# Obesity and its relation to cardiovascular disease risk factors in Canadian adults

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**Objective:** To describe the distribution of weight and abdominal obesity among Canadian adults and to determine the association of obesity with other risk factors for cardiovascular disease.

**Design:** Population-based cross-sectional surveys. Survey nurses administered a standard questionnaire and recorded two blood pressure measurements during a home visit. At a subsequent visit to a survey clinic two further blood pressure readings were made, anthropometric measurements recorded and a blood specimen taken for plasma lipid determination.

**Setting:** Nine Canadian provinces, from 1986 to 1990.

**Participants:** A probability sample of 26 293 men and women aged 18 to 74 years was selected from the health insurance registration files of each province. Anthropometry was performed on 17 858 subjects.

**Outcome measures:** Body mass index (BMI), ratio of waist to hip circumference (WHR), mean plasma lipid levels, prevalence of high blood pressure (diastolic $\geq$ 90 mm Hg or patient on treatment) and self-reported diabetes mellitus.

**Main results:** The prevalence of obesity (BMI $\geq$ 27) increased with age and was greater in men (35%) than in women (27%). Abdominal obesity was likewise higher in men and increased with both age and BMI. The prevalence of high blood pressure was greater in those with higher BMI, especially in those with a high WHR. Although total plasma cholesterol levels increased only modestly with BMI, levels of low density lipoprotien (LDL) cholesterol and triglycerides and the ratio of total cholesterol to high density lopoprotein (HDL) cholesterol increased steadily, while HDL-cholesterol decreased consistently with increasing BMI. High total cholesterol levels ($\geq$ 5.2 mmol/L) were more prevalent among people with high BMI, especially those with a high WHR. The prevalence of diabetes increased with BMI among those 35 years or older, especially those with abdominal obesity. About half of men and two-thirds of women who were obese were trying to lose weight.

**Conclusion:** Obesity remains common among Canadian adults. There is a need for broad-based programs that facilitate healthy eating and activity patterns for all age groups. Health professionals should incorporate measurement of BMI and WHR into their routine examinations of patients to enhance their evaluation of health risk.

Obesity, the presence of excess body fat, has been clearly associated with adverse health consequences.[1-5] Most studies indicate that the relation between weight and total mortality assumes a J-shaped curve, with those at the highest weights experiencing highest mortality rates and those at the lowest weights showing a slightly elevated mortality rate due, in part, to the presence of occult clinical disease.[5-9]

There is conflicting evidence regarding the relation between obesity and the incidence of cardiovascular disease (CVD).[10] The 26-year follow-up study of airline pilots[11] in Manitoba found a positive relation between obesity and both sudden death and

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myocardial infarction; the Framingham Study identified obesity as an independent risk factor for both coronary artery disease and, in women, stroke.[12]

Obesity has been associated with an increased incidence of several cancers[13-19] and a higher prevalence of hypertension,[20-22] hyperlipidemia[2,23,24] and diabetes mellitus.[21,25-28]

The distribution of fat in overweight people has important metabolic consequences.[29-31] Abdominal fat, measured by the ratio of waist to hip circumferences (WHR), is associated with increased incidence of ischemic heart disease, stroke and death[32-35] and a higher prevalence of hypertension,[34,36,37] hyperlipidemia[37-39] and diabetes.[2,31,35,40,41] There is general agreement that the increased health risks are associated with a WHR greater than 0.8 in women;[32] the corresponding level in men has been suggested to be 0.9[42] or 1.0.[32]

The prevalence of obesity in Canada has been estimated in the 1971 Nutrition Canada National Survey,[43,44] the 1978 Canada Health Survey[42] and the 1981 Canada Fitness Survey.[20] The pattern of obesity among Canadian Indians has also been assessed.[45] The measurement of concurrent CVD risk factors was a prominent feature only in the latter survey.

The provincial heart health surveys, conducted as part of the Canadian Heart Health Initiative, have provided a unique opportunity to examine the distribution of weight and abdominal obesity among adult Canadians and to assess the association of obesity with other risk factors for CVD.

## Methods

Non-institutionalized Canadian men and women, between the ages of 18 and 74 years, in 9 of 10 provinces (Nova Scotia, New Brunswick, Prince Edward Island, Newfoundland, Quebec, Manitoba, Saskatchewan, Alberta, British Columbia) participated in sample surveys conducted between 1986 and 1990. Details of the survey methods are described in the paper on survey methods and data analysis (pages 1969–1974). In brief, a probability sample of 26 293 people was selected from the health insurance registration files of each province. Trained survey nurses administered a standard questionnaire and recorded two blood pressure measurements during a home visit. Participants visited a survey clinic within 2 weeks, where two blood pressure measurements were again recorded, anthropometric measurements were performed and a blood specimen was taken for plasma lipid determination.

As part of the questionnaire, participants were asked if they were "presently trying to lose weight, gain weight or neither," and if they had "ever been told by a doctor that they had diabetes."

Body mass index (BMI) has been used in this report to measure obesity because it is a simple, convenient measure that correlates well with skinfold and body density measures[46,47] and has been adopted in the Canadian Guidelines for Healthy Weights.[1] The categories of BMI are those recommended by the Expert Group on Weight Standards.[1] WHR was used to assess the pattern of fat distribution because it is technically simpler and at least as reliable as skinfold measurement for this purpose.[1,48] High WHR has been defined as 0.8 or over for women and 0.9 or over for men. Although, a cutoff point of 1.0 has been used for men in some reports,[49] we adopted the level of 0.9 used in the Canada Fitness Survey.[20]

Anthropometric measurements were performed in the morning on fasting participants dressed in light indoor clothing without shoes. Height was measured to the nearest centimetre, with participants standing on a hard surface against a wall, using a square and tape measure fixed to the wall. Weight was measured to the nearest 100 g using a calibrated balance beam scale. BMI was calculated as weight in kilograms divided by the square of height in metres.

To measure waist circumference, the measuring tape was positioned horizontally at the level of noticeable waist narrowing. The measurement was made at the end of a normal expiration. When narrowing could not be determined, circumference was measured at the estimated lateral level of the twelfth or lower floating rib. For hip circumference, the tape was positioned around the hips at the level of the symphysis pubis and the greatest gluteal protuberance. Measurements were recorded to the nearest centimetre. WHR was calculated as waist circumference (cm)/hip circumference (cm).[50]

Height and weight were measured in all provincial surveys, whereas waist and hip circumferences were measured only in Quebec, Manitoba, Saskatchewan and Alberta (i.e., WHR data are for only these four provinces, BMI data are for all nine provinces). To provide statistically stable estimates of the prevalence of concurrent CVD risk factors, age categories have been collapsed in a uniform fashion in Tables 5 to 10. The sample size is greater than 20 in all cells of these tables.

Data from each province were compiled into a common database from which material was taken for this report. All percentage estimates are weighted to reflect the sampling design and the degree of nonresponse. Age-standardized estimates are based upon the age–sex distribution of the 1986 population of Canada.

Details of the survey response rate are given elsewhere; however, 78% of those invited to participate completed the household interview and 68% completed both the household interview and the clinic visit.

## Results

Men had a higher mean BMI than women at all ages except 65 to 74 years (Table 1). In both sexes, mean BMI increased with age to 55 to 64 years, then decreased in men but remained unchanged in women. The proportion of the population with a healthy body weight (BMI 20 to 24) decreased in men from 59% in the youngest to 35% in the oldest group and in women from 54% to 34%. The prevalence of obesity (BMI 27 to 34) in men (32%) was considerably greater than that in women (22%), whereas the prevalence of massive obesity (BMI $\geq$ 35) demonstrated the opposite trend, with the prevalence in women (5%) exceeding that in men (3%). This pattern of massive obesity is especially prominent among older women aged 55 to 74. The prevalence of extreme leanness (BMI < 20) is greater among women (14%) than men (4%) especially among the younger groups.

WHR, a measure of abdominal obesity, increased steadily with age in both sexes (Table 2). The increase in the prevalence of abdominal obesity with age was more marked among men than women. Mean WHR in men was greater than that in women at all ages, and the prevalence of abdominal obesity was likewise higher in men at all ages.

In both sexes, with increasing BMI there was development of centripetal fat distribution (Tables 3 and 4). In a given BMI category, the percentage of both men and women with a centripetal distribution of fat increased with age.

The prevalence of high blood pressure increased with BMI at all ages for both men and women (Table 5). High blood pressure was about twice as prevalent among men as among women from age 18 to 54 years; thereafter, the prevalence was greater among women in almost all BMI categories. The prevalence of high blood pressure increased with age among subjects in all categories of BMI including those with a healthy weight (BMI 20 to 24).

The prevalence of high blood pressure was two to three times greater among individuals with a high WHR than among those with a low ratio (Table 6). This applied to those with BMI less than 27 as well as to those with a BMI of 27 or greater.

Mean total plasma cholesterol and triglycerides (Fig. 1) as well as low density lipoprotein (LDL) cholesterol (Fig. 2) increased with BMI at all ages in both men and women. In both sexes, high density lipoprotein (HDL) cholesterol declined steadily with increasing levels of obesity, and the ratio of total cholesterol to HDL-cholesterol increased markedly (Fig. 3).

Elevated total cholesterol ($\geq$ 5.2 mmol/L) was more prevalent among men and women with higher BMI (Table 7) at all ages but most strikingly in the younger groups. People in the younger groups with a high WHR had a greater prevalence of elevated total cholesterol level than those with a low ratio. This applies to people in both the obese (BMI $\geq$ 27) and the non-obese (BMI < 27) categories (Table 8). The prevalence of high total cholesterol level differed little with WHR among individuals who were 55 to 74 years old.

Overall, 5% of men and women reported having been told that they had diabetes (Table 9). The prevalence of diabetes increased with age in both sexes. It changed little with BMI in the youngest group (18 to 34) but increased steadily with BMI in

Table 1: Distribution of participants by body mass index (BMI)

| Sex; age, yr | No. of subjects | Mean BMI (SD*) | BMI; % of subjects | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | < 20 | 20–24 | 25–26 | 27–29 | 30–34 | ≥ 35 |
| Men | | | | | | | | |
| 18–24 | 1 326 | 23.8 (4.3) | 14 | 59 | 10 | 11 | 5 | 2 |
| 25–34 | 2 965 | 25.5 (4.5) | 5 | 47 | 20 | 17 | 8 | 2 |
| 35–44 | 1 246 | 26.5 (4.2) | 3 | 34 | 26 | 21 | 12 | 4 |
| 45–54 | 820 | 27.0 (4.2) | 1 | 28 | 25 | 27 | 15 | 3 |
| 55–64 | 829 | 27.3 (4.5) | 2 | 31 | 19 | 25 | 18 | 4 |
| 65–74 | 1 610 | 26.5 (4.4) | 4 | 35 | 22 | 22 | 14 | 3 |
| All | 8 796 | 26.0 (4.5) | 4 | 40 | 21 | 20 | 12 | 3 |
| Women | | | | | | | | |
| 18–24 | 1 428 | 22.9 (4.4) | 24 | 54 | 9 | 6 | 5 | 2 |
| 25–34 | 3 160 | 23.7 (4.9) | 19 | 53 | 10 | 8 | 7 | 4 |
| 35–44 | 1 286 | 25.2 (6.2) | 14 | 49 | 10 | 12 | 8 | 7 |
| 45–54 | 907 | 25.8 (5.6) | 8 | 46 | 14 | 15 | 13 | 4 |
| 55–64 | 811 | 26.9 (5.5) | 5 | 40 | 13 | 15 | 18 | 9 |
| 65–74 | 1 470 | 26.9 (5.9) | 7 | 34 | 15 | 22 | 15 | 8 |
| All | 9 062 | 25.0 (5.6) | 14 | 48 | 11 | 12 | 10 | 5 |
| Total | 17 858 | 25.5 (5.1) | 9 | 44 | 16 | 16 | 11 | 4 |

*SD = standard deviation.

men and women aged 35 to 74 years. The prevalence of diabetes was greater among those with a high WHR than among those with a low WHR (Table 10) for all BMIs. It was most prominent among men and women aged 55 to 74.

Approximately half of men and two-thirds of women who were overweight (BMI $\geq$ 27) stated that they were trying to lose weight (Table 11). The proportion was greater among the younger groups but differed little with degree of obesity. About one-third of younger women (18 to 54) with a healthy weight (BMI 20 to 24) were still trying to lose weight, and 6% of women aged 18 to 34 years who were underweight (BMI < 20) were trying to lose more weight.

## Discussion

The overall response rate in the survey (78%) was high. It is possible that the 22% who did not respond differed from the rest of the population. The most likely bias would be that overweight people were less likely than those with a healthy weight to participate in the survey. If so, the estimates of the prevalence of obesity presented here underestimate the true magnitude of this problem.

Table 2: Distribution of participants* by waist–hip circumference ratio (WHR)

| Age, yr | No. of subjects | Mean WHR (SD) | WHR of men | | | |
|---|---|---|---|---|---|---|
| | | | < 0.8 | 0.80–0.89 | 0.90–0.99 | ≥ 1.00 |
| 18–24 | 518 | 0.85 (0.06) | 23 | 59 | 16 | 1 |
| 25–34 | 1 236 | 0.88 (0.06) | 9 | 56 | 31 | 4 |
| 35–44 | 578 | 0.91 (0.06) | 4 | 40 | 49 | 8 |
| 45–54 | 363 | 0.93 (0.06) | 0 | 34 | 54 | 13 |
| 55–64 | 383 | 0.94 (0.06) | 3 | 16 | 67 | 14 |
| 65–74 | 917 | 0.94 (0.07) | 1 | 24 | 53 | 22 |
| All | 3 995 | 0.90 (0.07) | 7 | 42 | 42 | 8 |
| | | | WHR of women | | | |
| | | | < 0.7 | 0.70–0.79 | 0.80–0.89 | ≥ 0.90 |
| 18–24 | 539 | 0.75 (0.06) | 22 | 62 | 15 | 1 |
| 25–34 | 1 317 | 0.76 (0.06) | 14 | 66 | 18 | 2 |
| 35–44 | 553 | 0.78 (0.08) | 6 | 64 | 25 | 5 |
| 45–54 | 436 | 0.79 (0.06) | 5 | 57 | 32 | 7 |
| 55–64 | 370 | 0.81 (0.08) | 5 | 38 | 43 | 14 |
| 65–74 | 838 | 0.83 (0.07) | 2 | 38 | 48 | 13 |
| All | 4 053 | 0.78 (0.07) | 9 | 57 | 28 | 6 |

*Data were obtained from Alberta, Quebec, Manitoba and Saskatchewan only.

Table 3: Relation of BMI to WHR by age in men

| Age, yr; BMI | No. of men | WHR; % of men | | | |
|---|---|---|---|---|---|
| | | < 0.8 | 0.80–0.89 | 0.90–0.99 | ≥ 1.00 |
| 18–34 | | | | | |
| < 20 | 117 | 36 | 61 | 3 | 0 |
| 20–24 | 864 | 17 | 68 | 14 | 1 |
| 25–26 | 302 | 7 | 59 | 31 | 2 |
| 27–29 | 275 | 1 | 39 | 56 | 3 |
| ≥ 30 | 184 | 4 | 25 | 53 | 18 |
| 35–54 | | | | | |
| < 20 | 23 | 36 | 62 | 2 | 0 |
| 20–24 | 265 | 4 | 61 | 34 | 1 |
| 25–26 | 207 | 0 | 42 | 53 | 4 |
| 27–29 | 242 | 0 | 18 | 70 | 11 |
| ≥ 30 | 195 | 1 | 11 | 54 | 34 |
| 55–74 | | | | | |
| < 20 | 33 | 2 | 70 | 28 | 0 |
| 20–24 | 354 | 2 | 30 | 58 | 9 |
| 25–26 | 292 | 1 | 10 | 80 | 9 |
| 27–29 | 320 | 0 | 21 | 61 | 18 |
| ≥ 30 | 280 | 5 | 4 | 54 | 37 |

Obesity remains a major health burden among Canadian adults. Although the age and BMI categories differ, the results of the present survey do not show a substantial change in the prevalence of obesity since the Canada Health Survey (1978)[42] and the Canada Fitness Survey (1981).[51] Compared with the adult population in the United States from the 1971–74 National Health and Examination Survey,[52] the present Canadian population demonstrated slightly higher mean BMI values among older men. Our finding that almost 40% of women and over 55% of men had BMIs exceeding 25 indicates little impact of recent attempts to promote a healthy weight and active lifestyle among Canadians. It underscores the need for additional if not newer approaches in this area of health promotion.

The pattern of abdominal obesity in Canadian adults is similar to that seen in the Canada Fitness Survey (1981),[51] the only other national survey in which WHR was measured. With increasing adiposity and age in both sexes, there was progressive development of an abdominal fat distribution. This trend was especially prominent among men with a BMI of 25 to 26. Among women in the youngest groups (18 to 24, 25 to 34) the prevalence of underweight (BMI < 20) was high (24% and 19%, respectively). A substantial proportion of these women (25%) had WHRs less than 0.7. This category may include not only athletes, but also smokers and people suffering from anorexia nervosa and bulimia.

The positive association between the prevalence of high blood pressure and degree of obesity in the present study has been previously described.[20–22,53] The overall prevalence of high blood pressure rises gradually with age among men, but rises more abruptly among women after age 45. This pattern

Table 4: Relation of BMI to WHR by age in women

| Age, yr; BMI | No. of women | WHR; % of women | | | |
|---|---|---|---|---|---|
| | | < 0.7 | 0.70–0.79 | 0.80–0.89 | ≥ 0.90 |
| 18–34 | | | | | |
| < 20 | 338 | 25 | 66 | 9 | 0 |
| 20–24 | 979 | 17 | 70 | 12 | 1 |
| 25–26 | 185 | 4 | 61 | 33 | 2 |
| 27–29 | 166 | 12 | 57 | 26 | 5 |
| ≥ 30 | 162 | 5 | 42 | 44 | 9 |
| 35–54 | | | | | |
| < 20 | 82 | 8 | 85 | 7 | 0 |
| 20–24 | 448 | 8 | 69 | 20 | 2 |
| 25–26 | 125 | 1 | 54 | 43 | 3 |
| 27–29 | 154 | 4 | 42 | 45 | 9 |
| ≥ 30 | 170 | 3 | 35 | 40 | 22 |
| 55–74 | | | | | |
| < 20 | 56 | 16 | 75 | 9 | 0 |
| 20–24 | 383 | 5 | 51 | 40 | 5 |
| 25–26 | 183 | 5 | 36 | 49 | 10 |
| 27–29 | 253 | 0 | 33 | 50 | 16 |
| ≥ 30 | 310 | 1 | 16 | 52 | 31 |

Table 5: Prevalence of high blood pressure* by BMI and by sex and age

| Sex; age, yr | BMI; % of subjects | | | | | | |
|---|---|---|---|---|---|---|---|
| | < 20 | 20–24 | 25–26 | 27–29 | 30–34 | ≥ 35 | All |
| Men | | | | | | | |
| 18–34 | 1 | 4 | 8 | 8 | 16 | 29 | 6 |
| 35–54 | 2 | 10 | 17 | 17 | 34 | 63 | 18 |
| 55–74 | 7 | 16 | 34 | 35 | 42 | 28 | 29 |
| All | 2 | 8 | 18 | 19 | 32 | 44 | 16 |
| Women | | | | | | | |
| 18–34 | 0 | 2 | 3 | 5 | 7 | 13 | 2 |
| 35–54 | 8 | 6 | 12 | 15 | 26 | 28 | 12 |
| 55–74 | 23 | 26 | 35 | 30 | 44 | 60 | 33 |
| All | 5 | 8 | 16 | 18 | 28 | 36 | 13 |
| Total | 4 | 8 | 17 | 18 | 30 | 39 | 14 |

*High blood pressure = diastolic blood pressure ≥ 90 mm Hg or on treatment (pharmacologic or non-pharmacologic) or both.

does not appear to represent confounding by obesity because it was seen in all BMI categories. Consistent with the findings of others[34,37] the measurement of WHR was of considerable benefit at all ages in identifying population subgroups with a greater prevalence of high blood pressure.

Mean levels of total plasma cholesterol, LDL-cholesterol and triglycerides increased with BMI level in men and women of all ages (Figs. 1 and 2) as has been reported elsewhere.[2,23,24] If one examines the relation between plasma lipids and obesity by viewing the percentage of individuals with elevated

Table 6: Prevalence of high blood pressure* by BMI and WHR† by sex and age

| | BMI < 27; % of subjects | | BMI ≥ 27; % of subjects | |
|---|---|---|---|---|
| Sex; age, yr | Low WHR | High WHR | Low WHR | High WHR |
| Men | | | | |
| 18–34 | 4 | 6 | 5 | 15 |
| 35–54 | 8 | 20 | 26 | 23 |
| 55–74 | 12 | 25 | 15 | 38 |
| All | 6 | 18 | 14 | 25 |
| Women | | | | |
| 18–34 | 1 | 3 | 3 | 8 |
| 35–54 | 7 | 12 | 18 | 18 |
| 55–74 | 23 | 33 | 36 | 40 |
| All | 6 | 17 | 17 | 27 |
| Total | 6 | 18 | 16 | 26 |

*Values for high blood pressure as in Table 5.
† For men, low WHR = < 0.9, high = ≥ 0.9; for women, low WHR = < 0.8, high = ≥ 0.8.

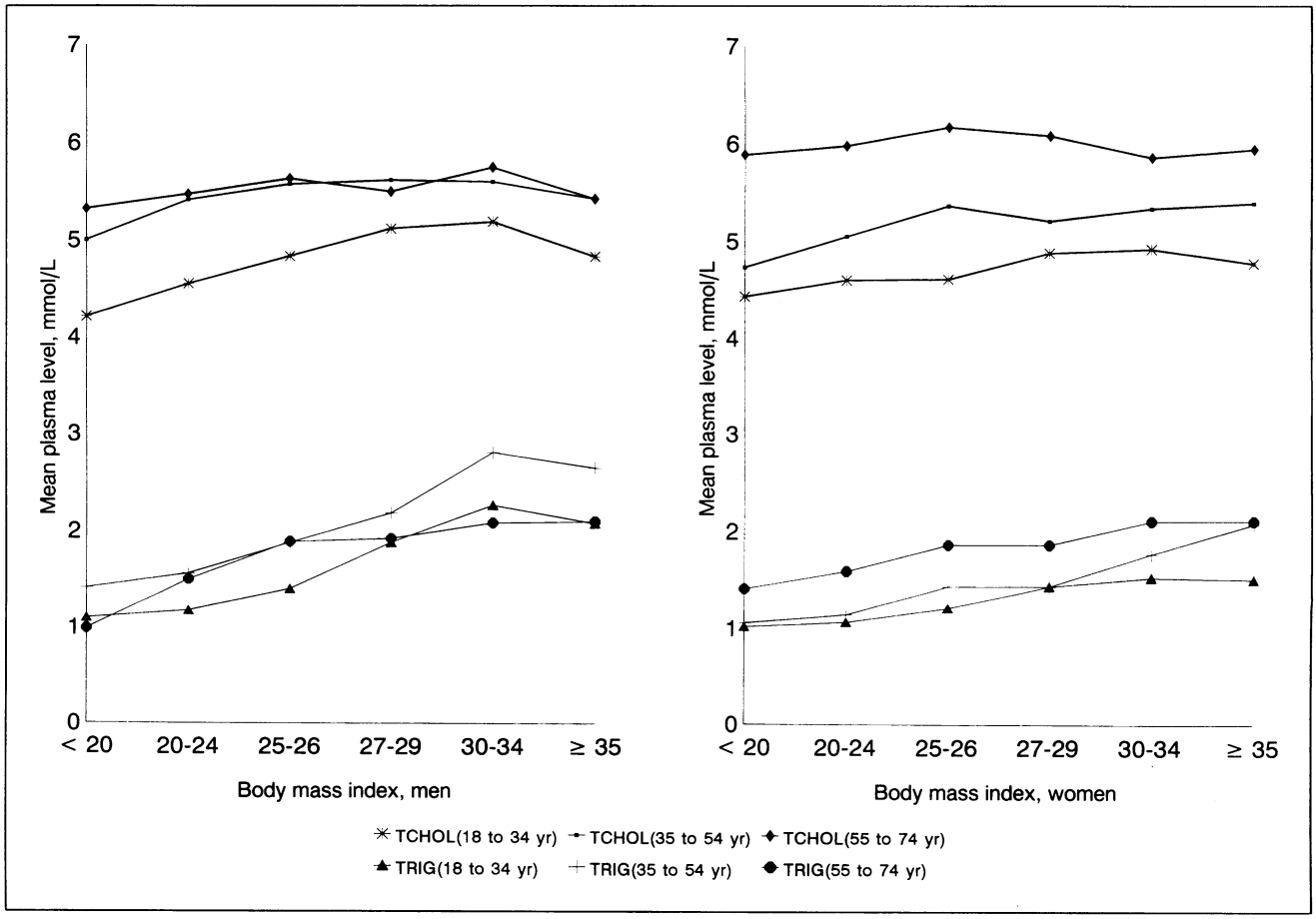


**Fig. 1: Mean total plasma cholesterol and triglyceride levels (mmol/L) by body mass index in men and women; TCHOL = total cholesterol, TRIG = triglycerides.**

levels rather than the changes in mean values, this pattern is even more striking. Total plasma cholesterol levels illustrate this relation. Mean HDL-cholesterol declined steadily with increasing degree of obesity, whereas the ratio of total cholesterol to HDL-cholesterol increased markedly (Fig. 3). As this ratio is considered an important measure of CVD risk, it is apparent that obese individuals are at increased risk due to unfavourable lipid alterations. The measurement of WHR in addition to BMI identifies a population subgroup with a higher prevalence of unfavourable lipid profile in our data and those of others.[32,35,37-39] WHR appears to be most useful in this regard for total plasma cholesterol in younger groups.

Self-report is expected to provide a reliable, although low, estimate of the prevalence of diabetes.[54] The prevalence in this survey is consistent with that from other North American surveys that incorporated laboratory features in the definition.[25,27,55] As reported by others, the prevalence of diabetes increases with age and the degree of obesity[21,25,26,28] and is greater among those with a high WHR.[2,31,40,41] However, obesity appears to play a larger role in the development of diabetes among older (45 to 74) than among younger (18 to 44) people.

In the 1985 Health Promotion Survey, 88% of Canadian women with a BMI of 25 to 27 and 93% of those with a BMI greater than 27 were dissatisfied with their weight and wanted to lose weight. However, this desire was also observed in 70% of Canadian women with a healthy BMI (20 to 25) and in 7% of those with a BMI less than 20.[56] Our results show the same trend. Moreover, this attitude was more common in the younger groups and was observed in women only. Dieting is the norm among young women in North America.[57] The sociocultural emphasis on thinness may be one of the major causes of dieting behaviour and has been regarded as one of the reasons for the rapid increase in the incidence of eating disorders[58] and binge eating.[57,59]

A sizable proportion of Canadians are massively obese, with BMI values exceeding 35 (3% of men, 5% of women). In the fifth to seventh decades of life, approximately twice as many women as men fall into this category. Van Itallie[60] has noted the unusually high incidence of metabolic complications among this group, and the present study confirms these findings. People with BMI over 35 display the highest prevalence of high blood pressure (44% in men, 36% in women), diabetes (13% in men, 14% in women) and a high prevalence of hypercholes-

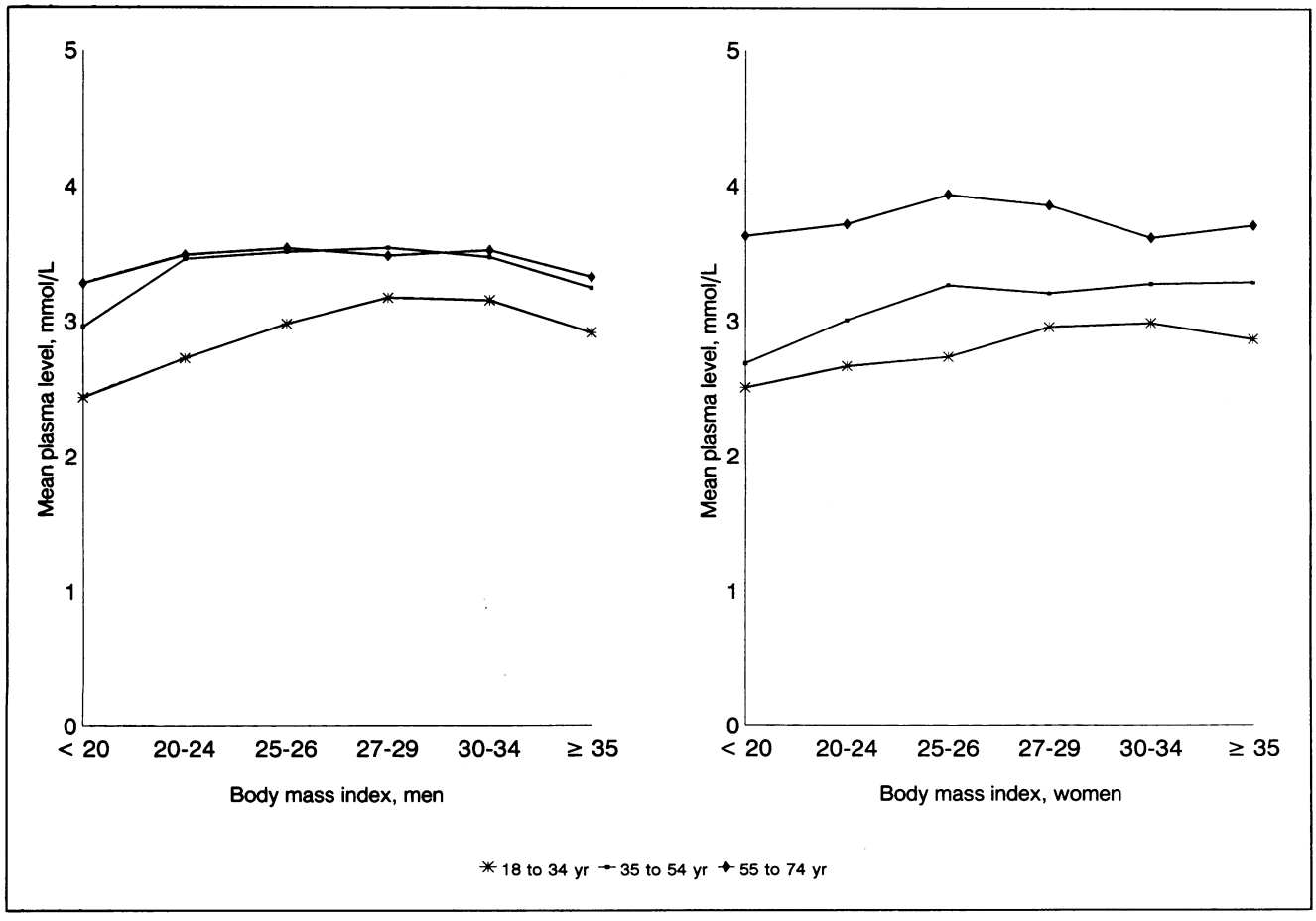


**Fig. 2: Mean levels of low density lipoprotein (LDL) cholesterol (mmol/L) in men and women.**

terolemia (57% in men, 60% in women). These people are thus at high risk for multiple health problems and should be the focus of special attempts to provide guidance and support.

The prevalence of obesity, particularly abdominal obesity, increased strikingly with age irrespective of gender. Given the strong association of obesity with such CVD risk factors as high blood pressure, diabetes, hypercholesterolemia, depressed HDL-cholesterol and increased total cholesterol to HDL-cholesterol ratio, it is clear that obesity will continue to impair the cardiovascular health of Canadians for some years to come.

Interventions are needed at several levels. All primary health care providers must routinely assess the obesity status of their patients. As body weight

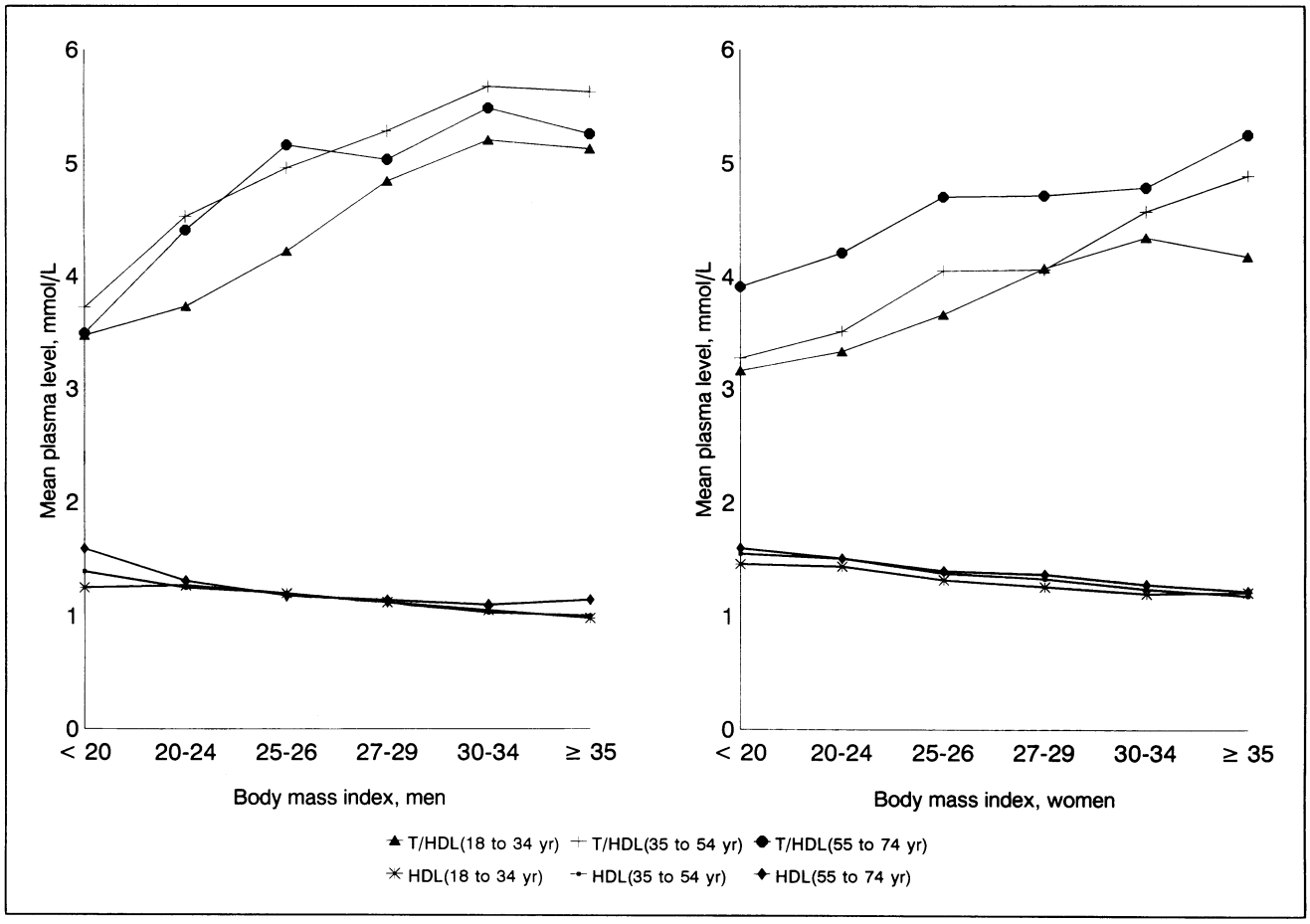


**Fig. 3: Mean levels of high density lipoprotein (HDL) cholesterol (mmol/L) and the ratio of total cholesterol to HDL-cholesterol by body mass index in men and women; T/HDL = total cholesterol to HDL ratio.**

Table 7: Prevalence of elevated total plasma cholesterol (≥ 5.2 mmol/L) by BMI, sex and age

| | BMI; % of subjects | | | | | | |
|---|---|---|---|---|---|---|---|
| Sex; age, yr | < 20 | 20–24 | 25–26 | 27–29 | 30–34 | ≥ 35 | All |
| Men | | | | | | | |
| 18–34 | 13 | 20 | 36 | 41 | 47 | 31 | 28 |
| 35–54 | 27 | 56 | 61 | 67 | 62 | 66 | 60 |
| 55–74 | 53 | 60 | 67 | 58 | 66 | 72 | 62 |
| All | 21 | 38 | 54 | 56 | 59 | 57 | 47 |
| Women | | | | | | | |
| 18–34 | 15 | 18 | 22 | 30 | 36 | 32 | 20 |
| 35–54 | 27 | 38 | 56 | 51 | 54 | 54 | 43 |
| 55–74 | 67 | 81 | 82 | 82 | 76 | 84 | 80 |
| All | 23 | 38 | 53 | 57 | 58 | 60 | 43 |
| Total | 23 | 38 | 54 | 57 | 59 | 59 | 45 |

measurements can no longer suffice as a single indicator of corpulence, measurement of BMI and WHR are essential to diagnose abdominal obesity. Although the cutoff values for WHR of 0.8 for women and 0.9 for men were used in the present study to identify risk, more detailed analysis of cutoff values must be undertaken to increase the diagnostic utility of this measurement.

As outlined by the recent national task force,[61] the treatment of obesity must include both regula-

Table 8: Prevalence of elevated total plasma cholesterol (≥ 5.2 mmol/L) by BMI and WHR*

| | BMI < 27; % of subjects | | BMI ≥ 27; % of subjects | |
|---|---|---|---|---|
| Sex; age, yr | Low WHR | High WHR | Low WHR | High WHR |
| Men | | | | |
| 18–34 | 20 | 38 | 36 | 47 |
| 35–54 | 55 | 60 | 72 | 64 |
| 55–74 | 60 | 66 | 71 | 59 |
| All | 33 | 57 | 55 | 58 |
| Women | | | | |
| 18–34 | 16 | 19 | 28 | 38 |
| 35–54 | 39 | 48 | 55 | 52 |
| 55–74 | 81 | 79 | 81 | 81 |
| All | 33 | 51 | 52 | 64 |
| Total | 33 | 54 | 53 | 60 |

*Values for WHR as in Table 6.

Table 9: Prevalence of self-reported diabetes by BMI, sex and age

| | BMI; % of subjects | | | | | | |
|---|---|---|---|---|---|---|---|
| Sex; age, yr | < 20 | 20–24 | 25–26 | 27–29 | 30–34 | ≥ 35 | All |
| Men | | | | | | | |
| 18–34 | 0 | 1 | 1 | 0 | 1 | 2 | 1 |
| 35–54 | 0 | 2 | 4 | 5 | 11 | 11 | 4 |
| 55–74 | 6 | 10 | 10 | 10 | 18 | 30 | 12 |
| All | 1 | 3 | 4 | 5 | 11 | 13 | 5 |
| Women | | | | | | | |
| 18–34 | 1 | 3 | 5 | 3 | 8 | 5 | 3 |
| 35–54 | 0 | 3 | 5 | 6 | 7 | 9 | 4 |
| 55–74 | 2 | 6 | 5 | 10 | 18 | 23 | 9 |
| All | 1 | 4 | 5 | 6 | 11 | 14 | 5 |
| Total | 1 | 3 | 4 | 6 | 11 | 14 | 5 |

Table 10: Prevalence of self-reported diabetes by BMI and WHR* and by sex and age

| | BMI < 27; % of subjects | | BMI ≥ 27; % of subjects | |
|---|---|---|---|---|
| Sex; age, yr | Low WHR | High WHR | Low WHR | High WHR |
| Men | | | | |
| 18–34 | 1 | 3 | 0 | 0 |
| 35–54 | 0 | 5 | 10 | 8 |
| 55–74 | 5 | 10 | 10 | 16 |
| All | 1 | 6 | 5 | 8 |
| Women | | | | |
| 18–34 | 3 | 7 | 4 | 8 |
| 35–54 | 3 | 3 | 2 | 10 |
| 55–74 | 3 | 9 | 4 | 20 |
| All | 3 | 6 | 3 | 14 |
| Total | 2 | 6 | 4 | 11 |

*Values for WHR as in Table 6.

tion of food consumption and enhancement of activity pattern. Treatment programs, which range from multidisciplinary university-affiliated clinics to self-help groups, commercial clinics and individual regimens, should be carefully scrutinized, selected and monitored for each patient.

Health promotion activities at the community level must focus on the development of physical and social environments supporting healthy food choices and activity patterns for Canadians of all ages. The attainment of a healthy weight and reduction of abdominal obesity should be emphasized.

## Conclusion

Obesity is common among Canadian adults. There has been little change in the prevalence of obesity during the past two decades. As health risks have been shown to be associated with a BMI over 25, nearly 40% of women and over 55% of men in Canada can be considered at increased health risk due to their weight. The increased prevalence of obesity, especially abdominal obesity, with age is striking. Such a prevalence indicates a need for broad-based programs that encourage and facilitate healthy eating and activity patterns for all age groups.

The best cutoff point to identify a high WHR especially in males is not clear. Further examination of the association of given cutoffs points with other risk factors and with adverse health outcomes is needed.

High blood pressure, elevated plasma cholesterol and diabetes are all more prevalent among obese individuals. The measurement of WHR contributes to the assessment of adiposity and identifies people with a high prevalence of concurrent CVD risk factors. Health professionals should incorporate the measurement of BMI and WHR into their routine examinations to enhance their evaluation of health risk.

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Table 11: Proportion of subjects trying to lose weight by BMI and by sex and age

| | BMI; % of subjects | | | | | | |
|---|---|---|---|---|---|---|---|
| | < 20 | 20–24 | 25–26 | 27–29 | 30–34 | ≥ 35 | All |
| Men | | | | | | | |
| 18–34 | 1 | 9 | 27 | 45 | 42 | 35 | 20 |
| 35–54 | 2 | 8 | 29 | 38 | 53 | 36 | 28 |
| 55–74 | 2 | 9 | 31 | 35 | 55 | 54 | 29 |
| All | 1 | 9 | 29 | 39 | 51 | 40 | 25 |
| Women | | | | | | | |
| 18–34 | 6 | 36 | 64 | 69 | 65 | 61 | 38 |
| 35–54 | 7 | 35 | 52 | 66 | 69 | 59 | 43 |
| 55–74 | 3 | 23 | 45 | 52 | 58 | 65 | 39 |
| All | 6 | 33 | 54 | 62 | 63 | 62 | 40 |
| Total | 5 | 22 | 38 | 48 | 57 | 54 | 32 |

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