Increasing Expenditure on Health Care Incurred by Diabetic Subjects in a Developing Country

A study from India

AMBADY RAMACHANDRAN, MD, PHD[1]
SHOBHANA RAMACHANDRAN, PHD[1]
CHAMUKUTTAN SNEHALATHA, DSC[1]
CHRISTINA AUGUSTINE, PHD[1]
NARAYANASAMY MURUGESAN, PHD[1]
VIJAY VISWANATHAN, MD, PHD[1]
ANIL KAPUR, MD[1]
RHYS WILLIAMS, MD, PHD[2]

OBJECTIVE — This study aimed to assess the direct cost incurred by diabetic subjects who were in different income groups in urban and rural India, as well as to examine the changing trends of costs in the urban setting from 1998 to 2005.

RESEARCH DESIGN AND METHODS — A total of 556 diabetic subjects from various urban and rural regions of seven Indian states were enrolled. A brief uniform coded questionnaire (24 items) on direct cost was used.

RESULTS — Annual family income was higher in urban subjects (rupees [Rs] 100,000 or $2,273) than in the rural subjects (Rs 36,000 or $818) ($P < 0.001$). Total median expenditure on health care was Rs 10,000 ($227) in urban and Rs 6,260 ($142) in rural ($P < 0.001$) subjects. Treatment costs increased with duration of diabetes, presence of complications, hospitalization, surgery, insulin therapy, and urban setting. Lower-income groups spent a higher proportion of their income on diabetes care (urban poor 34% and rural poor 27%). After accounting for inflation, a secular increase of 113% was observed in the total expenses between 1998 and 2005 in the urban population. The highest increase in percentage of household income devoted to diabetes care was in the lowest economic group (34% of income in 1998 vs. 24.5% in 2005) ($P < 0.01$). There was a significant improvement in urban subjects in medical reimbursement from 2% (1998) to 21.3% (2005).

CONCLUSIONS — Urban and rural diabetic subjects spend a large percentage of income on diabetes management. The economic burden on urban families in developing countries is rising, and the total direct cost has doubled from 1998 to 2005.

Diabetes Care 30:252–256, 2007

The rising prevalence of type 2 diabetes poses a major clinical, economic, and societal burden in India (1,2). The cost of diabetes care is high and is escalating worldwide. There are only sparse data available from developing countries on the expenditure on diabetes care (3–9). In developing countries like India, which lacks a comprehensive health care system, availability of uniform documentation of medical details, especially the cost of treatment, is limited. Both private and public health care systems exist. The government-organized hospitals offer free treatment to the poor. No uniform norms exist for management of diseases. A chronic care model is lacking, except in a few private centers. Private health care is preferred by many, although it is more costly. There are only a few studies from India on the cost of diabetes care (5–9). In our previous publications, the direct expenditure incurred by families for diabetes care in India was reported. One of the major findings was that subjects with the lowest income spent as much as 25% of their annual income on treating diabetes. In this study, we have assessed the trend with time of expenditure on diabetes care in urban populations.

RESEARCH DESIGN AND METHODS

— The study sample of type 2 diabetic subjects was drawn from various hospitals, clinics, and general practitioners in urban and rural areas of seven states in India. The physicians were selected at random from different regions of the country, and they were asked to collect data from consecutive diabetic cases for 1 month. The subjects were representative of the diabetic population receiving treatment in urban and rural areas of India.

A brief uniform coded questionnaire was used. This consisted of 24 items, which included demographic variables and items related to the direct costs of health care to the patient. (A copy of the questionnaire is available from the authors on request.) The questions on direct costs were about expenditure on *1*) medications, *2*) laboratory tests and other investigations, *3*) medical consultations, *4*) hospitalizations, and *5*) surgery expenses. In both studies, the details were collected using a similar questionnaire (5). The questionnaire was administered individually to all diabetic subjects after obtaining their consent. The elicited response to each question was recorded, and the process took ~25 min per person.

Validity of the direct costs reported by the subjects was tested by comparing it with bills in a random subsample of 158 subjects. Family income was a self-

From the [1]Diabetes Research Centre, M.V. Hospital for Diabetes, World Health Organization Collaborating Centre for Research, Education and Training in Diabetes, Royapuram, Chennai, India; and the [2]School of Medicine, University of Wales Swansea, Swansea, U.K.

Address correspondence and reprint requests to Prof. Ambady Ramachandran, MD, PhD, DSc, FRCP(Lond) (Edin), Director, Diabetes Research Centre, M.V. Hospital for Diabetes, WHO Collaborating Centre for Research, Education and Training in Diabetes, 4 Main Rd., Royapuram, Chennai 600 013, India. E-mail: ramachandran@vsnl.com.

Received for publication 20 January 2006 and accepted in revised form 24 October 2006.

Abbreviations: Rs, rupees.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

DOI: 10.2337/dc06-0144

reported annual earning. This was validated against the possession of wealth asset indexes, such as possession of one's own house, automobiles, or agricultural lands. If gross disparities were noted in the reported income, appropriate correction was made in the categorization of income. The annual income of the subjects were arbitrarily classified into four levels. These were (in rupees [Rs]) *1*) <40,000 ($909), *2*) 40,000–80,000 ($909–1,818), *3*) >80,000–120,000 ($1,818–2,727), and *4*) >120,000 ($2,727). The costs were analyzed in relation to presence and number of complications (zero, one, and two or more).

Statistical analyses

Due to the skewed distribution of the variables, the median values and ranges are reported. Median test was used for intergroup comparisons. χ^2 test with Yate's correction was used for comparison of proportions and for comparison of mean values. Multiple linear regression equation was computed to find the influence of complications, duration of diabetes, habitat, treatment modalities, surgery, and hospitalization on the total expenditure. The actual bill values and the subjects' reported costs were compared by Wilcoxon's matched-pairs signed-rank test. Intercooled Stata 7.0 was used for data analyses. The reported expenses for the year 2005 were corrected in real terms, accounting for inflation using gross domestic product deflator with 1993–1994 as the base year.

Table 1—*Demographic data of diabetic subjects*

Variables	Urban	Rural	*P* value
Sex			
Male	194 (62.8)	147 (59.5)	
Female	115 (37.2)	100 (40.5)	
Age (years)	56.2 ± 10.5	54.8 ± 11.8	
Education			
Illiterate	5 (1.6)	17 (6.9)	0.003
Elementary	92 (30)	144 (58.3)	0.001
Higher secondary	72 (23.4)	58 (23.4)	0.959
Graduation	84 (27.4)	14 (5.7)	0.001
Post graduation	54 (17.6)	14 (5.7)	0.001
Employment status			
Not employed	31 (10.6)	30 (12.3)	0.511
Housewife	93 (31.6)	94 (38.6)	0.059
Clerical	8 (2.7)	4 (1.6)	0.625
Management	70 (23.8)	42 (17.2)	0.122
Professional	50 (17)	53 (21.7)	0.138
Non-professional	11 (3.7)	19 (7.8)	0.050
Retired	31 (10.6)	2 (0.8)	0.001
Income status (Rs)*			
<40,000	47 (15.2)	124 (50.2)	0.001
40,000–80,000	92 (29.7)	75 (30.3)	0.95
80,000–120,000	62 (20)	27 (10.9)	0.005
>120,000	108 (34.9)	21 (8.5)	0.001
Duration of diabetes (years)	10.4 ± 7.1	7.5 ± 5.5	0.001

Data are *n* (%) or means ± SD. *Rs 44 = $1.00 (approximately).

RESULTS — The data were collected from 556 subjects (urban = 309, rural = 247); none refused to answer any of the questions. The questionnaire results of 158 subjects were compared with the entries on the relevant institution's bills, and there were no significant differences between the reported cost and the bills. Median bill values (total cost) were Rs 9,742 ($221.4) (range 300–153,120 [$7.0–3,480]), reported value was Rs 11,000 ($250) (1,000–88,000 [$23–2,000]), and *z* was −1.89 ($P = 0.06$). Therefore, the direct cost data given by the subjects were accepted as valid.

The demographic data of the subjects are presented in Table 1. Urban subjects had higher mean income and education and significantly longer duration of diabetes than the rural subjects. They had significantly higher family income (Rs 100,000 or $2,272) than the rural subjects (Rs 36,000 or $818) ($P < 0.001$) (Table 2). The total median expenditure on diabetes care was Rs 10,000 ($227) in the urban subjects, whereas it was Rs 6,260 ($142) in rural subjects ($P < 0.001$). Urban subjects spent a significantly higher amount on medications than the rural subjects, as well as for laboratory tests and medical consultation ($P < 0.001$ for all comparisons). Expenses on surgery were higher in urban subjects (Rs 21,000 or $ 477) versus rural

Table 2—*Income and treatment expenses of the diabetic subjects*

Variables	Urban	Rural	*P* value
n	309	247	
Annual family income	100,000 (10,000–1,000,000)	36,000 (10,000–300,000)	0.001
	$2,272 (227–22,727)	$818 (227–6,818)	
Expenditure on medications	4,000 (300–70,000)	2,500 (100–50,000)	0.001
Laboratory tests	1,500 (50–15,000)	500 (30–30,000)	0.001
Medical consultations	1,000 (30–22,000)	600 (30–30,000)	0.005
Expenditure on hospitalization	10,000 (350–150,000)	6,000 (300–75,000)	0.07
Expenditure on surgery	21,000 (2,000–180,000)	6,500 (500–90,000)	0.087
Total median expenditure	10,000 (1,000–319,000)	6,260 (1,000–125,000)	0.001
	$227 (23–7,250)	$142 (23–2,840)	

Data are median (range) in Indian Rs unless otherwise stated. Rs 44 = $1.00 (approximately).

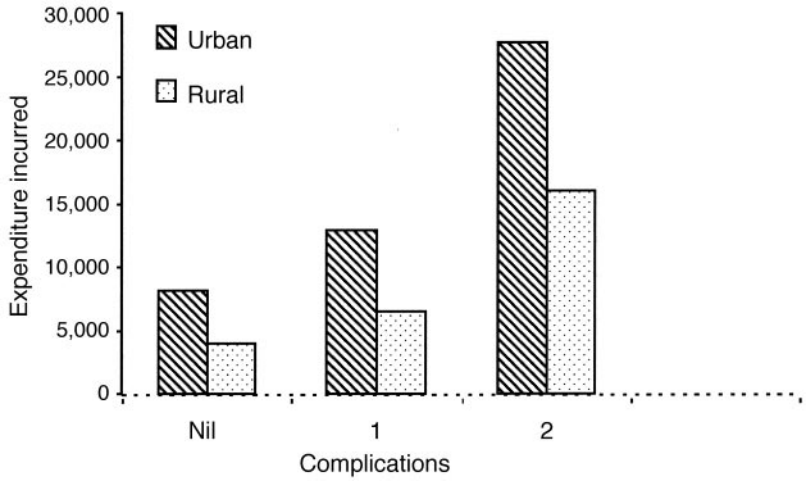

Figure 1—*Expenditure incurred by urban and rural subjects in relation to the number of complications. The x-axis shows the prevalence of complications, and the y-axis shows the expenditure incurred in Indian Rs.*

subjects (Rs 6,500 or $148), although this was not statistically significant.

Expenditure increased with duration of diabetes in both populations (urban: <5 years Rs 6,050 [$138] and ≥5 years Rs 11,355 [$258]; rural: <5 years Rs 3,920 [$89] and ≥5 years Rs 8,000 [$182], $P < 0.001$) in both comparisons.

The proportions of income spent on diabetes care by the urban low-, middle-, upper middle–, and high-income groups were 34.0, 16.9, 9.3, and 4.8%, respectively. The corresponding percentages in the rural population were 27.0, 12.6, 9.0, and 5.0%, respectively. Urban and rural subjects in the low-income group spent 34.0% and 27.0% of their income, respectively, for diabetes care.

Expenditure proportionately increased with the number of complications. Expenditure on treatment of complications varied significantly between the populations (Fig. 1). There were no significant urban-rural differences in the prevalence of complications. In the urban subjects, 56.9% had no complications, 29.4% had one complication, and 13.5% had two or more complications. In the rural group, 56.6% had no complications, 29.5% had one complication, and 13.7% had two or more complications.

Multivariate regression analysis showed that the expenditure increased significantly with the presence of complications ($\beta = 9,877$, $P < 0.0001$), duration of diabetes ($\beta = 801$, $P < 0.0001$), urban habitat ($\beta = 8,757$, $P < 0.0001$), insulin treatment ($\beta = 5,516$, $P < 0.0001$), surgery ($\beta = 15,787$, $P < 0.0001$), and hospitalization ($\beta = 16,548$, $P < 0.0001$). The model explained 33% of the variations.

When the present data from the urban sample were compared with the data of 1998, significant differences were noted. Annual income had increased twofold from Rs 48,000 ($1,091) to Rs 100,000 ($2,273) ($P < 0.0001$). The families' median expenditure on diabetes health care in 1998 was Rs 4,510 ($103), and it had more than doubled by 2005: Rs 10,000 ($227) ($P < 0.0001$). The increase was significant in all components of diabetes care ($P < 0.0001$ for all comparisons). The direct cost was computed to account for inflation, which is shown in Table 3. The corrected median expenditure of the urban sample had more than doubled from Rs 4,194 ($95) in 1998 to Rs 8,930 ($203) in 2005. Significant increases were observed in all components of the expenditure ($P < 0.0003$ in all comparisons). The largest increase was on expenses of surgery (632%), and the least was on expenditure of medications (39.5%). The annual cost of diabetes care had increased by 112.9%, while there was only a 108.0% increase in the annual income.

There was an increase in the proportion of income spent on diabetes care, between 1998 and 2005, which was statistically significant in all categories of family income except in the high-income group (Fig. 2). The largest proportional increase was seen in the lowest economic group (34.0 vs. 24.5%) ($P < 0.01$).

Medical reimbursement was obtained in 14.2% of urban, but in only 3.2% of rural, subjects. The proportion of subjects receiving reimbursement was the highest (21.3%) in the urban higher-income group.

CONCLUSIONS— The present study illustrates the increasing trend in expenditure on diabetes care in this developing country. The study sample was collected from different urban and rural regions of India to represent the national populations. Urban families spent more on diabetes than rural families, both as absolute values and as proportions of family income. This was due to the higher expenditure on medical consultations, laboratory investigations, and medications and may be partly attributed to the differences in the availability of these more expensive treatments in urban areas. However, it cannot be inferred from these results alone whether this availability leads to better quality of health care.

Table 3—*Comparison of treatment expenses of the urban sample of diabetic subjects between 1998 and 2005 after accounting for inflation*

Variables	1998 (Rs)	2005 (Rs)	*P* value	Increases (%)
Expenditure on medications	2,560	3,571	<0.0001	39.5
Laboratory tests	307	1,339	<0.0001	336.2
Medical consultations	299	893	<0.0001	198.7
Expenditure on hospitalization	4,267	8,929	0.0002	109.3
Expenditure on surgery	2,560	18,750	0.0003	632.4
Median expenditure	4,194 (871–64,182)	8,930 (893–284,821)	<0.0001	112.9
	$95 (20–1,459)	$203 (20–6,473)		

Data are median or median (range) in Indian Rs unless otherwise indicated. Rs 44 = $1.00 (approximately).

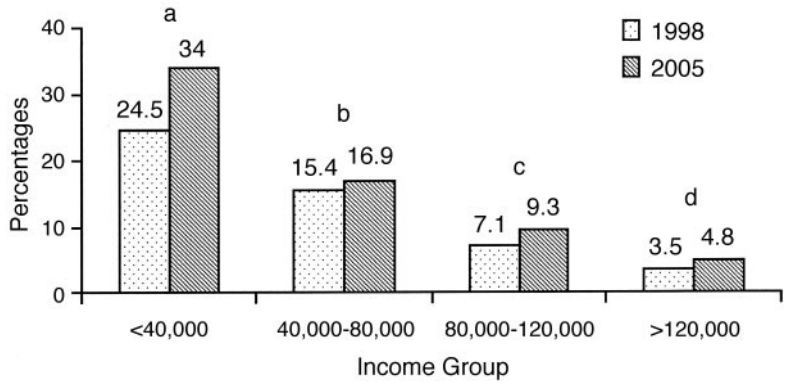

Figure 2—*Change in the proportion of income spent on diabetes by different income groups between the 1998 and 2005 in the urban population. The x-axis shows the income group, and y-axis shows the percentages of income spent. The low-income group showed the highest increase (34% in 2005 vs. 24.5% in 1998,* $P < 0.01$*). a,* $\chi^2 = -7.25$*,* $P = 0.007$*; b,* $\chi^2 = -16.94$*,* $P < 0.0001$*; c,* $\chi^2 = -10.34$*,* $P < 0.001$*; d,* $\chi^2 = -3.01$*,* $P = 0.08$*.*

Studies on the outcome of care in urban and rural settings are needed, which account for the variations in confounding factors such as diet, physical activity, and the influence of comorbidity.

Awareness of diabetes is likely to be better in urban than in rural subjects due to higher literacy levels in the former. Awareness of diabetes is the subject of an on-going study being carried out under the Diabetes Action Now program (10). Moreover, both diabetic subjects and many medical practitioners lack awareness of the need for constant disease monitoring and consistent glycemic control, and this may also differ in urban and rural settings (11). The apparent contradiction of lower-income groups spending a higher proportion of their income on diabetes care among both the populations, but rural residents spending a lower proportion of their income on diabetes care than urban residents, may be explained by the combination of greater availability and awareness of diabetes care among urban poor.

The proportion of annual income spent on health care by the urban poor has increased from 24.5% in 1998 to 34.0% in 2005. This is an important observation, as subjects with limited financial resources continue to spend a major proportion of their income on diabetes management. This scenario has been found to be similar even in the developed countries (12). In India, the expenditure on health care is borne mainly from self-earned resources. Only 6.4% of the urban low-income group received medical reimbursement, whereas this was 21.3% in the high-income group. In urban settings, the concepts of health insurance and medi-claim policies seem better understood and are utilized by the high-income group. Even the urban low-income group prefers treatment from private practitioners or health centers rather than government hospitals (5). Although private health care facilities are sought after, it is likely that many patients may cross over to public health care facilities. We lack data on this aspect.

The cost of diabetes care in urban areas showed a twofold increase from 1998 to 2005, due to significantly increased expenditure on diabetes medications, laboratory tests, medical consultations, hospitalizations, and surgical procedures. Presence of complications, duration of diabetes, need for surgery, and hospitalization increased the expenditure considerably. Similar observations were made in the study done in 1998 (7), which showed that diabetic subjects with foot infections had costs threefold higher than subjects with no complications, and costs increased further when hospitalization was required. According to Bjork (13), three times the health care resources were being spent on diabetes complications than on diabetes control. Jönsson et al. (14) made an important observation that young adults diagnosed with diabetes between ages 15 and 34 years spent larger amounts on diabetes care, which decreased in subsequent years. A second phase of high cost might result with the onset of complications.

The direct cost of diabetes care in India has been reported by others (8,9,11). There was one report (11) on the indirect cost from this part of the world, being Rs 12,756 ($290). The methodological difficulties of estimating indirect costs, particularly in developing countries, are many. The present study did not attempt to principally estimate indirect cost because the main foci of this study were the comparisons of direct costs and comparisons between income groups, urban and rural settings, and between 1998 and 2005.

The major limitations of the study were as follows: there could have been some underreporting of family income, which would have caused an overestimation of the percentage of income spent on health care. This was most likely to have occurred in the high-income group. However, similar bias is likely to have existed even in the previous study. Therefore, the comparisons of the two datasets are likely to be valid. Secondly, we did not have data on a comparison population showing the expenses on general health care. The major objective of the study was to note the cost of treating a chronic disease, which would be higher than that of general health care, and also to see whether it is increased with time.

The present study indicated that the economic burden of diabetes care on families in developing countries is rising rapidly, even after accounting for the inflation. Further studies of these costs in India and other developing countries might address in more detail factors such as the duration of diabetes, diabetes treatments, the extent of glycemic and other metabolic control, the presence and severity of diabetes complications, and important comobidities, which influence personal and family costs. Such studies have been published on developed countries (e.g., Brandle et al. [15]) with methods, that could be adapted to developing countries. They have demonstrated the substantial impact that several of these factors have on diabetes costs.

Acknowledgments— We acknowledge the participation of the World Diabetes Foundation trainee doctors and patients in the study. We thank the staff of the Department of Education and Psychosocial Research who facilitated the study and the secretarial service of Ms. Bobby Alex.

References

1. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das AK, Rao PV, Yajnik CS, Prasanna Kumar KM, Jyotsna D, the Diabetes Epidemiology Study Group in India (DESI): High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia* 44:1094–1101, 2001

2. Ramachandran A, Snehalatha C, Latha E, Vijay V, Viswanathan M: Rising prevalence of NIDDM in urban population in India. *Diabetologia* 40:232–237, 1997
3. International Diabetes Federation: The economic impact of diabetes. In *Diabetes Atlas*. 2nd ed. Brussels, International Diabetes Federation, 2003, p. 175–192
4. Gruber W, Lander T, Leese B, Songer T, William R (Eds.): *The Economics of Diabetes and Diabetes Care–A Report of a Diabetes Health Economics Study Group*. International Diabetes Federation and World Health Organization Publication, Geneva, Switzerland, 1997, p. 75–81
5. Shobhana R, Rama Rao P, Lavanya A, Williams R, Vijay V, Ramachandran A: Expenditure on health care incurred by diabetic subjects in a developing country: a study from southern India. *Diabetes Res Clin Prac* 48:37–42, 2000
6. International Diabetes Federation: *Diabetes Health Economics: Facts, Figures, and Forecasts*. Brussels, IDF Task Force on Health Economics, 1999, p. 7–12 and 24–27
7. Shobhana R, Rama PR, Lavanya A, Vijay V, Ramachandran A: Cost burden to diabetic patients with foot complications: a study from southern India. *J Assoc Physicians India* 48:1147–1150, 2000
8. Rayappa PH, Raju KNM, Kapur A, Bjork S, Sylvest C, Dilipkumar KM: Economic cost of diabetes care: the Bangalore urban district diabetes study. *Inter J Diab Developing Countries* 19:87–96, 1999
9. Kapur A, Bjork S, Nair J, Kelkar S, Ramachandran A: Socio-economic determinants of the cost of diabetes in India. *Diabetes Voice* 49:18–21, 2004
10. *Diabetes Action Now: An Initiative of the World Health Organization and the International Diabetes Federation*. Geneva, Switzerland, World Health Org. and International Diabetes Federation, 2004, p. 2–14
11. Bjork S, Kapur A, Kelkar SK, Nair J, Ramachandran A: Global policy: aspects of diabetes in India. *Health Policy* 66:61–72, 2003
12. Songer TJ, Lapote RE, Rave JR, Dorman JS, Becker DS: Health insurance and the financial impact of IDDM in families with a child with IDDM. *Diabetes Care* 20:577–584, 1997
13. Bjork S: The cost of diabetes and diabetes care. *Diabetes Res Clin Pract* 54 (Suppl. 1): S13–S18, 2001
14. Jönsson P, Marke LA, Nystrom L, Wall S, Ostman J: Excess costs of medical care 1 and 8 years after diagnosis of diabetes: estimates from young and middle-aged incidence cohorts in Sweden. *Diabetes Res Clin Pract* 50:35–47, 2000
15. Brandle M, Burke R, Zhou H, Tabaei BP, Smith BRK, Brown MB, Marriott D, Herman WH: The direct medical cost of type 2 diabetes. *Diabetes Care* 26:2300–2304, 2003