

Health at a Glance

Aerobic fitness, body mass index and health-related risk factors

by Janine Clarke and Shirley Bryan

Release date: March 28, 2017



How to obtain more information

For information about this product or the wide range of services and data available from Statistics Canada, visit our website, www.statcan.gc.ca.

You can also contact us by

email at STATCAN.infostats-infostats.STATCAN@canada.ca

telephone, from Monday to Friday, 8:30 a.m. to 4:30 p.m., at the following numbers:

- | | |
|---|----------------|
| • Statistical Information Service | 1-800-263-1136 |
| • National telecommunications device for the hearing impaired | 1-800-363-7629 |
| • Fax line | 1-514-283-9350 |

Depository Services Program

- | | |
|------------------|----------------|
| • Inquiries line | 1-800-635-7943 |
| • Fax line | 1-800-565-7757 |

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner. To this end, Statistics Canada has developed standards of service that its employees observe. To obtain a copy of these service standards, please contact Statistics Canada toll-free at 1-800-263-1136. The service standards are also published on www.statcan.gc.ca under “Contact us” > “Standards of service to the public.”

Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued co-operation and goodwill.

Standard table symbols

The following symbols are used in Statistics Canada publications:

- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0^o value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- ^P preliminary
- ^r revised
- X suppressed to meet the confidentiality requirements of the *Statistics Act*
- ^E use with caution
- F too unreliable to be published
- * significantly different from reference category ($p < 0.05$)

Published by authority of the Minister responsible for Statistics Canada

© Minister of Industry, 2017

All rights reserved. Use of this publication is governed by the Statistics Canada [Open Licence Agreement](#).

An HTML version is also available.

Cette publication est aussi disponible en français.

Health at a Glance

Aerobic fitness, body mass index and health-related risk factors

by Janine Clarke and Shirley Bryan

Highlights

- Health-related risk factors (such as high blood pressure or a large waist circumference) were more common among adults who have aerobic fitness ratings of needs improvement or fair compared with adults who have good, very good or excellent aerobic fitness.
- The presence of one or more health-related risk factor was less likely among adults with good, very good or excellent aerobic fitness compared with their less fit counterparts, even among those who were overweight or obese.
- Large waist circumference was the health-related risk factor that showed the largest differences across aerobic fitness ratings, particularly among overweight and obese adults.

Introduction

Physical fitness plays an important role in improving health and well-being. There are several components of physical fitness, including aerobic fitness and body composition. Aerobic fitness—referring to the ability of the lungs, heart and circulatory system to efficiently deliver oxygen to working muscles for use during **physical activity**—benefits many parts of the body, including the heart, lungs, muscles, bones, blood, immune system and nervous system.¹ In relation to health disorders, a high level of aerobic fitness reduces the risk for such conditions as type 2 diabetes, cardiovascular disease, hypertension, cancer, and osteoporosis.^{2,3,4,5} There are also benefits to mental health, including a reduced risk for depression.^{2,3,4,5} As well, people at higher levels of

aerobic fitness, compared with those at lower levels, have a reduced risk of premature death from all causes.^{5,6}

Body composition, or more specifically excess body fat (i.e., overweight or obesity), is also associated with an increased risk for conditions such as type 2 diabetes, cardiovascular disease, hypertension, cancer, and osteoporosis, as well as an increased risk of premature death.⁷ However, it has been shown that a high level of aerobic fitness can reduce some of the health risks associated with overweight and obesity.^{6,8,9}

This article explores the percentage of adults aged 20 to 59 with various health-related risk factors according to

aerobic fitness rating (as measured by a fitness test called the **modified Canadian Aerobic Fitness Test** or mCAFT). Specifically, the percentage of adults with selected **health-related risk factors** is reported by aerobic fitness rating (needs improvement or fair, good, very good or excellent). The risk factors examined include high blood pressure, large waist circumference, high triglyceride levels (a type of fat), low high density lipoprotein levels (“good” cholesterol) and high blood sugar. The risk factors were selected on the basis of their relationship to metabolic syndrome—defined as a constellation (or clustering) of at least three of the risk factors. Metabolic syndrome, which is present in about one-fifth of Canadian adults,¹⁰ is associated with an increased risk of cardiovascular disease and type 2 diabetes.¹¹

As a second part of the analysis, adults aged 20 to 59 were classified as either having one or more of the five health-related risk factors mentioned above, or having no risk factors. The percentage of adults classified as having one or more health-related risk factor is presented by aerobic fitness rating and body mass index (BMI) category (normal weight, overweight, obese). Overweight (defined as a body mass index, or BMI, of 25 to 29.9 kg/m²) and obesity (BMI of 30 kg/m² or higher) is an important public health issue in Canada—recent estimates suggest that nearly two out of every three Canadian adults is overweight or obese.¹²

Data for this article are from the combined 2007 to 2011 **Canadian Health Measures Survey**.

Health-related risk factors are less common among adults with better aerobic fitness ratings

In Canadian adults aged 20 to 59, each of the five health-related risk factors were much less common among those with good, very good or excellent aerobic fitness compared to those with a fitness rating of needs improvement or fair (Chart 1). In fact, for each health-related risk factor examined, the percentage of adults with a given risk factor was at least 40% lower among those with good aerobic fitness and at least 50% lower among those with very good or excellent aerobic fitness, compared to those with an aerobic fitness rating of needs improvement or fair. This is consistent with evidence suggesting that higher levels of physical activity and physical fitness are associated with a lower percentage of adults with metabolic syndrome and its risk factors.^{17,18}

The greatest difference observed across aerobic fitness ratings was for large waist circumference. That is, 50% of those with a fitness rating of needs improvement or fair had a large waist circumference, more than triple the percentage of those with good aerobic fitness (14%) and just over 12 times the percentage of those with very good or excellent fitness (4%). The relationship between aerobic fitness and large waist circumference is discussed in more detail later in this article.

About physical activity

Physical activity and physical fitness are terms that are often used interchangeably. Although related, they are not the same. Physical activity refers to any movement or action that increases the heart rate and rate of breathing. In the context of health, physical fitness is defined as “the ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies.”²¹ Physical fitness, including aerobic fitness and body composition, is improved and maintained through regular participation in physical activity.

Physical activity of at least moderate intensity appears to be required for beneficial effects on health¹³ while improvements to aerobic fitness are realized when physical activity is pursued at a more vigorous level.¹⁴ Canada’s Physical Activity Guidelines recommend that adults participate in activities of moderate-to-vigorous intensity for at least 150 minutes each week.¹⁵

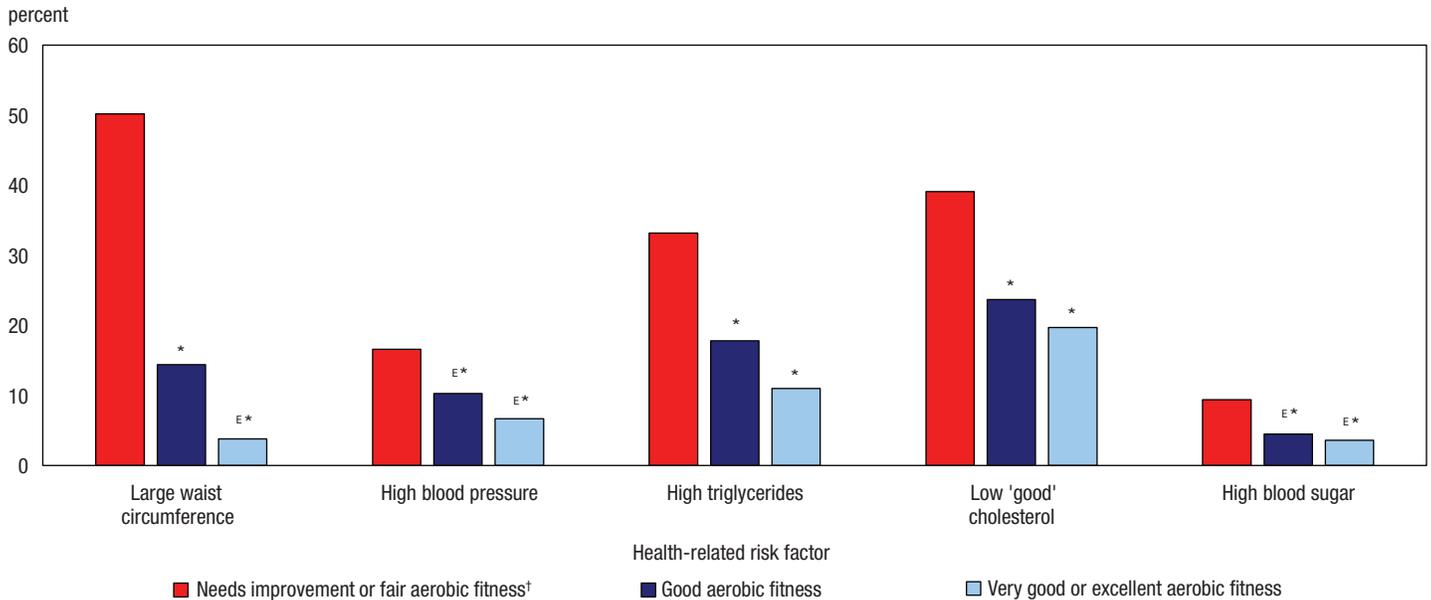
An activity is considered moderate or vigorous based on how hard you are working to carry out that activity and how much energy you are using to do it. The following guidelines can help determine whether an activity is moderate or vigorous:

Moderate-intensity physical activities are those where you are working hard enough to raise your heart rate but you can still talk, but not sing your favourite song, during the activity.¹⁵

Vigorous-intensity physical activities are those that make your heart rate go up quite a bit. During these activities you will not be able to say more than a few words without pausing for a breath.¹⁵

Recent results show that very few Canadian adults are considered physically active according to Canada’s Physical Activity Guidelines—one in five Canadian adults aged 18 to 79 achieved the recommended level of physical activity each week.¹⁶

Chart 1
Percentage of Canadians aged 20 to 59 with selected health-related risk factors, by aerobic fitness rating



[‡] use with caution

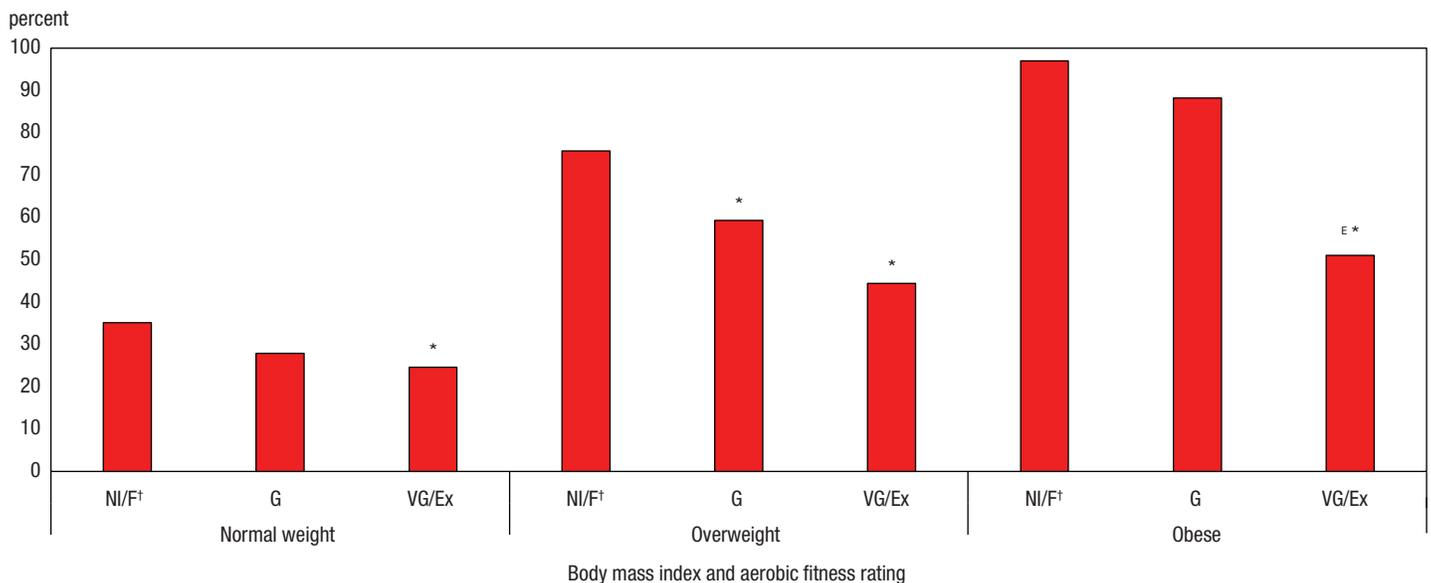
* significantly different from reference group ($p < 0.01$)

† reference group

Note: See the "Data source, methods and definitions" text box for more information on aerobic fitness and on the health-related risk factors included in this chart.

Source: Statistics Canada, combined cycle 1 (2007 to 2009) and cycle 2 (2009 to 2011), Canadian Health Measures Survey.

Chart 2
Percentage of Canadians aged 20 to 59 with one or more health-related risk factor, by body mass index (normal weight, overweight, obese)¹ and aerobic fitness rating (needs improvement or fair, good, very good or excellent)



NI needs improvement; F fair; G good; VG very good; Ex excellent

[‡] use with caution

* significantly different from reference group ($p < 0.05$)

† reference group

1. Normal weight is a body mass index (BMI) of 18.5 to 24.9 kg/m². Overweight is a BMI of 25.0 to 29.9 kg/m². Obese is a BMI of 30 kg/m² or higher.

Note: See the "Data source, methods and definitions" text box for more information on aerobic fitness and on the health-related risk factors included in this chart.

Source: Statistics Canada, combined cycle 1 (2007 to 2009) and cycle 2 (2009 to 2011), Canadian Health Measures Survey.

Presence of one or more health-related risk factor was less common among adults with very good or excellent aerobic fitness regardless of obesity status

In each BMI category, the likelihood of having one or more health-related risk factors was significantly lower among adults with very good or excellent aerobic fitness compared with adults with an aerobic fitness rating of needs improvement or fair (Chart 2). Similarly, in those classified as overweight and who had a good aerobic fitness rating, the percentage with at least one health-related risk factor was significantly lower than in those who were overweight but had an aerobic fitness rating of needs improvement or fair. These results are consistent with research showing a lower risk of developing metabolic syndrome among adults with high aerobic fitness levels, even in those who were overweight or obese.⁸

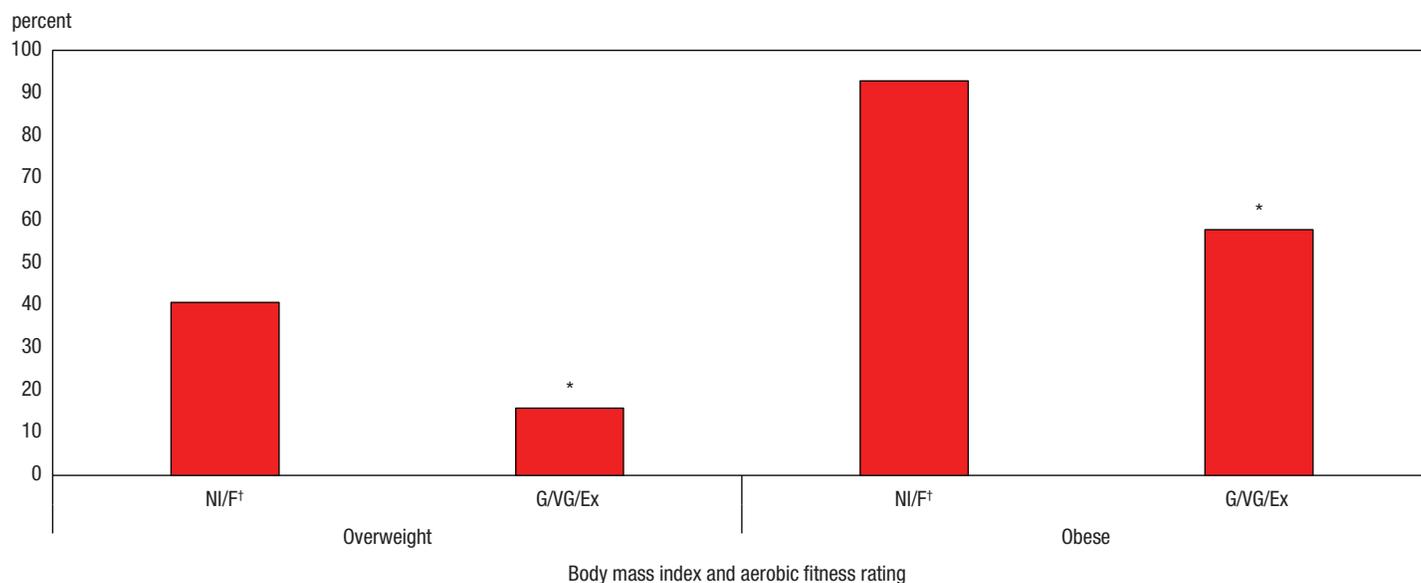
One way that aerobic fitness is thought to be related to health among people who are overweight or obese is due to the effect of regular physical activity on excess body fat, particularly in the abdominal area. Excess abdominal fat is associated with an increased risk of type 2 diabetes, coronary

heart disease and hypertension.^{19,20,21} As we saw above, a large waist circumference was the risk factor that was most significantly influenced by aerobic fitness rating. Chart 3 looks at large waist circumference (≥ 102 cm for males or ≥ 88 cm for females) by BMI and aerobic fitness rating. It shows that even among overweight and obese adults, the percentage with large waist circumference was significantly lower for those with good, very good or excellent²² aerobic fitness compared to those with an aerobic fitness rating of needs improvement or fair. This is consistent with several studies reporting that an increase in physical activity and aerobic fitness resulted in a decrease in abdominal fat, even without overall weight loss or a change in BMI category.^{8,23,24} A decrease in body fat can have a positive influence on overall health and significantly reduce the risk of disease and death.^{8,23,24}

Conclusion

This study shows that in adults aged 20 to 59 with an aerobic fitness rating of good, very good or excellent, the percentage with selected health-related risk factors was lower than in their less fit counterparts. While the benefit of higher aerobic fitness was observed for blood pressure, triglyceride,

Chart 3
Percentage of Canadians aged 20 to 59 with large waist circumference,¹ by body mass index² and aerobic fitness rating (needs improvement or fair, good, very good or excellent)



NI needs improvement; F fair; G good; VG very good; Ex excellent

* significantly different from reference group ($p < 0.05$)

[†] reference group

1. A large waist circumference is ≥ 102 cm for males or ≥ 88 cm for females.

2. Overweight is a body mass index (BMI) of 25.0 to 29.9 kg/m². Obese is a BMI of 30 kg/m² or higher.

Note: See the "Data source, methods and definitions" text box for more information on aerobic fitness.

Source: Statistics Canada, combined cycle 1 (2007 to 2009) and cycle 2 (2009 to 2011), Canadian Health Measures Survey.

cholesterol and blood sugar levels, the difference was greatest for large waist circumference, which may reflect the influence of physical activity and aerobic fitness on excess body fat, specifically abdominal fat. The analysis also shows that even among adults classified as overweight or obese, aerobic fitness is related to a lower likelihood of having one or more risk factors. These findings underscore the importance of aerobic fitness in lowering the risk of chronic conditions such as metabolic syndrome, type 2 diabetes,

coronary heart disease and hypertension and thus may be useful in informing policy and programming aimed at improving the health of Canadians.

Janine Clarke and **Shirley Bryan** are analysts with the Health Statistics Division at Statistics Canada

Data sources, methods and definitions

Data source

The **Canadian Health Measures Survey** (CHMS) (<http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5071>) is a cross-sectional survey conducted by Statistics Canada in partnership with Health Canada and the Public Health Agency of Canada. Data were collected over a two-year collection cycle from a nationally representative sample of Canadians aged 6 to 79 in cycle 1 (March 2007 to February 2009) and 3 to 79 in cycle 2 (August 2009 to November 2011). The results are representative of approximately 96% of the Canadian population with the following exclusions: persons living on reserves or other Aboriginal settlements, full-time members of the Canadian Forces, institutionalized populations, and persons living in certain remote regions. The CHMS includes an in-home interview and a visit to a mobile clinic where physical measurements (e.g., height and weight) and blood and urine samples are taken.

Methods

For this study, data from cycles 1 and 2 of the CHMS were combined to increase the sample size. Respondents were included ($n = 3,845$) if they were 20 to 59 years of age and had valid results for each of the following tests or measurements: aerobic fitness, body mass index (BMI), and five health-related risk factors. Each are described in more detail below.

The **aerobic fitness rating** was determined from a submaximal exercise test called the **modified Canadian Aerobic Fitness test** (mCAFT).^{1,12,25,26} The mCAFT is a moderate intensity exercise test that was performed by the respondents at the CHMS clinic. During the test the respondent's heart rate was monitored while they stepped up and down a set of stairs continuously to music during a series of three minute stages. The heart rate at the end of

the last completed stage of stepping was used to calculate the respondent's aerobic fitness score. The score is then used to assign, based on their age and sex, one of the following aerobic fitness ratings:

- needs improvement
- fair
- good
- very good
- excellent

Due to small sample sizes in this study, the aerobic fitness ratings were regrouped into three categories as follows: needs improvement/fair, good, and very good/excellent.

Body mass index (BMI) was directly measured in the CHMS clinic following standard procedures.^{25,26} It was calculated by dividing a person's weight in kilograms (kg) by their height, squared, in metres (m^2). For non-pregnant adults ages 18 and older, BMI was categorized according to cut-points recommended by Health Canada¹⁹ and the World Health Organization²⁷ as follows:

- normal weight (18.5 to 24.9 kg/m^2)
- overweight (25.0 to 29.9 kg/m^2)
- obese (30.0 kg/m^2 and over)

When interpreting BMI, it is important to note that it is not a direct measure of body fat. As a result, misclassification can occur among those with higher levels of fat-free mass (e.g., muscle, bone). For example, a person who is particularly muscular (and therefore has a high fat-free mass) might be categorized as overweight based on their BMI. However, this person's actual health risk would be lower than someone with the same BMI who has a higher fat mass.¹⁹

The **health-related risk factors** included in this analysis were directly measured at the CHMS clinic and include large waist circumference, high blood pressure, high **triglycerides**, low **high-density lipoprotein (HDL) cholesterol** and high blood sugar (determined from blood **glucose** levels for fasted respondents or from **glycated hemoglobin A1c** from non-fasted respondents). Using the cut-offs outlined in Table 1, respondents were classified as having at least one risk factor or having no risk factors.¹¹

Table 1
Cut-offs for the health-related risk factors examined in this article

Risk factor	Cut-off ¹	
	Males	Females
Large waist circumference	≥ 102 cm	≥ 88 cm
High blood pressure	≥130/85 mmHg	≥130/85 mmHg
High triglycerides ^{2,3}	≥ 1.7 mmol/L	≥ 1.7 mmol/L
Low high-density lipoprotein cholesterol ⁴	< 1.03 mmol/L	< 1.3 mmol/L
High blood sugar ⁵		
Glucose	≥ 5.6 mmol/L	≥ 5.6 mmol/L
Glycated hemoglobin A1c (HbA1c)	≥ 6.5 %	≥ 6.5 %

1. Medication use related to any of the above components was considered as having the risk factor.
 2. Measured for fasted respondents only.
 3. A type of fat that the body uses for energy.
 4. Also known as “good cholesterol” because it helps to remove cholesterol from the blood vessels for breakdown and disposal, preventing fatty build up.
 5. If the respondent was fasted then the result for glucose was used. If the respondent was non-fasted, then the result for glycated hemoglobin A1c (HbA1c) was used. HbA1c provides an average blood sugar level over the past two to three months.
- Source:** Alberti K., R.H. Eckel, S.M. Grundy, et al. 2009. “Harmonizing the metabolic syndrome. A joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity.” *Circulation*. Vol. 120, no. 16, p. 1640–1645.

Definitions

Glucose is a type of sugar in the blood used as a source of energy for all body organs and functions.

Glycated hemoglobin A1c (or HbA1c) is an indicator of the average levels of sugar in the blood during the previous two to three months.

High-density lipoprotein (HDL) cholesterol is known as “good cholesterol” because it helps to remove cholesterol from the blood vessels for breakdown and disposal, preventing fatty build up.

Metabolic syndrome is a condition that increases a person’s relative risk of cardiovascular diseases and type 2 diabetes. Metabolic syndrome is present when a person has 3 or more of the health-related risk factors discussed in this article.¹¹

Triglycerides are a type of fat that the body uses to produce energy. They are the form in which most fat is stored in the body.

References and notes

1. Canadian Society for Exercise Physiology. 2013. *Canadian Society for Exercise Physiology – Physical Activity Training for Health (CSEP-PATH)*. Ottawa : Canadian Society for Exercise Physiology.
2. Blair, S.N., Y. Cheng and J.S. Holder. 2001. “Is physical activity or physical fitness more important in defining health benefits?” *Medicine & Science in Sports & Exercise*. Vol. 33, no. 6 (Supplement), p. S379–S399.
3. Janssen, I. 2012. “Health care costs of physical inactivity in Canadian adults.” *Applied Physiology, Nutrition, and Metabolism*. Vol. 37, no. 4, p. 803–806.
4. Warburton, D., S. Charlesworth, A. Ivey, L. Nettlefold, and S. Bredin. 2010. “A systematic review of the evidence for Canada’s Physical Activity Guidelines for Adults.” (<http://ijbnpa.biomedcentral.com/articles/10.1186/1479-5868-7-39>) *International Journal of Behavioral Nutrition and Physical Activity*. Vol. 7, no. 39.
5. World Health Organization. 2016. “Physical activity.” *Global Strategy on Diet, Physical Activity and Health*. (<http://www.who.int/dietphysicalactivity/pa/en>) Geneva : World Health Organization (accessed August 31, 2016).
6. Kodama, S., K. Saito, S. Tanaka, et al. 2009. “Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: a meta-analysis.” *Journal of the American Medical Association*. Vol. 301, no. 19, p. 2024–2035.
7. Public Health Agency of Canada and Canadian Institute for Health Information. 2011. *Obesity in Canada: A Joint Report from the Public Health Agency of Canada and the Canadian Institute for the Health Information*. (<http://www.phac-aspc.gc.ca/hp-ps/hl-mvs/oic-oac/index-eng.php>) Ottawa.
8. Barry, V.W., M. Baruth, M.W. Beets, J.L. Durstine, J. Liu, and S.N. Blair. 2014. “Fitness vs. fatness on all-cause mortality: a meta-analysis.” ([http://www.onlinepcd.com/article/S0033-0620\(13\)00155-2/abstract](http://www.onlinepcd.com/article/S0033-0620(13)00155-2/abstract)) *Progress in Cardiovascular Diseases*. Vol. 56, no. 4, p. 382–390 (accessed September 23, 2016).
9. Lamonte, M.J., C.E. Barlow, R. Jurca, et al. 2005. “Cardiorespiratory fitness is inversely associated with the incidence of metabolic syndrome – A prospective study of men and women.” *Circulation*. Vol. 112, no. 4, p. 505–512.
10. Statistics Canada. 2014. “Metabolic syndrome in adults, 2012 and 2013.” (<http://www.statcan.gc.ca/pub/82-625-x/2015001/article/14135-eng.htm>) *Health Fact Sheets*. Statistics Canada Catalogue no. 82-625-X.
11. Alberti, K., R.H. Eckel, S.M. Grundy, et al. 2009. “Harmonizing the metabolic syndrome: A Joint Interim Statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity.” *Circulation*. Vol. 120, no. 16, p. 1640–1645.
12. Statistics Canada. 2014. “Body composition of adults, 2012 and 2013.” (<http://www.statcan.gc.ca/pub/82-625-x/2014001/article/14104-eng.htm>) *Health Fact Sheets*. Statistics Canada Catalogue no. 82-625-X.
13. Canadian Society for Exercise Physiology. 2003. *Canadian Physical Activity, Fitness and Lifestyle Approach, 3rd edition*. Ottawa, Ontario : Canadian Society for Exercise Physiology.
14. Drenowatz, C., V.K. Prasad, G.A. Hand, R.P. Shook, and S.N. Blair. 2016. “Effects of moderate and vigorous physical activity on fitness and body composition.” *Journal of Behavioral Medicine*. Vol. 39, no. 4, p. 624–632.
15. Canadian Society for Exercise Physiology. 2012. *Canadian Physical Activity Guidelines / Canadian Sedentary Behaviour Guidelines Handbook*. Ottawa : Canadian Society for Exercise Physiology.
16. Statistics Canada. 2014. “Directly measured physical activity of adults, 2012 and 2013.” (<http://www.statcan.gc.ca/pub/82-625-x/2015001/article/14135-eng.htm>) *Health Fact Sheets*. Statistics Canada Catalogue no. 82-625-X.
17. Farrell, S.W., Y.J. Cheng, and S.N. Blair. 2004. “Prevalence of the metabolic syndrome across cardiorespiratory fitness levels in women.” *Obesity Research*. Vol. 12, no. 5, p. 824–830.
18. Jurca, R., M.J. Lamonte, T.S. Church, et al. 2004. “Associations of muscle strength and fitness with metabolic syndrome in men.” *Medicine & Science in Sports & Exercise*. Vol. 36, no. 8, p. 1301–1307.
19. Health Canada. 2003. *Canadian Guidelines for Body Weight Classification in Adults*. (<http://hc-sc.gc.ca/fn-an/nutrition/weights-poids/guide-ld-adult/index-eng.php>) Ottawa : Health Canada.
20. Janssen, I., P.T. Katzmarzyk, and R. Ross. 2004. “Waist circumference and not body mass index explains obesity-related health risk.” *American Journal of Clinical Nutrition*. Vol. 79, no. 3, p. 379–384.
21. Kannel, W.B., L.A. Cupples, R. Ramaswami, et al. 1991. “Regional obesity and risk of cardiovascular disease: the Framingham Study.” *Journal of Clinical Epidemiology*. Vol. 44, no. 2, p. 183–190.
22. Due to small sample size, the aerobic fitness rating of good was grouped with very good and excellent.
23. Lee, D.-C., E.G. Artero, X. Sui, and S.N. Blair. 2010. “Mortality trends in the general population: the importance of cardiorespiratory fitness.” *Journal of Psychopharmacology*. Vol. 24, supplement 4, p. 24–35.
24. Janssen, I., P.T. Katzmarzyk, R. Ross, et al. 2004. “Fitness alters the association of BMI and waist circumference with total and abdominal fat.” (<http://onlinelibrary.wiley.com/doi/10.1038/oby.2004.60/full>) *Obesity Research*. Vol. 12, no. 3, p. 525–537.
25. Statistics Canada. 2011. *Canadian Health Measures Survey (CHMS) Data User Guide: Cycle 1*. Ottawa: Statistics Canada.
26. Statistics Canada. 2013. *Canadian Health Measures Survey (CHMS) Data User Guide: Cycle 2*. Ottawa: Statistics Canada.
27. World Health Organization. 2000. *Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation on Obesity*. Geneva : World Health Organization.