
The social determinants of the incidence and management of type 2 *diabetes mellitus*: are we prepared to rethink our questions and redirect our research activities?

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Abstract

This paper discusses the role played by social determinants of health in the incidence and management of type 2 *diabetes mellitus* (diabetes) among vulnerable populations. This issue is especially important in light of recent data from Statistics Canada indicating that mortality rates from diabetes have been increasing among Canadians since the mid-1980s, with increases being especially great among those living in low-income communities. Diabetes therefore appears – like cardiovascular disease – to be an affliction more common among the poor and excluded. It also appears to be especially likely to afflict poor women. Yet we know little about how these social determinants of health influence diabetes incidence and management. What evidence is available is provided and the case is made that the crisis in diabetes requires new ways of thinking about this disease, its causes, and its management.

An expanding literature is examining the dimensions of health inequalities in industrialized nations (Acheson, 1998; Raphael, 2002a). Specific focus is on dimensions of social exclusion that reflect increasing income, housing, and food insecurity associated with the weakening of the welfare state (Canadian Council on Social Development, 2001; Health Promotion Atlantic, 2001; Raphael, in press). *Diabetes mellitus* (diabetes) – like cardiovascular disease – is an affliction more common among the poor and excluded (Chaturvedi *et al.*, 1998; Hux *et al.*, 2002). A few studies in Canada have included income as a relevant variable in the incidence of diabetes, but these studies lack adequate conceptualization of the role social determinants of health play in diabetes incidence (Raphael, 2002c). Also, conceptual and empirical analyses have not been carried out in a way that has income as a determinant of the risk factors usually associated with diabetes morbidity and mortality.

This paper outlines what is known about the social determinants of type 2 diabetes and challenges health researchers and workers to begin asking different questions as to the causes of its incidence and the factors affecting its management. It does not include examination of the possible role that genes play in the incidence of diabetes. McDermott argues that the evidence for such a role is

limited as compared to issues of social and material deprivation. She also considers how an emphasis on biological determinism as an explanation of the late twentieth century epidemic of diabetes distracts from consideration of the types of social and economic issues we raise in this paper (McDermott, 1998).

Diabetes: definition, incidence, and management

Diabetes is a common chronic disease that affects over two million Canadians. All forms of diabetes are characterized by the presence of high blood glucose (hyperglycemia) due to defective insulin secretion, insulin action, or both. During an acute episode, coma and even death may result from blood sugar that is very high or very low, due to medication overdoses. Chronic hyperglycemia may lead to serious complications including damage to the heart, kidneys, eyes, nerves and blood vessels (Canadian Medical Association and Canadian Diabetes Association, 1998). The treatment for diabetes rests on blood glucose (glycemic) control to be achieved with diet, exercise and (if necessary) medications – the “three pillars” of the diabetes management regimen (Canadian Medical Association and Canadian Diabetes Association, 1998).

Health Canada reports that diabetes is the seventh leading cause of death in Canada, claiming 5,000 lives annually (Health Canada,



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1999). It is estimated that by 2010, close to four million Canadians will have this disease. Some \$9 billion is spent annually on diabetes care in Canada. Diabetes is a challenge because it is subject to the “rule of halves” – only half of all cases of diabetes are diagnosed, only half of those diagnosed are treated, and only half of those having treatment are managed successfully (McKinlay and Marceau, 2000). Little is known about the determinants that help put Canadians into each of these important halves.

Diabetes is classified into two main types:
1 type 1, gestational diabetes (GDM); and
2 type 2 (Canadian Medical Association and Canadian Diabetes Association, 1998).

Type 1 diabetes usually develops during childhood and its onset is generally acute. It occurs when the pancreas fails to produce insulin, often as a result of auto-immune damage and pancreatic beta-cell destruction. Gestational diabetes is a temporary condition of glucose intolerance during pregnancy and is often a precursor to type 2 diabetes later in life. Type 2 diabetes usually develops during adulthood, although age of incidence is decreasing and results from predominant insulin resistance with relative insulin deficiency to a predominant secretory defect with insulin resistance. Onset can be insidious as insulin secretion may decline gradually. Type 2 diabetes affects approximately 90 percent of Canadians diagnosed with diabetes (Canadian Diabetes Association, 2000) and is the primary focus of this paper. In Canada, Type 2 diabetes is appearing at younger ages (Canadian Medical Association and Canadian Diabetes Association, 1998).

Greater burden on vulnerable populations

An examination of the distribution of diabetes in the population reveals a disproportionate burden among low-income – including aboriginal – Canadians. Recent data from the Institute for Clinical Evaluation Sciences indicate that in Ontario the risk of diabetes is four times greater among low-income women than that seen among high-income women (Hux *et al.*, 2002). The rate for low-income males is 40 percent higher, and among lower-middle-income males, 50 percent higher than the well-off, still very significant figures. Cross-Canadian data indicate that the prevalence of diabetes among Canadians aged 45-64 years

with household incomes of \$10,000-29,999 is twice (6 percent) that of those living in households with incomes of \$60,000 or more (3 percent) (James *et al.*, 1997). Similar findings are seen in the UK (Riste *et al.*, 2001).

Wilkins and colleagues provide striking evidence in the September 2002 issue of *Health Reports* of how increases in mortality rates from diabetes among Canadians since the mid-1980s have been especially great among Canadians living in urban low income communities (Wilkins *et al.*, 2002). These researchers link the causes of death and postal code data with census data to provide profiles of mortality rates in urban Canadian neighbourhoods classified into income quintiles. Wilkins *et al.* (2002, p. 19) describe the findings regarding mortality associated with diabetes in urban Canada as follows:

For diabetes among males, mortality rates for most quintiles decreased from 1971 to 1986, but then increased from 1986 to 1996. Because the increases in the latter period were especially large for the poorest quintiles, the inter-quintile rate differences widened from 1986 to 1996. For diabetes among females, mortality rates for all quintiles declined from 1971 to 1986 and then changed little from 1986 to 1996, except for the poorest quintile, in which rates increased rapidly. Therefore, the inter-quintile rate difference was considerably greater in 1996 than it had been in 1986. The trends with respect to the overall rates and socio-economic disparities in diabetes mortality are disquieting and deserve further study.

Similar findings concerning morbidity and mortality among low-income communities are apparent in the USA and UK (Riste *et al.*, 2001; McKinlay and Marceau, 2000). Diabetes therefore appears – like cardiovascular disease – to be an affliction more common among the poor and excluded. Evidence of increasing income inequality among Canadians and increasing numbers of low income families during the past decade directs special attention to the potential effects of low income upon the health and wellbeing of those living with diabetes (Canadian Institute for Health Information, 2002).

Social determinants of health and diabetes: potential contributions to understanding

Virtually nothing is known about the causes of recent increases in morbidity and mortality among the Canadian population in general, and the low-income population in particular. The presence of the metabolic

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syndrome has been identified as a significant indicator of a predisposition to diabetes (as well as cardiovascular disease). Presence of three or more of the following identify the syndrome:

- 1 abdominal obesity: waist circumference > 88cm in women;
- 2 hypertriglyceridemia: 150mg/dL (1.69mmol/L);
- 3 low high-density lipoprotein (HDL) cholesterol: < 40mg/dL (1.04 mmol/L) in men and < 50 mg/dL (1.29 mmol/L) in women;
- 4 high blood pressure: 130/85mm Hg; or
- 5 high fasting glucose: 110mg/dL (6.1mmol/L) (Ford *et al.*, 2002).

Conventional thinking among health care, public health workers, and disease-oriented associations attributes increases in the presence of the metabolic syndrome and increases in morbidity and mortality to changes in dietary and physical activity patterns among Canadians (Ford *et al.*, 2002). This is similar to traditional thinking concerning cardiovascular-related issues (Raphael, 2002c). Yet, this dominant “health behaviors” paradigm takes little account of the increasing literature concerning the importance of the social determinants of health in population health in general and the incidence and management of diseases such as diabetes in particular. Brunner and Marmot (1999) point out that 90 percent of the variance in occurrence of metabolic syndrome observed in the UK Whitehall studies cannot be accounted for by conventional behavioral risk factors. The literature on societal determinants of health can contribute to understanding of the causes of diabetes morbidity and mortality.

The social determinants of health framework presented by Bruner and Marmot is helpful for illuminating the potential contributions of these concepts for understanding the incidence and management of type 2 diabetes (Brunner and Marmot, 1999). The framework also illuminates the gaps in conceptualizing the causes of type 2 diabetes and related management issues. In this model, proximal causes of morbidity, mortality and wellbeing are identified such as pathophysiological changes and organ impairment, and neuroendocrine and immune responses.

Slightly more distal behavioral antecedents such as health behaviors (e.g. diet, physical activity, tobacco use, etc.) are also identified in this model. Of importance to the present discussion are the even more distal antecedents of disease such as

psychological responses to work and social environments which themselves result from, are reproduced as, aspects of social structure. The model also identifies the direct effects on mortality, morbidity, and wellbeing of material factors that accumulate across the lifespan.

These model components are common to most conceptualizations related to population health (Health Canada, 2001; Marmot and Wilkinson, 2000; Raphael, 2002b). However, in the diabetes area, these more distal factors – with very few exceptions (McKinlay and Marceau, 2000; Riste *et al.*, 2001) – are rarely, if ever, considered by health researchers, public health workers, and disease-oriented associations. Virtually all diabetes research and health discourse is limited to the proximal issues of health behaviors, pathophysiological changes and, in some cases, neuroendocrine and immune processes. There is a need to address these other societal determinants of health relative to diabetes incidence and management.

Drawing on this model, it would appear that societal determinants of health could influence diabetes morbidity and mortality in at least two broad ways. First, these determinants may influence the incidence – and therefore the prevalence – of the disorder among the population and its sub-populations. Second, these determinants may influence the successful management of the disorder. At the very minimum, societal determinants of health will influence the adoption of behaviors that contribute to the incidence and successful management of diabetes. But there is also increasing evidence that societal determinants of health – especially aspects of material deprivation – may directly influence the incidence and management of this complex disorder through a variety of biological, psychological, and social pathways across the life-span. As argued by Kuh and Ben-Shlomo (1997, p. 3):

The prevailing aetiological model for adult disease which emphasizes adult risk factors, particularly aspects of adult life style, has been challenged in recent years by research that has shown that poor growth and development and adverse early environmental conditions are associated with an increased risk of adult chronic disease.

Raphael (2002c) brought together much of this work on the societal determinants of cardiovascular disease and during that work began to locate a similar literature related to diabetes. But the literature on societal determinants of diabetes is more dispersed

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than that seen for cardiovascular disease. Also, the diabetes area has not benefited from having very well known authorities such as Sir Michael Marmot and George Davey Smith – both of whom have written extensively on the life-course approach to the incidence of cardiovascular disease – working on these issues in relation to diabetes.

The societal determinants of the incidence of diabetes

Raphael shows that societal determinants of health are linked with each other and that income plays an especially important role (Raphael, 2002c). Income influences the quality of early life, levels of stress, availability of food and quality of diet, physical activity participation, degree of social exclusion, and so on. Shaw *et al.* (1999, p. 65) state that:

Health inequalities are produced by the clustering of disadvantage – in opportunity, material circumstances, and behaviors related to health – across people's lives.

Benzeval *et al.*'s argument that societal determinants of health such as income influence health through three main mechanisms – material deprivation during early life and adulthood, excessive psychosocial stress, and the adoption of health-threatening behaviors – proved useful for considering the social determinants of cardiovascular disease. These mechanisms may be useful for identifying how societal factors influence the incidence and management of diabetes among vulnerable populations (Benzeval *et al.*, 1995). McKeigue (1997) and Lawlor *et al.* (2002) show how early material deprivation predicts diabetes in later life.

Material deprivation and the incidence of diabetes

Material deprivation refers to the differences individuals experience in exposures to both beneficial and damaging aspects of the physical world (Lynch *et al.*, 2000). These exposures accumulate over the course of the lifespan and are determined in large part by the amount of income people have available to them (Shaw *et al.*, 1999). Individuals who suffer from material deprivation have greater exposures to negative events such as hunger and lack of quality food, poor quality housing, inadequate clothing, and poor environmental conditions at home and work. In addition, individuals suffering from

material deprivation have less exposure to positive resources such as education, books, newspapers, and other stimulating resources, attendance at cultural events, opportunities for recreation and other leisure activities that contribute to human development over the lifespan. How might these factors be related to the eventual incidence of diabetes during adulthood?

Recent studies have shown that intrauterine-growth retarded and low birthweight babies are at a higher risk of developing diabetes in adulthood. And growth retardation and lower birth weight are frequently consequences of poor early nutrition associated with low income mothers' living in materially-deprived conditions (Leger *et al.*, 1994; Phipps *et al.*, 1993). The thrifty phenotype hypothesis suggests that poor nutrition in early life leads to poor foetal and infant growth and produces permanent changes to glucose metabolism. These changes eventually lead to development of the metabolic syndrome and diabetes (Hales *et al.*, 2001).

These changes of reduced insulin secretion and insulin resistance when combined with obesity, physical inactivity and advancing age make individuals highly susceptible to diabetes. Numerous studies have supported this hypothesis (McCance *et al.*, 1994; Leger *et al.*, 1994; Jaquet *et al.*, 2000). Beringue *et al.* (2002) provide evidence that the mechanisms involve insulin resistance rather than decreased insulin secretion in adults. Clearly, compromised foetal growth at birth may be associated with diabetes in adulthood.

Wimbush found that middle-class mothers were more likely to participate in social and recreational activity groups than were low-income mothers (Wimbush, 1988). More recently, Brown *et al.* (2001) found further support for the notion that mothers of lower socio-economic status spent less time each week in active leisure. Brown *et al.* (2001) speculated that part of the reason for these findings related to women of lower socio-economic status being unemployed or under-employed, the likes of which resulted in fewer social networks and connections to the community. Social and community supports have been found to be extremely important facilitators for physical activity and leisure opportunities for mothers of young children of all socioeconomic backgrounds (Frisby *et al.*, 1997). Thus, these findings further reinforce the need to better understand the role of material and social forces that underpin constraints to physical activity and

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leisure participation, particularly for low-income mothers living in poverty who are at risk of, or who have, Type 2 diabetes.

Lifespan models of chronic disease risk that take into account life periods after very early childhood are being developed for numerous chronic diseases (Davey Smith and Hart, 2002; Davey Smith and Gordon, 2000; Davey Smith *et al.*, 2001; Kuh and Ben-Shilmo, 1997). These conceptualizations are much more advanced for the cardiovascular area, but it appears that common mechanisms may underlie both these diseases (Brunner and Marmot, 1999). One key aspect of life-course models is the role played by stress. Another is the adoption of unhealthy behaviors.

Psychosocial stress and the incidence of type 2 diabetes

Brunner and Marmot (1999) present a model that provides potential insights into the role stress plays in the incidence of chronic disease. They identify potential pathways by which the stress of living under difficult living conditions becomes translated into incidence of both diabetes and cardiovascular disease. As discussed later, at the very minimum, exposure to psychosocial stress influences the adoption of behaviors such as poor diet and inactivity, all associated with greater likelihood of type 2 diabetes during adulthood.

But the direct effects that stress has on metabolic and physiological pathways that make an individual susceptible to type 2 diabetes may be of more potential value. Two neuroendocrine pathways that involve the release of hormones may contribute to the incidence of this disorder. The sympathetic adrenal pathway involves the release of noradrenaline from the sympathetic nerve endings and adrenaline from the adrenal medulla into the blood stream. These hormones affect the target organ of the heart since it is under the control of both the autonomic nervous system and adrenaline levels in the blood. These hormones increase the heart rate, metabolic rate, blood pressure, respiration rate, and produce vasoconstriction, sweating and dryness of the mouth.

The second pathway comes into play a few minutes or maybe even a few hours after an initial stressor stimulus. It causes the release of hormones from the hypothalamus, pituitary gland and the adrenal glands and is known as the hypothalamic pituitary adrenal axis. The activity of this axis begins in the

brain with the release of corticotrophin-releasing factor from the hypothalamus. This hormone causes the release of the adrenocorticotrophic hormone from the pituitary gland into the circulation. This hormone stimulates the release of cortisol from the adrenal gland. Cortisol is an antagonist of insulin and increases the levels of blood glucose and also causes the release of fatty acids from fat tissues. The role of stress in the occurrence of the metabolic syndrome – specifically insulin resistance – and the incidence of diabetes has been under-researched (Brunner and Marmot, 1999).

Concerning the relationship between psychosocial stress and the metabolic syndrome, Brunner and Marmot (1999, p. 33) argue that:

... this cluster of risk factors may be the product of altered activity of the HPA (hypothalamic-pituitary-adrenal) axis in response to long-term exposure to adverse psychosocial circumstances.

There is a historical link between lower socioeconomic status and increased adrenocortical activity. Destitute people of nineteenth century England who were subject to chronic malnutrition were found to have larger than normal sized adrenal glands (Sapolsky, 1992). Brunner and Marmot's (1999) conclusion that the presence of the metabolic syndrome is strongly predicted by income and social status would suggest its presence would also be related to societal determinants of health associated with income such as food security, housing uncertainty and social exclusion, among other factors.

Adoption of unhealthy behaviors and the incidence of diabetes

The behavioral risk factors for the incidence of diabetes are well known: poor nutrition and sedentary lifestyle are associated with obesity (Canadian Medical Association and Canadian Diabetes Association, 1998). There are also barriers to successful management of the disorder:

- poor meal planning/poor diet;
- tobacco smoking; and
- physical inactivity (Canadian Medical Association and Canadian Diabetes Association, 1998).

All of these behaviors are associated with lower income and social status. However, much of the diabetes health literature assumes that these behavioral patterns are adopted through voluntary lifestyle choices

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(Wilkinson and Marmot, 1999). It is becoming increasingly clear that patterns of health behaviors are strongly shaped by the social and economic environments in which people live. Stress produces behaviors aimed at ameliorating tension such as high carbohydrate and fat diets, and tobacco use (Wilkinson, 1996). Meal planning (and engaging in physical activity) may be difficult when concerns about meeting basic needs of housing, food, and clothing intrude on daily activities (Travers, 1996).

It should not be surprising then that individuals faced with low income or other stress inducing issues such as unemployment or underemployment, racism, insecure or unaffordable housing would have difficulties maintaining “healthy lifestyles”. This would especially be the case for those managing their diabetes. A sole emphasis by the diabetes health community on explaining unhealthy behaviors as a matter of individual choice may be counter-productive in the battle against the effects of this disease. First, these behavioral factors may not account for the majority of variance associated with the incidence of diabetes or its successful management. Second, it leads towards a “blaming the victim” approach whereby those with disadvantage are blamed for adopting means – admittedly unhealthy – for coping with their difficult life situations. Third, an emphasis solely on individual choice fails to address underlying issues of why disadvantaged people adopt these behaviors.

An extensive analysis of the determinants of adults’ health-related behaviors such as tobacco use, physical activity, and healthy diets, found these behaviors were predicted by poor childhood conditions, low levels of education, and low status employment (Lynch *et al.*, 1997). The study also found that poor socioeconomic conditions during early life make it less likely that people feel they have control over their lives – a factor that can contribute to illness. Identifying some of the possible pathways to type 2 diabetes such as material deprivation, excessive psychosocial stress, and adoption of health threatening behaviors suggests value in applying a societal determinants of diabetes approach. Certainly, such an analysis would contribute to our understanding of why and how diabetes is an especially important issue for low income and other vulnerable populations. Considering the increasing numbers of low income families living in urban Canada, such a focus seems especially

important (Canadian Institute for Health Information, 2002).

The societal determinants of the successful management of diabetes

As noted, Wilkins *et al.* (2002) have documented the exceptional increases in diabetes mortality among Canadians living in low-income communities. The risk of the disease is especially related to low income among women. Virtually nothing is known about the causes of such increases. One possibility may be that increasing difficulties in day-to-day living among people living in disadvantaged circumstances are contributing to difficulties in disease management. The diabetes management regimen is considered “among the most demanding regimens of any chronic illness” (Callaghan and Williams, 1994). The regimen is associated with a number of lifestyle changes that people with diabetes often find difficult to incorporate into their everyday lives (Maclean and Oram, 1988). Anstice (2002) argues that there are many reasons to believe that adherence to the diabetes management regimen may be especially challenging for members of low-income families, and particularly for low-income mothers who are living with diabetes. Many are also unable to find time or safe spaces for exercise or to afford blood sugar testing equipment to better manage their diabetes.

Studies have found that, for families living in poverty, meeting food needs is a persistent problem (Fitchen, 1988; Radimer *et al.*, 1992). Furthermore, it is commonly reported that during times of acute food shortage mothers in low-income families will compromise their own food intake in order to provide more for others (Graham, 1993; Hamelin *et al.*, 2002; Tarasuk *et al.*, 1998). The fact that women bear children and frequently have responsibility for caring for the health needs of their family suggests another mechanism by which gender may play a role in the incidence of diabetes. Prospective mothers may skimp on their own nutritional needs in order to provide food for the rest of their family. This may be associated with lower birthweight and greater likelihood of their offspring developing diabetes in later life.

Since good nutrition is considered the cornerstone of good diabetes management, it may be that mothers with diabetes who live in low-income families experience exceptional food problems that challenge the dietary management of their own diabetes (Anstice, 2002). A small body of qualitative

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research indicates that the material context of everyday life helps shape personal experience of diabetes, and further that acute financial constraints may present barriers to successful management. Mason (1985) found that among people living in socially disadvantaged areas in Scotland, those faced with acute financial constraints made decisions that did not necessarily prioritize their diabetes management. Miewald (1997) studied low-income clients at a US clinic and found that both financial constraint and shortcomings of low-income neighbourhoods challenged participants' adherence to a dietary regimen. She notes that:

Lack of access to inexpensive grocery stores and tight food budgets ... made it difficult for clients to make changes in their eating habits (Miewald, 1997, p. 359).

Studies have also found low amounts of leisure-time physical activity to be strongly associated with low income (Stachenko *et al.*, 1992; Steenland, 1992), low education (Sternfeld *et al.*, 1999), and low socio-economic status (Blanksby *et al.*, 1996; Mensink *et al.*, 1997). Furthermore, the lowest participation rates are found among the poor and women of child-rearing age, many of whom are the same people (Frisby *et al.*, 1997). While literature in this area tends not to explore physical activity participation from a critical or social determinants of health perspective, it has been noted that physical activity is heavily dependent on financial resources and cultural capital (Kidd, 1995). In support of this, research links material and structural circumstances (e.g. living in disadvantaged neighborhoods with more crime) to lower levels of physical activity (Wimbush, 1988; Lindstrom *et al.*, 2001).

Despite this, the complexity of the relationship between the foregoing social determinants and physical activity practices has not been adequately addressed. Thus, not surprisingly, little information exists on low-income families, physical activity, and diabetes management. However, the results of a participatory action research study in Canada – The Woman's Action Project – found that low-income women identified a lack of access to physical activity in their community as a major factor inhibiting the development of healthy lifestyles for themselves and their families (Frisby *et al.*, 1997). Focus groups confirmed that although women in this income bracket desired benefits from physical activity participation similar to those of women in higher income brackets, low-income women experienced

social, financial, health and personal problems that impeded their involvement.

The Canadian literature on the difficulties of diabetes management faced by vulnerable populations is small. Anderson and colleagues examined the diabetes experience of low-income immigrant women and found also found that the constraints of low income helped shape management decisions (Anderson, 1991, 1998; Anderson *et al.*, 1993, 1995). The researchers contend that an immigrant woman with diabetes who lacks access to material resources is in a paradoxical situation:

On the one hand, she is expected to take responsibility for carrying out her care. On the other hand, she does not have access to the resources that would allow her to do so (Anderson, 1991, p. 111).

Anderson's research focused on the role of ethnicity in women's experiences of diabetes; it is probable that other low-income women face this self-care paradox.

An investigation by Anstice (2002) provides further evidence of the importance of this area of inquiry. In her grounded theory study, Anstice used multiple, in-depth, one-on-one interviews with three Toronto women to explore the question: How do sole-support mothers who live on income support describe their everyday experiences of *diabetes mellitus*? She found that financial vulnerability, characterized by income inadequacy and a sense of precariousness, was manifested in experiences of housing, food and transportation difficulties. This everyday context profoundly shaped diabetes management decisions. For example, food problems associated with income inadequacy such as household food shortages were described as major barriers to implementing the dietary recommendations of the diabetes management regimen. Uncertainty concerning the adequacy of other societal determinants of health such as housing certainly plays a role as well in poor dietary management. These insecurities certainly create an early childhood environment not conducive to the healthy development of children (Hertzman, 1999; Keating and Hertzman, 1999) – another area profoundly under-researched by those concerned with the health effects of diabetes.

Implications for the further study of the social determinants of diabetes

These kinds of hypotheses would suggest that if the appropriate analyses were completed,

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income and social status would have direct association with the presence of both the metabolic syndrome and the presence of diabetes in populations independent of the health behaviors usually identified as the primary causes of diabetes. Indeed, there is evidence that this is the case. Wamala *et al.* (1999) studied precursors of the metabolic syndrome among Swedish women. They found that low education (a proxy for lower income) was associated with a 2.3 times greater likelihood of the presence of the metabolic syndrome even after accounting for age, family history, smoking, lack of exercise, and alcohol consumption. In Canada, Choi and Shi (2001) found that income status differences produced a 26 percent greater excess risk of diabetes among low-income Canadians independent of other behavioral risk factors. Similar findings can be inferred, but were not explicitly presented, in the ICES diabetes report (Hux *et al.*, 2002).

Clearly, there is a need to analyze available data within the life-course frameworks suggested by these models and empirical findings. These would require statistical analyses that were firmly grounded within a life-course perspective. Much of the available analyses take a less complex risk-factor approach by which income is treated as one of many risk factors to be considered, rather than as a determinant of the behavioral risk factors themselves. If data that would allow for these analyses to be carried out are not available, mechanisms need to be developed to gather and analyze such data.

Canada has been a world leader in conceptualizing the social determinants of health. Yet recent initiatives in preventing chronic disease and promoting health appear to be relegating these concepts to the sidelines in favor of healthy lifestyle choices. This appears to be especially the case in the approaches being taken by the new Chronic Disease Prevention Alliance of Canada and the Healthy Living Initiative of the Federal Government (Chronic Disease Prevention Alliance of Canada, 2003; Health Canada, 2003). The crisis in diabetes appears to call for new ways of thinking about and redirecting our research activities in regards to this disease. Are health workers and researchers up to this challenge?

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