The total annual cost of diabetes in 2005 for Australians aged ≥30 years was A$10.6 billion (A$4.4 billion in direct costs; A$6.2 billion in government subsidies) which equates to A$14.6 billion in 2010 dollars. Total annual excess cost associated with diabetes in 2005 was A$4.5 billion (A$2.2 billion in direct costs; A$2.3 billion in government subsidies).

Conclusion: The excess cost of diabetes to individuals and government is substantial and is greater in those with complications. Costs could potentially be reduced by preventing the development of diabetes or its complications.

1. Introduction

The global diabetes epidemic shows no signs of slowing [1]. Reliable costing data are required to assist policy makers in making informed decisions about future health policy and budgets. The International Diabetes Federation previously estimated total healthcare expenditures due to diabetes in 2010 for countries with appropriate health expenditure data [2]. Although their estimates were comparable to those reported by some countries, the estimates do not reflect the total healthcare cost of people with diabetes since they did not include expenditures not associated with diabetes.

In Australia, approximately 1.0 million people aged ≥25 years had diabetes in 2000 and this is projected to reach 2.0–2.9 million by 2025 [3]. Previous economic impact studies such as that undertaken by the Australian Institute of Health and Welfare [4] applied a 'top down' approach where the cost of a disease such as diabetes is obtained by apportioning known total healthcare costs according to the attributable fraction of the disease. This approach, however, may not reflect the total cost incurred by people with the disease since costs not

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directly associated with the disease are not considered in the estimation. A method which takes into account all healthcare expenses borne by an individual with a disease is the 'bottom up' approach where cost data from individuals are collected and extrapolated to the cost to society. The DiabCo$t study applied the 'bottom up' approach but relied on self-reported co-morbidity data and did not include a non-diabetic comparison group [5].

The Australian Diabetes, Obesity and Lifestyle study (AusDiab) is the largest Australian population-based study on diabetes and its complications [6]. The initial AusDiab survey was conducted in 1999–2000 with individual data on the use of health services and health related expenditure collected in a 5 year follow-up of the baseline cohort in 2004–2005. These data provided an opportunity to compare costs in people with and without diabetes and lesser forms of glucose intolerance in Australia. The aim of this study was to use data collected in the AusDiab follow-up study to perform a comparative costing analysis in people with different glucose tolerance status using the more robust 'bottom up' approach.

2. Subjects, materials and methods

2.1. Study participants

In 1999–2000, 11247 adults aged ≥25 years participated in the AusDiab baseline study. In 2004–2005, 6400 of those participants attended the 5-year follow-up survey. Details of the study have been published elsewhere [6,7]. The current study included participants with glucose tolerance status data and cost data collected in 2004–2005. Glucose tolerance was classified according to the World Health Organization diagnostic criteria [8]. Known diabetes included participants who answered yes to the following question: ''have you ever been told by a doctor or nurse that you have diabetes?'' as well as either taking glucose-lowering medication or having fasting blood glucose or 2-h post load glucose within the diagnostic range for diabetes. Newly diagnosed diabetes included those who reported that they had never been told they have diabetes by a doctor or nurse but had fasting or 2-h blood glucose measurements within the diabetes diagnostic range.

AusDiab was approved by the International Diabetes Institute Ethics Committee and the Standing Committee on Ethics in Research Involving Humans, Monash University. Written informed consent was obtained from all participants.

2.2. Costing data

Costing data were available for direct healthcare and non-healthcare costs and government subsidies. Items included for cost calculation are summarized in Table 1. Costing data for medical services and diagnostics were obtained from the Medicare Benefits Schedule (www.mbsonline.gov.au) and Australian Medical Association fees (ama.com.au). Costs of medications were obtained from the Pharmaceutical Benefits Scheme (www.pbs.gov.au) and the Monthly Index of Medical Specialities Annual (www.mims.com.au). Costs in relation to diabetes consumables, hospitals, and pensions and allowances were obtained from the National Diabetes Services Scheme (www.ndss.com.au), National Hospital Cost Data Collection (www.health.gov.au/internet/main/publishing.nsf/Content/health-casemix-data-collections-about_NHCDC) and Centrelink (www.centrelink.gov.au), respectively.

Table 1 – Summary of items included for cost calculation.

Costs	Items included
Direct healthcare	• Ambulatory service (visits to general practitioners, medical specialists and/or health care professionals, hospital emergency admission) • Hospitalization • Prescription medication (other than those in the form of cream, eye drop, and inhaler) including insulin • Aspirin (The only non-prescription medication included) • Medically related consumables (Self blood glucose measuring meters and strips)
Direct non-healthcare	• Transport to hospital • Supported accommodation (nursing home, hostel (low care facility), independent units) • Home service (home help/support, Meals on Wheels) and day center • Purchase of special food
Government subsidies	• Age pension • Disability pension • Veteran pension • Mobility allowance • Sickness allowance • Unemployment benefit

In general, questions in the survey on the use of health services and health related expenditure were for the previous 12 months. The annual cost of a blood glucose meter was the average cost of a meter divided by 3 as a meter was assumed to be renewed every 3 years. For glucose meter test strips, the average number of test strips used per week reported by participants was multiplied by 52 to obtain an annual cost. Participants self-reported medication use but were encouraged to provide either a list from their general practitioner or to bring their medications to the examination. Each medication, taking into account tablet strength and daily dosage, was converted to the cost for 12 months. For antibiotics and medications used on an as required basis, the cost of a single packet of medications was used. When the strength of a medication was not provided, the cost of the lowest available strength was used. Similarly, when the number of tablets per day was omitted, the lowest dose was assumed.

2.3. Statistical analysis

The 'bottom up' approach was used in this study. The annual costs per person for direct healthcare, direct non-healthcare and government subsidies are reported by glucose tolerance status in 2004–2005. Costs were estimated using generalized linear models including terms for age and sex.

For those with diabetes, the annual costs per person are also reported by microvascular (i.e. retinopathy, nephropathy, neuropathy and foot ulcers) and macrovascular (i.e. heart attack, stroke and amputation) status. Complications data were collected through physical examination and biochemical

tests with the exception of heart attack and stroke which were collected by questionnaire. Retinopathy was classified using a simplified version of the Wisconsin grading system. Nephropathy was defined as estimated glomerular filtration rate < 60 ml/min/1.73 m^2 and/or urine albumin:creatinine ratio ≥2.5 mg/mmol in men or ≥3.5 mg/mmol in women. Neuropathy was classified according to the neuropathy symptom score, neuropathy disability score, pressure perception test, and systolic blood pressure.

The direct cost of diabetes in Australia in 2005 in people aged ≥30 years was calculated by multiplying the prevalence of diabetes [3] and the number of people aged ≥30 years in 2005 by the annual cost per person. To estimate the cost in Australia in 2010, the prevalence of diabetes and the number of people aged ≥30 years in 2010 were multiplied by the per person costs in 2005 after inflating to 2010 dollars using the change in consumer price index (CPI) from 2005 to 2010. The change in CPI was calculated as 100 × [(average CPI points in 2010) − (average CPI points in 2005)]/(average CPI points in 2005). Data on CPI and number of adults in the Australian population were obtained from the Australian Bureau of Statistics (www.abs.gov.au). All statistical analyses were performed using SAS 9.2 for Windows (SAS Institute, Inc., Cary, NC, USA).

3. Results

3.1. Characteristics of participants

A total of 6101 participants [54.0% females; mean (SD) age = 56.6 (12.7) years; mean BMI = 27.7 (5.1) kg/m^2] were included in the analysis. According to glucose tolerance status in 2004–2005, 6.0% had known diabetes, 3.1% had newly diagnosed diabetes, 9.1% had impaired glucose tolerance (IGT), 4.8% had impaired fasting glucose (IFG) and 77.0% had normal glucose tolerance (NGT). Compared with the entire cohort, those with diabetes were older [mean age = 63.9 (11.4) years], more overweight [mean BMI = 30.7 (6.1) kg/m^2], less likely to be female (45.5%) and more likely to be hypertensive (68.4%). When divided by complication groups, 55% of people with diabetes had no complications, 28% had microvascular complications only, 7% had macrovascular complications only, and 9% had both. Within those with microvascular complications, 70% had one complication, 27% had two complications, 3% had three complications and none had all four complications. For those with macrovascular complications, 88% had one complication, 11% had two complications, and 1% had all three complications. The proportion of individual complications for people with diabetes were 26% for nephropathy, 13% for neuropathy, 12% for heart attack, 10% for retinopathy, 7% for stroke, 0.5% for amputation and 0.2% for foot ulcers.

Baseline characteristics of participants who did not return for follow-up were similar to those who returned for follow-up (mean age 51.5 years vs. 51.6 years; female 56% vs. 54%; hypertension 33% vs. 31%; mean BMI 27.1 kg/m^2 vs. 26.9 kg/m^2). However, those with diabetes at baseline were less likely to return for follow-up (10% vs. 7%).

3.2. Direct healthcare and non healthcare costs

The annual direct age- and sex-adjusted healthcare costs were A$1446 per person for those with NGT to A$3005 per person for those with known diabetes (Table 2). The overall breakdown of contribution to direct healthcare costs was 34.9% for hospitalization, 31.8% for medication, 28.1% for ambulatory service, and 5.2% for consumables. The mean numbers of visits to hospital emergency and overnight hospital stays were similar for those with and without diabetes. However, the proportion requiring these services was greater in those with diabetes (10% vs. 8% for hospital emergency, 9% vs. 5% for overnight stay in public hospital, 10% vs. 7% for overnight stay in private hospital). People with diabetes also had more frequent visits to general practitioners than those without diabetes (mean visits over three months = 2.1 times for those with diabetes vs. 1.3 times for those without diabetes). For people with diabetes, the direct healthcare cost in those with both micro- and macrovascular complications was 2.5 times that of those without complications ($p < 0.01$; Table 2). The cost in those with macrovascular complications only was 1.9 times that of those with microvascular complications only ($p < 0.01$).

The annual direct age- and sex-adjusted non-healthcare costs were A$452 per person for those with NGT to A$1385 per person for those with known diabetes (Table 2). The overall

Table 2 – Age- and sex-adjusted annual cost per person (A$) and 95% confidence intervals by glucose tolerance status and by complication for those with diabetes in 2004/2005.

	n	Direct healthcare cost	Direct non-healthcare cost	Total direct cost	Government subsidies
NGT	4696	1446 (1343–1550)	452 (347–558)	1899 (1741–2056)	3361 (3218–3504)
IFG	294	1296 (884–1707)	262 (-157–681)	1558 (931–2184)	3420 (2851–3990)
IGT	553	1991 (1689–2294)	595 (286–903)	2586 (2125–3047)	3966 (3548–4385)
New diabetes	191	2081 (1570–2591)	618 (98–1138)	2699 (1921–3477)	4648 (3941–5355)
Known diabetes	367	3005 (2632–3377)	1385 (1006–1765)	4390 (3823–4957)	5764 (5249–6280)
By complication for those with diabetes					
No complications	308	2357 (1850–2863)	1133 (455–1811)	3490 (2615–4365)	7045 (6308–7782)
Microvascular only	158	3051 (2356–3745)	1716 (786–2646)	4766 (3566–5966)	7391 (6380–8401)
Macrovascular only	41	5826 (4469–7183)	638 (-1179–2455)	6464 (4119–8809)	7250 (5275–9224)
Both	51	5935 (4692–7178)	3693 (2029–5358)	9628 (7480–11777)	9327 (7518–11136)

NGT, normal glucose tolerance; IFG, impaired fasting glucose; IGT, impaired glucose tolerance.

breakdown of direct non-healthcare costs was 48.7% for supported accommodation, 35.4% for home service and day center, 13.9% for transport, and 1.9% for purchase of special food. The proportion of participants requiring non-healthcare services was greater in the diabetes group compared to the group without diabetes (12% vs. 9% for emergency ambulance, 7% vs. 2% for home help, and 1.3% vs. 0.3% for Meals on Wheels). For people with diabetes and both micro- and macrovascular complications, the cost was 3.3 times that of those without complications ($p < 0.01$; Table 2).

3.3. *Government subsidies*

The annual age- and sex-adjusted payment for government subsidies were A$3361 per person for those with NGT to A$5764 per person for those with known diabetes (Table 2). The proportion of participants receiving government subsidies was greater in the diabetes group (9% vs. 4% for disability pension, 41% vs. 18% for age pension, 7% vs. 3% for veteran pension), For those with diabetes and both micro- and macrovascular complications, government subsidies was 1.3 times that of those without complications ($p = 0.02$; Table 2).

3.4. *Cost comparison between people with diabetes and NGT*

The per person age- and sex-adjusted costs for diabetes (known and newly diagnosed) were A$3806 (A$3345–A$4268) for total direct cost and A$5379 (A$4959–A$5798) for government subsides. The respective costs for NGT were A$1900 (A$1742–A$2057) and A$3362 (A$3219–A$3505). Hence the excess total direct cost for diabetes was A$1906 per person and the excess spending on government subsidies for diabetes was A$2017 per person. The mean annual cost of prescription medication was higher in those with diabetes (A$1063 vs. A$406 per person, $p < 0.01$), which included higher costs for cardiovascular and anxiety medications (cardiovascular medication A$543 vs. A$181 per person, $p < 0.01$; anxiety medication A$80 vs. A$30 per person, $p < 0.01$).

3.5. *National cost of diabetes in Australia*

In 2005, 12.1 million adults were aged ≥30 years in Australia. Of these, 9.4% or 1.1 million were estimated to have diabetes [3]. The total costs associated with diabetes in those aged ≥30 years were A$10.6 billion (A$9.8–A$11.3 billion)–A$3.1 billion (A$2.7-A$3.4 billion) from direct healthcare, A$1.3 billion (A$0.9–A$1.6 billion) from direct non-healthcare and A$6.2 billion (A$5.7–A$6.6 billion) from government subsidies. The total annual excess cost associated with diabetes was A$4.5 billion (A$2.2 billion from direct costs and A$2.3 billion from government subsidies).

There were 13.2 million adults aged ≥30 years in 2010 and 10.4% were estimated to have diabetes [3]. The average CPI in 2005 and 2010 were 149.1 and 172.6 points, respectively. The change in CPI over this period was 15.8%. Therefore, the total estimated cost in 2010 was A$14.6 billion (A$4.3 billion for direct healthcare, A$1.8 billion for direct non-healthcare, and A$8.5 billion for government subsidies).

4. Discussion

The annual direct cost of diabetes in 2005 for the Australian population aged ≥30 years was A$4.4 billion and a further A$6.2 billion was spent on government subsidies making a total of A$10.6 billion. In 2010 dollars, this equates to A$14.6 billion.

The estimated costs increased as glucose intolerance progressed from NGT to IGT and diabetes, except for IFG where the costs were not significantly different to NGT. The reason for the lack of difference in health related expenditure between people with NGT and IFG is unclear but may be related to the small number of people with IFG.

Compared with the estimates by the DiabCo$t study in 2001 [5], the current study costs were similar for direct non-healthcare and government subsidies but substantially lower for direct healthcare. The lower direct healthcare cost per person reported here may be related to the exclusion of non-prescription medication, smaller proportion of smokers in the AusDiab known diabetes group, or that DiabCo$t reported costs unadjusted for age or sex. Adjusting direct healthcare cost for those with known diabetes reduced costs (A$3514 per person unadjusted vs. A$3005 adjusted). Previous studies have reported higher costs for direct healthcare, hospitalization and medication in older people with diabetes [5,9,10]. The Fremantle Diabetes Study, which also used a 'bottom up' approach [11], reported annual direct healthcare costs of A$954 million for people aged ≥25 years with diabetes in 2000. This is considerably lower than the cost reported here even after adjusting for inflation and the number of people with diabetes in 2005. This difference can partly be accounted for by the exclusion of hospital admission for non diabetes-related conditions and emergency services in the Fremantle cost calculation.

The excess cost associated with diabetes was 100% for total direct cost (86% for direct healthcare and 147% for direct non-healthcare). These excess direct healthcare costs are higher than the 38% reported for Australian data collected between 1995 and 1999 [12] but similar to the 91% reported in Germany [13]. The main contributions to these excess costs were a larger proportion requiring hospital emergency admission and overnight hospital stays, and more frequent visits to general practitioners in people with diabetes. These are in agreement with previous reports [12,14]. The use of non-healthcare services such as home help/support also contributed to the excess cost. The mean annual cost of prescription medication was also higher in people with diabetes. This is due to their use of diabetes medication and higher prescription rate for cardiovascular and anxiety medications. An Australian study reported that 75% of the cost of prescription medication in people with diabetes was from medications other than those for lowering blood glucose [15]. At study baseline, the proportion of participants with diabetes who used blood pressure and lipid lowering medications was 48% and 13%, respectively, which increased to 56% and 36%, respectively, after 4 years [15]. An Italian study reported that cardiovascular medication accounted for 46% of the total drug cost in the diabetic population compared with 33% in the non-diabetic population after excluding glucose lowering medications [10].

Our results are comparable but higher at 57% and 48%, respectively. In relation to the higher prescription rate for anxiety medications, depression has been reported to be more prevalent in people with diabetes [16]. A Dutch study estimated the outpatient costs for people with diabetes were substantially higher in the depressed compared with the non-depressed group [17].

The excess cost associated with diabetes is not limited to expenses borne by individuals and governments but also the cost from loss in productivity due to increased sick leave, early retirement and premature death as a result of diabetes, or caring for those with the disease. AusDiab did not collect data regarding carers or relevant employment information on all participants. However of those with known diabetes prior to the 2004–2005 survey (mean age 65 years), only 29% were employed and 26% of those took an average of 4.4 days out of 3 months off work due to illness (3.8 days for those aged < 65 years and 6.6 days for those aged ≥ 65 years). For those who were not employed, 14% were retired or currently not working as a result of the disease.

The cost associated with diabetes differs according to the presence of associated complications. Total direct costs were 1.8 times in those with macrovascular complications only ($p = 0.02$) compared with those without complications and 2.8 times higher in those with both micro- and macrovascular complications ($p < 0.01$). These higher costs reflected more frequent use of medical services including visits to general practitioner, emergency hospital admission and overnight hospital stays compared with those who had diabetes without complications. This is consistent with the findings of another Australian study which reported the cost of complications of diabetes [18].

The major strength of the present study was the use of the more robust 'bottom up' analytical approach. The inclusion of non-diabetic participants allowed a cost comparison between people with varying glucose tolerance status. Moreover, micro- and macrovascular complications were determined by actual examination rather than from self-report. However, limited data were collected on indirect costs and costs for non-prescription medication and admission to day clinics were not assessed. Only 54% of the AusDiab baseline cohort was included in this study, however those who did and did not return for follow-up varied little in age, body weight or hypertension status. Those who had diabetes were less likely to return for follow-up but no difference in self-report diabetes was observed between the 6400 who attended the follow-up survey and the 2261 who only answered a phone questionnaire about diabetes status [19]. A point to consider when interpreting the costs for known and newly diagnosed diabetes is the fact that all participants were screened 5 years earlier. Hence, this sample is skewed toward more people being diagnosed with diabetes. As a result, people with known diabetes in this sample, on average, will have shorter duration of diabetes than in a true population sample.

Diabetes is a costly condition at both individual and societal levels. If the increase in the number of adults with diabetes in Australia continues and reaches the predicted 2.0–2.9 million by 2025, the financial strain on the health system will be even greater. Clear evidence exists that diabetes can be prevented and complications reduced with some studies proving to be cost-effective [20,21]. Both strategies would be required to produce financial benefits since this study has demonstrated that the direct healthcare and non-healthcare costs are lower in those with less severe forms of hyperglycemia. For those with diabetes, costs are substantially lower in people without micro- and/or macrovascular complications.

Conflict of interest

The authors declare that they have no conflict of interest.

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REFERENCES

[1] Whiting DR, Guariguata L, Weil C, Shaw J. IDF diabetes atlas: global estimates of the prevalence of diabetes for 2011 and 2030. Diabetes Res Clin Pract 2011;94:311–21.
[2] Zhang P, Zhang X, Brown J, Vistisen D, Sicree R, Shaw J, et al. Global healthcare expenditure on diabetes for 2010 and 2030. Diabetes Res Clin Pract 2010;87:293–301.
[3] Magliano DJ, Shaw JE, Shortreed SM, Nusselder WJ, Liew D, Barr EL, et al. Lifetime risk and projected population prevalence of diabetes. Diabetologia 2008;51:2179–86.
[4] Mathers C, Penm R. Health system costs of cardiovascular diseases and diabetes in Australia 1993–94. AIHW cat. No. HWE 11. Canberra: Australian Institute of Health and Welfare (Health and Welfare Expenditure Series no. 5); 1999.

[5] Colagiuri S, Colagiuri R, Conway B, Grainage D, Davey P. DiabCo$t Australia: assessing the burden of type 2 diabetes in Australia. Canberra: Diabetes Australia; 2003.
[6] Barr EL, Magliano DJ, Zimmet PZ, Polkinghorne KR, Atkins RC, Dunstan DW, et al. The Australian Diabetes, Obesity and Lifestyle Study. Tracking the accelerating epidemic: its causes and outcomes. Melbourne: International Diabetes Institute; 2006.
[7] Magliano DJ, Barr EL, Zimmet PZ, Cameron AJ, Dunstan DW, Colagiuri S, et al. Glucose indices, health behaviors, and incidence of diabetes in Australia: the Australian Diabetes, Obesity and Lifestyle Study. Diabetes Care 2008;31: 267–72.
[8] World Health Organization. Definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia: report of a WHO/IDF consultation. Geneva: World Health Organization; 2006.
[9] Olveira-Fuster G, Olvera-Marquez P, Carral-Sanlaureano F, Gonzalez-Romero S, Aquilar-Diosdado M, Soriquer-Escofet F. Excess hospitalizations, hospital days, and inpatient costs among people with diabetes in Andalusia, Spain. Diabetes Care 2004;27:1904–9.
[10] Bruno G, Karaghiosoff L, Merletti F, Costa G, De Maria M, Panero F, et al. The impact of diabetes on prescription drug costs: the population-based Turin study. Diabetologia 2008;51:795–801.
[11] Davis WA, Knuiman MW, Hendrie D, Davis TME. The obesity-driven rising costs of type 2 diabetes in Australia: projections from the Fremantle Diabetes Study. Intern Med J 2006;36:155–61.
[12] Clarke P, Kelman C, Colagiuri S. Factors influencing the cost of hospital care for people with diabetes in Australia. J Diabetes Complications 2006;20:349–55.
[13] Koster I, von Ferber L, Ihle P, Schubert I, Hauner H. The cost burden of diabetes mellitus: the evidence from Germany – the CoDiM study. Diabetologia 2006;49:1498–504.
[14] American Diabetes Association. Economic costs of diabetes in the U.S. in 2007. Diabetes Care 2008;31:596–615.
[15] Davis WA, Knuiman MW, Hendrie D, Davis TME. Determinants of diabetes-attributable non-blood glucose-lowering medication costs in type 2 diabetes. The Fremantle Diabetes Study. Diabetes Care 2005;28:329–36.
[16] Ali S, Stone MA, Peters JL, Davies MJ, Khunti K. The prevalence of co-morbid depression in adults with type 2 diabetes: a systematic review and meta-analysis. Diabet Med 2006;23:1165–73.
[17] Bosmans JE, Adriaanse MC. Outpatient costs in pharmaceutically treated diabetes patients with and without a diagnosis of depression in a Dutch primary care setting. BMC Health Serv Res 2012;12:46.
[18] Clarke P, Leal J, Kelman C, Smith M, Colagiuri S. Estimating the cost of complications of diabetes in Australia using administrative health-care data. Value Health 2008;11: 199–206.
[19] Magliano DJ, Barr EL, Zimmet PZ, Cameron AJ, Dunstan DW, Colagiuri S, et al. Glucose indices, health behaviors, and incidence of diabetes in Australia. The Australian Diabetes, Obesity and Lifestyle Study. Diabetes Care 2008;31:267–72.
[20] Palmer AJ, Valentine WJ, Ray JA. Cost-effectiveness studies of diabetes prevention in high-risk patients. Expert Rev Pharmacoecon Outcomes Res 2004;4:393–402.
[21] Gilmer TP, Roze S, Valentine WJ, Emy-Albrecht K, Ray JA, Cobden D, et al. Cost-effectiveness of diabetes case management for low-income populations. Health Serv Res 2007;42:1943–59.