Report of Population Health Survey

2020-22

(Part II)

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18/F, Wu Chung House, 213 Queen's Road East, Wan Chai, Hong Kong

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Executive Summary

The Population Health Survey (PHS) 2020-22 comprised two parts, namely (I) household survey; and (II) health examination. The fieldwork of the household survey was conducted between 2 November 2020 and 2 January 2022, with temporary suspension between 2 December 2020 and 22 February 2021 due to COVID-19 pandemic. It covered the land-based non-institutional population aged 15 or above in Hong Kong, excluding foreign domestic helpers and visitors. Health examination was conducted between 1 March 2021 and 19 February 2022. Age-gender stratified random subsample of respondents aged between 15 and 84, who were successfully enumerated in the household survey and had signed consent for health examination, were further invited to undergo health examination. A total of 3 757 respondents out of 6 373 consented respondents were selected and invited to make appointment for health examination, including 2 072 respondents who completed physical measurements and blood tests. These represented a participation rate of 55.2%. 2 066 of the invited respondents completed spot urine test for iodine (participation rate: 55.0%), and 1 981 of the invited respondents also completed 24-hour urine tests (participation rate: 52.7%). The survey data were adjusted for the differential participation rates by type of housing and grossed up to control for the age and gender profile of the study population for the second quarter (Q2) of 2021. PHS 2020-22 Part I Survey Report which presented findings on household survey has been published in December 2022. This report is the Part II Survey Report of PHS 2020-22 to present findings on health examination. The health examination included anthropometric and blood pressure measurements as well as blood tests for fasting plasma glucose, haemoglobin A1c (HbA1c) and fasting lipid profile, and 24-hour urine test for sodium and potassium. The health examination also collected data on hepatitis, iron and iodine profile, and the results will be presented in the subsequent separate reports. The details of survey method, quality control measures and characteristics of the sample could be referred to Chapter 1 of the Part I Report.

Physical Measurements

The patterns and prevalence of overweight/obese and raised blood pressure were estimated by physical measurement including anthropometric and blood pressure measurements. The blood pressure measurement findings were combined with the self-reported data collected in household interview for estimation of local prevalence.

Body Mass Index (BMI) / Overweight and Obesity

The mean BMI for females and males aged 15-84 were 23.2 kg/m^2 and 24.6 kg/m^2 respectively. Overall, 22.0% (19.7% of females and 24.6% of males) were overweight (i.e. 23.0 kg/m^2 ≤ BMI < 25.0 kg/m^2) and another 32.6% (26.4% of females and 39.4% of males) persons aged 15-84 were obese (i.e. BMI ≥ 25.0 kg/m^2), according to the classification of BMI categories for Asian adults adopted by the Western Pacific Regional Office of the WHO. Obesity and overweight were most common among females aged 65-84 (57.0%) and among males aged 45-54 (74.6%).

According to the Asian BMI classification (i.e. overweight BMI ≥ 23.0 kg/m^2; obesity BMI ≥ 25.0 kg/m^2), the age-standardised prevalence of overweight and obesity was 51.3% in persons aged 18-84 years (Crude prevalence: 55.1%). According to WHO's BMI classification (i.e. overweight BMI ≥ 25.0 kg/m^2; obesity BMI ≥ 30.0 kg/m^2), the age-standardised prevalence of overweight and obesity was 30.8% in persons aged 18-84 years (Crude prevalence: 32.8%).

Waist Circumference and Waist-hip Ratio / Central Obesity

Among persons aged 15-84, the mean waist circumference (WC) was 77.7 cm for females and 86.4 cm for males; and the mean waist-hip ratio (WHR) was 0.82 for females and 0.88 for males. Overall, 37.8% (38.7% for females and 36.8% for males) of persons aged 15-84 had central obesity as defined by WC (≥ 80 cm for females; ≥ 90cm for males) and 35.4% (31.4% for females and 39.9% for males) of persons aged 15-84 had central obesity as defined by WHR (≥ 0.85 females; ≥ 0.9 for males).

Raised Blood Pressure / Hypertension

The mean systolic blood pressure (SBP) of persons aged 15-84 was 119.6 mmHg (116.4 mmHg for females and 123.0 mmHg for males). The mean diastolic blood pressure (DBP) was 78.2 mmHg (76.1 mmHg for females and 80.5 mmHg for males). The prevalence of raised blood pressure / hypertension among persons aged 15-84 including those self-reported doctor-diagnosed hypertension and those with no self-reported history but raised blood pressure by physical measurement was 29.5% (26.2% for females and 33.2% for males). The prevalence of raised blood pressure / hypertension increased steadily with age from 4.9% among those aged 15-24 to 57.4% among those aged 65-84. Among those aged 15-84, 12.1% (9.8% of females and 14.7% of males) had no self-reported history but with raised blood pressure by physical measurement. 17.4% (16.4% of females and 18.5% of males) of persons aged 15-84 had self-reported doctor-diagnosed hypertension, including 6.9% (5.9% of females and 8.0% of males) measured to have raised blood pressure with SBP ≥ 140 mmHg and / or DBP ≥ 90 mmHg in health examination.

The age-standardised prevalence of raised blood pressure (defined as systolic blood pressure (SBP) ≥ 140 mmHg and / or diastolic blood pressure ≥ 90 mmHg disregarding of known history of hypertension) among persons aged 18-84 years was 15.0% (Crude prevalence: 19.4%). The age-standardised mean SBP among persons aged 18-84 years was 116.0 mmHg (Crude mean: 119.8 mmHg).

Biochemical Testing – Blood

The patterns and prevalence of DM and raised blood cholesterol were estimated by biochemical testing covering blood tests for fasting plasma glucose, HbA1c and lipid profile, and combined with the self-reported data collected in household interview.

Raised Blood Glucose / Diabetes Mellitus (DM)

The mean values of fasting plasma glucose (FPG) for females and males aged 15-84 were 5.0 mmol/L and 5.2 mmol/L respectively. The mean values of glycated haemoglobin (HbA1c) for females and males aged 15-84 were 5.5% and 5.7% respectively. Among those aged 15-84, 8.5% (6.1% for females and 11.1% for males) had DM including 5.4% (3.6% for females and 7.3% for males) with self-reported doctor-diagnosed DM and 3.1% (2.5% of females and 3.8% of males) with no self-reported history but raised blood glucose or HbA1c (fasting plasma glucose ≥ 7.0 mmol/L or HbA1c ≥ 6.5%) by biochemical testing. The prevalence of DM increased with age from 0.6% for persons aged 15-24 to 19.0% for those aged 65-84. In addition, another 1.6% of persons aged 15-84 had impaired fasting glucose (IFG), i.e. with FPG between 6.1 and 6.9 mmol/L by biochemical testing.

The age-standardised prevalence of raised blood glucose / diabetes (defined as fasting plasma glucose concentration ≥ 7.0 mmol/L or on medication for raised blood glucose disregarding known history of diabetes or raised blood sugar but not on medication for these conditions) among persons aged 18-84 years was 4.6% (Crude prevalence: 6.9%).

Raised blood cholesterol / Hypercholesterolaemia

Among persons aged 15-84, the mean total cholesterol (TC) was 5.0 mmol/L (5.1 mmol/L for females and 5.0 mmol/L for males), mean high-density lipoprotein (HDL) was 1.5 mmol/L (1.7 mmol/L for females and 1.4 mmol/L for males) and mean low-density lipoprotein (LDL) was 3.0 mmol/L (2.9 mmol/L for females and 3.0 mmol/L for males). Overall, 42.4%, 15.8% and 30.0% of persons aged 15-84 had raised

TC (≥ 5.2 mmol/L), low HDL (< 1.3 mmol/L for females, < 1.0 mmol/L for males), and raised LDL (≥ 3.4 mmol/L) respectively.

Among persons aged 15-84, prevalence of raised blood cholesterol / hypercholesterolaemia was 51.9% (51.0% for females and 52.9% for males), including 15.7% with self-reported doctor-diagnosed high blood cholesterol and 36.2% with no self-reported history but raised total cholesterol (defined as TC ≥ 5.2 mmol/L) by biochemical testing. Analysed by age group, the highest prevalence of raised blood cholesterol / hypercholesterolaemia was observed in the age group 55-64 in both genders (76.6% in females and 67.0% in males).

Among persons aged 15-84, 25.3% (22.1% for females and 28.8% for males) had no self-reported history but with raised LDL level (≥ 3.4 mmol/L) by biochemical testing. The combined prevalence of self-reported doctor-diagnosed high blood cholesterol or with no self-reported history but raised LDL level was 41.0% (36.4% for females and 46.2% for males). Analysed by age group, the combined prevalence generally increased with age, with the highest prevalence (58.8%) among those aged 55-64 in both genders (59.0% in females and 58.5% in males).

Among persons aged 15-84, 37.1% (36.9% for females and 37.2% for males) had no self-reported history but with raised TC / LDL level (TC ≥ 5.2 mmol/L or LDL ≥ 3.4 mmol/L) by biochemical testing. The combined prevalence of self-reported doctor-diagnosed high blood cholesterol or with no self-reported history but raised TC / LDL level was 52.8% (51.2% for females and 54.5% for males). Analysed by age group, the combined prevalence generally increased with age, with the highest prevalence (72.8%) among those aged 55-64 in both genders (77.1% in females and 68.2% in males).

Among persons aged 18-84 years, the age-standardised prevalence of raised total cholesterol (defined as total cholesterol ≥ 5.0 mmol/L disregarding known history of high blood cholesterol) was 45.0% (Crude prevalence: 49.7%). The age-standardised mean total cholesterol was 5.0 mmol/L (Crude mean total cholesterol: 5.1 mmol/L).

Biochemical Testing – Urine

The PHS 2020-22 estimated daily sodium and potassium intake through measurement of sodium and potassium excretion from 24-hour urine collection.

Sodium Intake

Among persons aged 15-84, the mean 24-hour urinary sodium excretion was 144.0 mmol (127.0 mmol for females and 162.9 mmol for males), which is equivalent to a daily salt intake of 8.4 g per day (7.4 g per day for females and 9.5 g per day for males). The majority (83.9%) of persons aged 15-84 had dietary salt intake above the WHO recommended daily limit of less than 5 g per day, which was more common in males (91.5%) than females (77.1%). The mean daily salt intake increased with the frequency of eating-out, from 7.6 g per day among persons eating out less than once per week to 9.3 g per day among persons eating out 6 times or more per week. The age-standardised mean intake of salt (sodium chloride) among persons aged 18-84 years was 8.5 g per day (Crude mean: 8.4 g per day).

Potassium Intake

Among the persons aged 15-84, the estimated mean daily potassium intake was 2.3 g (2.1 g for females and 2.4 g for males). Majority of (90.9%) persons aged 15-84 had dietary potassium intake below the WHO recommended level of 3.5 g per day. The mean values of daily potassium intake increased from 2.1 g per day to 2.4 g per day for those consuming less than 2 servings a day and those consuming 5 servings or more a day respectively.

Risk of Cardiovascular Disease

The PHS adopted the Framingham Risk Model for cardiovascular disease (CVD) risks to predict the risk of CVD over the next 10 years in the general adult population aged 30-74 of Hong Kong.

Risk of Cardiovascular Disease over 10 Years Predicted by Framingham Risk Model

The Framingham Risk Model predicts the total risk of all cardiovascular outcomes including coronary heart disease, stroke, peripheral artery disease and heart failure. Among persons aged 30-74, the mean CVD risk over the next 10 years was 11.4% (6.4% for females and 17.0% for males). The mean CVD risk increased with age in both genders from 1.4% among females aged 30-44 to 14.8% among females aged 65-74, and from 4.7% among males aged 30-44 to 36.7% among males aged 65-74. Among persons aged 30-74, 14.5% were classified as high-risk (10-year CVD risk ≥ 20%), 19.2% as medium-risk (10-year CVD risk ≥ 10% and < 20%) and 66.3% as low-risk (10-year CVD risk < 10%) according to the Framingham Risk Model.

The proportion of high-risk persons was much lower in females (3.9%) than males (26.8%) and increased sharply with age and peaked at 14.9% and 75.8% among females and males aged 65-74 respectively.

The age-standardised prevalence of high cardiovascular disease (CVD) risk, defined by the Framingham Risk Model as ≥ 20%, among persons aged 40-74 was 14.7% (Crude prevalence: 18.4%). Among respondents aged 40-74 with high CVD risk, 37.6% received both drug therapy and counselling (including glycaemic control) to prevent heart attacks and strokes.

Chapter 1
Survey Method

1.1 Survey Method

The PHS 2020-22 comprised two parts, namely (I) household survey; and (II) health examination, including physical and biochemical measurements. The DH commissioned a private research firm and a private healthcare organisation with laboratory service to conduct the fieldworks of household survey and health examination respectively. Data analysis and reporting of the PHS 2020-22 was commissioned to the Jockey Club School of Public Health and Primary Care, the Chinese University of Hong Kong. The DH was responsible for the overall planning of the survey including the study design and development of questionnaire as well as monitoring the quality of various part of the survey.

1.1.1 Target Population Coverage

The household survey covered the land-based non-institutional population aged 15 or above in Hong Kong, excluding foreign domestic helpers and visitors of Hong Kong. The health examination covered persons aged between 15 and 84 (both ages inclusive) who had been enumerated in the household survey.

1.1.2 Sampling Frame and Sample Selection

The survey adopted the Frame of Quarters maintained by the Census and Statistics Department (C&SD) as the sampling frame. The Frame of Quarters consists of the Register of Quarters (RQ) and the Register of Segments (RS) which contain records of all addresses of permanent quarters in built-up areas and records of area segments in non-built-up areas respectively. Systematic replicated sampling was deployed for selecting a sample of replicates of living quarters in built-up areas from the RQ and a sample of area segments in non-built-up areas from the RS. Each replicate of living quarters is a representative sample of domestic households in Hong Kong.

1.1.3 Participants of Health Examination

All domestic households in the selected living quarters and all members aged 15 or above who met the target population coverage criteria stated in Section 1.1.1 above in the selected households were enumerated individually. All enumerated persons aged between 15 and 84 were invited to sign consent for health examination. For respondents under 18 years of age, their consent were signed by parents or guardians.

Eligible and consented members of enumerated households, stratified into gender and age groups were randomly invited to undergo a follow-up health examination.

1.1.4 Data Collection Method

Respondents who consented for health examination after completing the household interview were stratified into gender and age groups. For each group, the randomly selected respondents were contacted by telephone to make appointment at designated health examination centres. Appointment confirmation letters or SMS, a health examination pamphlet and instructions for blood test were sent to respondents who accepted the invitation. Another hotline was set up for enquiries and making appointments for health examination. Identities of respondents attending health examination were verified. Respondents were requested to complete a self-administered questionnaire on the day of the health examination. Physical measurements, blood taking and spot urine collection for iodine were performed by trained staff supervised by medical practitioner in four designated health examination centres, one each in Central, Causeway Bay, Mong Kok and Tsuen Wan. If respondents were eligible for performing the 24-hour urine tests, they were given two 24-hour urine collection bottles of 3 litres each and instructions for 24-hour urine collection, and were required to return their urine samples on the same day after the collection.

Procedures of physical measurements and biochemical tests followed the WHO STEPS Surveillance Manual [1] and the Protocol for Population Level Sodium Determination in 24-hour Urine Samples [2] from the World Health Organization (WHO). Procedures for handling biochemical specimens followed the Safety Guidelines on Transport of Clinical Specimens and Infectious Substances for Courier Team and the relevant Infection Control Guidelines issued by the Centre for Health Protection of the DH.

According to the Protocol[2] from the WHO, respondents meeting any one of the following criteria were excluded from 24-hour urine tests:

(a) Respondents who were unable to sign the consent form of health examination;
(b) Those with known history of heart or kidney failure, stroke or liver disease;
(c) Those who had recently begun therapy with diuretics (for less than two weeks preceding the survey); or
(d) Those with other conditions that would make 24-hour urine collection difficult, e.g. incontinence.

Dissemination of health examination results

All laboratory reports were reviewed by registered medical laboratory technologists before passing to the DH. Medical staff of DH further reviewed all laboratory results before sending to the respondents concerned. Health advice was provided to the respondents with results outside reference range.

1.1.5 Survey Instrument

The health examination includes the following items:

Self-administered questionnaire:
A self-administered questionnaire including questions on general well-being and conditions related to iron and iodine statuses, such as recent use of oral supplement or multivitamins.

Physical measurements:

(a) Measurement of blood pressure;
(b) Measurement of body height and body weight for calculation of body mass index; and
(c) Measurement of hip and waist circumferences for calculation of waist-hip ratio.

Biochemical testing:

(a) Fasting lipid profile, including total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL) and triglyceride;
(b) Fasting plasma glucose;
(c) Glycated haemoglobin (HbA1c);
(d) Haemoglobin, tests for iron status, e.g. serum iron, serum ferritin, and C-reactive protein;
(e) Tests for viral hepatitis, e.g. hepatitis A, C & E antibodies and hepatitis B antigens;
(f) Spot urinary iodine; and
(g) 24-hour urine testing for sodium and potassium.

The fieldwork of health examination was conducted between 1 March 2021 and 19 February 2022. A total of 3 757 respondents out of 6 373 consented respondents were selected according to age-gender stratified sampling and invited to make appointment for health examination. Among these 3 757 invited respondents, 2 072 respondents completed physical measurements and blood test (participation rate: 55.2%). The participation rate in females (55.8%) was slightly higher than that in males (54.4%). As regards the participation rates by age group, they ranged from 49.6% among respondents aged 65-84 to 62.5% among

those aged 55-64. 2 066 of the invited respondents completed spot urine test for iodine (participation rate: 55.0%), and 1 981 of the invited respondents also completed 24-hour urine tests (participation rate: 52.7%).

Part I Survey Report PHS 2020-22 which presented findings on household survey has been published in December 2022. This report is the Part II Survey Report of PHS 2020-22 to present findings on health examination. The health examination also collected data on hepatitis, iron and iodine profile, and the results will be presented in the subsequent separate reports. The details of survey method, quality control measures and characteristics of the sample could be referred to Chapter 1 of the Part I Report.

1.1.6 Grossing-up Method

The data collected from the health examination were adjusted by the differential participation rates for the three types of housing (i.e. public rental housing, subsidised sale flats and private housing), and grossed-up to the control for the age and gender profile of the local target population for the second quarter (Q2) of 2021. One set of statistical weights each was derived for (i) household survey, (ii) health examination (exclude 24-hour urine tests), (iii) 24-hour urine tests, and (iv) spot urine iodine. After these adjustments, the survey estimates can represent those of the study population during the survey period.

1.1.7 Reliability of the Estimates

The estimates of this survey are subject to sampling error and non-sampling error. For comparing the precision of the estimates of various variables related to sampling error, the coefficient of variation (CV) is obtained, by expressing the standard error (SE) as a percentage of the estimate to which it refers. The smaller the CV, the more precise is the estimate. The CVs of the estimates of selected variables presented in this report are given in Appendix.

1.1.8 Confidentiality

All questionnaires and data files were regarded as confidential documents, and the research team exercised due care in handling the records to avoid the leakage of information. At the beginning of the survey, all relevant staff of the private data collection firm commissioned for the survey were required to sign an undertaking not to disclose any confidential information related to the survey.

In accordance with the Personal Data (Privacy) Ordinance (Cap. 486) and the code of conduct of the research agency, all data collected from the survey were used only for research and statistical purposes. All worksheets filled with households' information would be destroyed within six months after completion of the survey.

1.1.9 Ethical Approval

The survey was approved by the Ethics Committee of the DH.

1.1.10 Notes to Tables and Symbols

In general, estimated population figures presented in this survey report are rounded to the nearest 100 while percentages are rounded to one decimal place and percentages are derived from the corresponding unrounded figures. There may be a slight discrepancy between the sum of individual items and the respective total or sub-total as shown in the tables owing to rounding. Regarding the symbols, "-" denotes a nil figure, "N.A." denotes not applicable and “$” denotes Hong Kong dollar unless otherwise stated.

References

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2. World Health Organization. Protocol for population level sodium determination in 24-h urine samples. Prepared by WHO/PAHO Regional Expert Group for Cardiovascular Disease Prevention through Population-Wide Dietary Salt Reduction: Sub-Group for Research and Surveillance. 2010. Available from: https://www.paho.org/hq/dmdocuments/2013/24h-urine-Protocol-eng.pdf.

Chapter 2

Physical Measurements

Although self-reported prevalences of doctor-diagnosed chronic diseases have been reported in Chapter 3 of the Part I Report, it may not reflect the true prevalence due to underestimation or under-reporting, including cases that were undiagnosed. In this section, the prevalence of diagnosed and undiagnosed cases of overweight, obesity and raised blood pressure/ hypertension were estimated by health examination including anthropometric and blood pressure measurements, together with the self-reported data collected in household interview.

Snapshot of Physical Measurements of the Population (for persons aged 15 to 84)

Indicator	Female	Male	Overall
Prevalence of population who were overweight and obese			
• Overweight by physical measurements[#]	19.7%	24.6%	22.0%
• Obese by physical measurements[#]	26.4%	39.4%	32.6%
• Overweight or obese by physical measurements	46.1%	64.0%	54.6%
◦ Self-reported doctor-diagnosed overweight / obese	10.6%	11.9%	11.2%
◦ No self-reported doctor-diagnosed overweight / obese	35.4%	52.1%	43.3%
Prevalence of population who had central obesity (by physical measurements)			
• Central obesity defined by waist circumference*	38.7%	36.8%	37.8%
• Central obesity defined by waist-hip ratio[!]	31.4%	39.9%	35.4%

Indicator	Female	Male	Overall
Prevalence of raised blood pressure / hypertension (combine household interview and physical measurement)	26.2%	33.2%	29.5%
• Raised blood pressure[¶] by physical measurement	15.6%	22.8%	19.0%
◦ Self-reported doctor-diagnosed hypertension	5.9%	8.0%	6.9%
◦ No self-reported doctor-diagnosed hypertension	9.8%	14.7%	12.1%
• Self-reported doctor-diagnosed hypertension with normal blood pressure by physical measurement	10.5%	10.5%	10.5%

Notes: # Overweight: body mass index ≥ 23.0 kg/m^2 and < 25 kg/m^2; Obese: body mass index ≥ 25.0 kg/m^2 [Body mass index (BMI) is defined as weight (kilogram) divided by the square of height (metre). Its unit of measurement is kilogram/metre^2 (kg/m^2)]

* Central obesity (waist circumference): Male ≥ 90 cm, Female ≥ 80 cm

! Central obesity (waist-to-hip ratio): Male ≥ 0.90, Female ≥ 0.85

¶ Raised blood pressure: systolic blood pressure ≥ 140 mmHg and / or diastolic blood pressure ≥ 90mmHg

2.1 Anthropometric Measurements

Anthropometric measurements were performed in designated health examination centres under standardised procedures with standardised equipment. Anthropometric indicators including participant's body weight, height, waist, and hip circumferences were measured. These data were used for computing body mass index (BMI), waist circumference (WC) and waist-hip ratio (WHR) that were predictors of NCD risk [1].

2.1.1 Weight and Height

Body weight and height are measures of body size and can be used to calculate respondents' BMI. Based on the results of the health examination attended by respondents aged 15-84, it is estimated that the mean body weights of females and males aged 15-84 were 57.2 kg and 70.7 kg respectively, and the mean body heights were 157.2 cm and 169.4 cm respectively (Table 2.1.1a).

Table 2.1.1a: Mean weight and height among persons aged 15 to 84 by age group and gender

	Female	Male	Total	Female	Male	Total
Age group	**Weight (kg)**			**Height (cm)**		
15 – 24	54.6	68.9	61.9	160.4	172.9	166.8
25 – 34	56.9	71.2	63.9	159.0	171.6	165.2
35 – 44	58.8	74.7	66.1	159.4	171.8	165.1
45 – 54	59.2	74.3	65.8	157.9	169.8	163.2
55 – 64	57.5	70.1	63.5	155.7	168.3	161.7
65 – 84	55.1	65.8	60.3	152.9	165.0	158.8
15 – 84	57.2	70.7	63.6	157.2	169.4	163.0

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

2.1.2 Body Mass Index (BMI) / Overweight and Obesity

BMI is an index used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of her / his height in metres. Raised BMI is a major risk factor for NCDs such as cardiovascular diseases (mainly heart disease and stroke), diabetes, musculoskeletal disorders and some cancers [2]. Based on the classification of BMI categories for Asian adults adopted by the Western Pacific Regional Office of the WHO [3], the ranges of BMI values for classification of underweight, normal, overweight, and obese were:

BMI category	**Range of BMI values**
Underweight	< 18.5 kg/m^2
Normal	≥ 18.5 and < 23.0 kg/m^2
Overweight	≥ 23.0 and < 25.0 kg/m^2
Obese	≥ 25.0 kg/m^2
Obese I	≥ 25.0 and < 30.0 kg/m^2
Obese II	≥ 30.0 kg/m^2

The mean BMI for females and males aged 15-84 were 23.2 kg/m^2 and 24.6 kg/m^2 respectively (Table 2.1.2a).

Among persons aged 15-84 participating in health examination, 32.6% were classified as obese and 22.0% overweight, 40.0% within normal range and 5.5% underweight. Analysed by gender, 26.4% of females and 39.4% of males were classified as obese and 19.7% of females and 24.6% of males were overweight. Analysed by age group, the proportion of females classified as obese increased with age from 12.3% for those aged 15-24 to 32.1% for those aged 65-84. The proportion of males classified as obese increased from 25.0% among males aged 15-24 to 47.4% for males aged 45-54, then decreased to 34.7% for those aged 65-84 (Table 2.1.2a).

Table 2.1.2a: Distribution of body mass index (BMI) categories among persons aged 15 to 84 by age group and gender

Age group/ BMI categories	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 - 24						
Underweight	61.2	21.6%	37.0	12.5%	98.2	17.0%
Normal	158.8	56.1%	136.7	46.1%	295.5	51.0%
Overweight	28.0	9.9%	48.7	16.4%	76.7	13.2%
Obese I	26.2	9.2%	48.8	16.4%	74.9	12.9%
Obese II	8.7	3.1%	25.4	8.6%	34.1	5.9%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 - 34						
Underweight	58.3	12.8%	17.7	4.1%	76.0	8.5%
Normal	249.8	54.8%	171.8	39.4%	421.6	47.2%
Overweight	61.1	13.4%	100.8	23.1%	161.8	18.1%
Obese I	60.9	13.3%	113.6	26.0%	174.5	19.5%
Obese II	26.1	5.7%	32.8	7.5%	58.9	6.6%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 - 44						
Underweight	30.3	5.5%	5.6	1.2%	35.8	3.5%
Normal	284.7	51.9%	128.0	27.7%	412.7	40.8%
Overweight	93.8	17.1%	114.4	24.7%	208.3	20.6%
Obese I	103.0	18.8%	170.0	36.7%	272.9	27.0%
Obese II	36.4	6.6%	44.6	9.7%	81.0	8.0%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Underweight	25.9	4.3%	11.1	2.3%	37.0	3.4%
Normal	269.6	44.6%	110.5	23.1%	380.2	35.1%
Overweight	136.7	22.6%	130.1	27.2%	266.8	24.6%
Obese I	133.2	22.0%	157.7	33.0%	290.9	26.9%
Obese II	39.1	6.5%	69.0	14.4%	108.2	10.0%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Underweight	27.9	4.4%	16.4	2.9%	44.3	3.7%
Normal	263.8	41.4%	163.3	28.4%	427.1	35.2%
Overweight	146.4	23.0%	143.8	25.0%	290.2	23.9%
Obese I	164.5	25.8%	209.6	36.4%	374.1	30.9%
Obese II	34.2	5.4%	42.4	7.4%	76.6	6.3%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%

(To be continued)

Table 2.1.2a: Distribution of body mass index (BMI) categories among persons aged 15 to 84 by age group and gender (continued)

Age group/ BMI categories	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
65 - 84						
Underweight	22.1	3.6%	13.1	2.3%	35.2	3.0%
Normal	238.9	39.4%	206.0	35.8%	444.9	37.7%
Overweight	150.5	24.8%	156.4	27.2%	306.9	26.0%
Obese I	176.5	29.1%	166.7	29.0%	343.1	29.0%
Obese II	18.4	3.0%	32.8	5.7%	51.2	4.3%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Underweight	225.7	7.2%	100.8	3.6%	326.5	5.5%
Normal	1 465.6	46.7%	916.3	32.4%	2 381.9	40.0%
Overweight	616.6	19.7%	694.2	24.6%	1 310.8	22.0%
Obese I	664.1	21.2%	866.3	30.7%	1 530.5	25.7%
Obese II	163.0	5.2%	247.0	8.7%	410.0	6.9%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

	Mean BMI (kg/m^2)		
Gender / Age group	**Female**	**Male**	**Total**
15 - 24	21.2	23.0	22.1
25 - 34	22.5	24.1	23.3
35 - 44	23.1	25.3	24.1
45 - 54	23.7	25.7	24.6
55 - 64	23.7	24.7	24.2
65 - 84	23.6	24.1	23.9
15 - 84	23.2	24.6	23.8

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: Underweight: BMI < 18.5 kg/m^2
Normal: BMI ≥ 18.5 and < 23.0 kg/m^2
Overweight: BMI ≥ 23.0 and < 25.0 kg/m^2
Obese I: BMI ≥ 25.0 and < 30.0 kg/m^2
Obese II: BMI ≥ 30.0 kg/m^2
Figures may not add up to the total due to rounding.

54.6% persons (46.1% for females and 64.0% for males) aged 15-84 were overweight / obese by physical measurements, including 11.2% (10.6% for females and 11.9% for males) had self-reported doctor-diagnosed overweight or obese, and 43.3% of persons (35.4% for females and 52.1% for males) had no self-reported doctor-diagnosed overweight or obese but found to have BMI ≥ 23.0 kg/m^2, i.e. overweight or obese by physical measurements. Analysis by age group, the prevalences of overweight / obese generally increase with age, from 32.1% among those aged 15-24 to the 61.5% among those aged 45-54 (Table 2.1.2b).

According to the Asian BMI classification (i.e. overweight BMI ≥ 23.0 kg/m^2; obesity BMI ≥ 25.0 kg/m^2), the age-standardised prevalence of overweight and obesity was 51.3% in persons aged 18-84 years (Crude prevalence: 55.1%). According to WHO's BMI classification (i.e. overweight BMI ≥ 25.0 kg/m^2; obesity BMI ≥ 30.0 kg/m^2), the age-standardised prevalence of overweight and obesity was 30.8% in persons aged 18-84 years (Crude prevalence: 32.8%).

Table 2.1.2b: Prevalence of overweight or obese by physical measurements* among persons aged 15 to 84 by age group and gender and whether had self-reported doctor-diagnosed overweight or obese in household interview

Age group / Whether was overweight or obese	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 - 24						
Yes *	62.9	22.2%	122.8	41.4%	185.8	32.1%
Self-reported doctor-diagnosed overweight or obese	*12.3*	*4.3%*	*29.2*	*9.9%*	*41.5*	*7.2%*
*No self-reported history but computed BMI ≥ 23.0 kg/m² **	*50.7*	*17.9%*	*93.6*	*31.6%*	*144.3*	*24.9%*
No	220.1	77.8%	173.7	58.6%	393.7	67.9%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 - 34						
Yes *	148.1	32.5%	247.1	56.6%	395.2	44.3%
Self-reported doctor-diagnosed overweight or obese	*29.1*	*6.4%*	*25.2*	*5.8%*	*54.3*	*6.1%*
*No self-reported history but computed BMI ≥ 23.0 kg/m² **	*119.0*	*26.1%*	*222.0*	*50.8%*	*340.9*	*38.2%*
No	308.1	67.5%	189.6	43.4%	497.7	55.7%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 - 44						
Yes *	233.2	42.5%	329.0	71.1%	562.2	55.6%
Self-reported doctor-diagnosed overweight or obese	*45.4*	*8.3%*	*41.7*	*9.0%*	*87.1*	*8.6%*
*No self-reported history but computed BMI ≥ 23.0 kg/m² **	*187.8*	*34.3%*	*287.4*	*62.1%*	*475.1*	*47.0%*
No	314.9	57.5%	133.6	28.9%	448.5	44.4%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Yes *	309.0	51.1%	356.9	74.6%	665.9	61.5%
Self-reported doctor-diagnosed overweight or obese	*81.3*	*13.5%*	*74.6*	*15.6%*	*156.0*	*14.4%*
*No self-reported history but computed BMI ≥ 23.0 kg/m² **	*227.6*	*37.7%*	*282.3*	*59.0%*	*509.9*	*47.1%*
No	295.5	48.9%	121.6	25.4%	417.1	38.5%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Yes *	345.1	54.2%	395.8	68.8%	740.9	61.1%
Self-reported doctor-diagnosed overweight or obese	*65.2*	*10.2%*	*88.2*	*15.3%*	*153.4*	*12.7%*
*No self-reported history but computed BMI ≥ 23.0 kg/m² **	*280.0*	*44.0%*	*307.6*	*53.4%*	*587.5*	*48.5%*
No	291.7	45.8%	179.7	31.2%	471.4	38.9%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 84						
Yes *	345.4	57.0%	355.8	61.9%	701.2	59.4%
Self-reported doctor-diagnosed overweight or obese	*99.2*	*16.4%*	*78.3*	*13.6%*	*177.5*	*15.0%*
*No self-reported history but computed BMI ≥ 23.0 kg/m² **	*246.2*	*40.6%*	*277.5*	*48.3%*	*523.7*	*44.3%*
No	261.0	43.0%	219.1	38.1%	480.1	40.6%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Yes *	1 443.7	46.1%	1 807.5	64.0%	3 251.2	54.6%
Self-reported doctor-diagnosed overweight or obese	*332.5*	*10.6%*	*337.2*	*11.9%*	*669.7*	*11.2%*
*No self-reported history but computed BMI ≥ 23.0 kg/m² **	*1 111.3*	*35.4%*	*1 470.3*	*52.1%*	*2 581.6*	*43.3%*
No	1 691.3	53.9%	1 017.2	36.0%	2 708.5	45.4%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * Overweight: body mass index ≥ 23.0 kg/m² and < 25 kg/m²; Obese: body mass index ≥ 25.0 kg/m² [Body mass index (BMI) is defined as weight (kilogram) divided by the square of height (metre). Its unit of measurement is kilogram/metre² (kg/m²)]

Figures may not add up to the total due to rounding.

Analysed by household income, the proportion of persons classified as overweight or obese varied in the range of highest at 59.2% among those with a monthly household income of 20,000-$29,999 to the lowest at 46.1% among those with monthly household income of $40,000-$49,999 (Table 2.1.2c).

Table 2.1.2c: Distribution of body mass index (BMI) categories among persons aged 15 to 84 by monthly household income

	Less than $5,000		$5,000 - $9,999		$10,000 - $19,999		$20,000 - $29,999		$30,000 - $39,999		$40,000 - $49,999		$50,000 or more		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
BMI categories by physical measurement																
Underweight	13.7	4.1%	5.3	1.3%	63.5	7.3%	61.7	5.2%	53.5	6.1%	54.6	8.0%	74.2	4.6%	326.5	5.5%
Normal	141.2	42.6%	176.3	44.1%	305.2	35.0%	421.2	35.5%	389.2	44.7%	313.5	45.9%	635.3	39.2%	2 381.9	40.0%
Overweight	79.8	24.1%	82.9	20.8%	189.6	21.8%	251.3	21.2%	177.5	20.4%	130.5	19.1%	399.1	24.7%	1 310.8	22.0%
Obese I	74.7	22.5%	119.3	29.9%	240.4	27.6%	347.0	29.3%	196.9	22.6%	149.9	21.9%	402.3	24.9%	1 530.5	25.7%
Obese II	22.1	6.7%	15.5	3.9%	72.0	8.3%	103.6	8.7%	53.8	6.2%	34.9	5.1%	108.0	6.7%	410.0	6.9%
Total	331.5	100.0%	399.3	100.0%	870.7	100.0%	1 184.8	100.0%	870.9	100.0%	683.4	100.0%	1 618.9	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: Underweight: BMI < 18.5 kg/m^2

Normal: BMI ≥ 18.5 and < 23.0 kg/m^2

Overweight: BMI ≥ 23.0 and < 25.0 kg/m^2

Obese I: BMI ≥ 25.0 and < 30.0 kg/m^2

Obese II: BMI ≥ 30.0 kg/m^2

Figures may not add up to the total due to rounding.

Table 2.1.2d presents perception of own body weight of persons aged 15-84 by their BMI categories. 65.1% of those who were overweight, 27.6% of those classified as obese I and 3.2% of those classified as obese II perceived themselves underweight or having about the right weight ('just right') (Table 2.1.2d).

Table 2.1.2d: Perception of body weight among persons aged 15 to 84 by body mass index (BMI) categories

Perception of body weight \ BMI category	Underweight		Normal		Overweight		Obese I		Obese II		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
Underweight	177.0	54.2%	175.5	7.4%	19.0	1.5%	7.3	0.5%	-	-	378.8	6.4%
Just right	149.6	45.8%	2 030.2	85.2%	833.9	63.6%	415.4	27.1%	13.0	3.2%	3 442.1	57.8%
Overweight	-	-	153.4	6.4%	367.3	28.0%	889.6	58.1%	200.2	48.8%	1 610.4	27.0%
Obese	-	-	22.8	1.0%	90.6	6.9%	218.2	14.3%	196.8	48.0%	528.4	8.9%
Total	326.5	100.0%	2 381.9	100.0%	1 310.8	100.0%	1 530.5	100.0%	410.0	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).
Notes: Underweight: BMI < 18.5 kg/m^2
Normal: BMI ≥ 18.5 and < 23.0 kg/m^2
Overweight: BMI ≥ 23.0 and < 25.0 kg/m^2
Obese I: BMI ≥ 25.0 and < 30.0 kg/m^2
Obese II: BMI ≥ 30.0 kg/m^2
Figures may not add up to the total due to rounding.

2.1.3 Waist Circumference, Hip Circumference and Waist-hip Ratio

Waist circumference (WC) and waist-hip ratio (WHR) are indicators to measure central or abdominal obesity. The WHR is the WC divided by hip circumference (HC). The WHO suggests that WC and WHR are better indicators than BMI in predicting risk of cardiovascular diseases and diabetes because these indicators can better reflect visceral adipose tissue mass, which is associated with different metabolic abnormalities [1]. According to the International Diabetes Federation classification of the Asian standard, females with WC 80 cm or above and males with WC 90 cm or above are classified as centrally obese [4]. According to the WHO, sex-specific cut-off points for WHR at 0.85 or above in females and 0.90 or above in males are used to signify substantially increased risk of metabolic complications associated with obesity [1].

Among persons aged 15-84, the mean values of WC were 77.7 cm for females and 86.4 cm for males; the mean values of HC were 94.6 cm for females and 97.8 cm for males; and the mean values of WHR were 0.82 for females and 0.88 for males (Table 2.1.3a).

Table 2.1.3a: Mean waist circumference (WC), hip circumference (HC) and waist-to-hip ratio (WHR) among persons aged 15 to 84 by age group and gender

	Female	Male	Total	Female	Male	Total	Female	Male	Total
Age group	**WC (cm)**			**HC (cm)**			**WHR**		
15 - 24	71.6	79.9	75.9	92.2	96.8	94.6	0.78	0.82	0.80
25 - 34	73.5	82.7	78.0	94.0	98.3	96.1	0.78	0.84	0.81
35 - 44	76.3	87.0	81.2	95.8	99.5	97.5	0.80	0.87	0.83
45 - 54	78.1	89.1	83.0	95.7	99.0	97.2	0.81	0.90	0.85
55 - 64	80.6	87.8	84.0	94.9	97.6	96.2	0.85	0.90	0.87
65 - 84	81.2	88.2	84.6	93.4	95.5	94.4	0.87	0.92	0.89
15 - 84	77.7	86.4	81.8	94.6	97.8	96.1	0.82	0.88	0.85

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

According to the sex-specific cut-off points for WC mentioned above, it was estimated that more than one-third (37.8%) of persons aged 15-84 (38.7% for females and 36.8% for males) had central obesity defined by WC (Table 2.1.3b). According to the classification of WHR, 35.4% of persons aged 15-84 (31.4% for females and 39.9% for males) had central obesity (Table 2.1.3c). Analysed by age group, the prevalences of central obesity based on both WC (from 15.7% for those aged 15-24 to 49.2% for those aged 65-84) and WHR (from 9.4% for those aged 15-24 to 60.2% for those aged 65-84) generally increased with age (Table 2.1.3b and Table 2.1.3c).

Table 2.1.3b: Proportion of population who had central obesity as defined by waist circumference (WC) among persons aged 15 to 84 by age group and gender

Gender / Age group	Whether had central obesity as defined by WC*					
	Yes		No		Total	
	No. of persons ('000)	Rate# (%)	No. of Persons ('000)	Rate# (%)	No. of persons ('000)	Rate# (%)
Female						
15 - 24	41.9	14.8%	241.1	85.2%	283.0	100.0%
25 - 34	95.8	21.0%	360.4	79.0%	456.2	100.0%
35 - 44	181.8	33.2%	366.3	66.8%	548.1	100.0%
45 - 54	243.9	40.4%	360.6	59.6%	604.5	100.0%
55 - 64	326.3	51.2%	310.5	48.8%	636.8	100.0%
65 - 84	323.2	53.3%	283.2	46.7%	606.4	100.0%
Sub-total	1 212.9	38.7%	1 922.1	61.3%	3 135.0	100.0%
Male						
15 - 24	48.8	16.5%	247.7	83.5%	296.5	100.0%
25 - 34	105.9	24.3%	330.8	75.7%	436.7	100.0%
35 - 44	167.3	36.2%	295.3	63.8%	462.6	100.0%
45 - 54	212.8	44.5%	265.7	55.5%	478.5	100.0%
55 - 64	245.4	42.6%	330.1	57.4%	575.5	100.0%
65 - 84	258.0	44.9%	316.9	55.1%	574.9	100.0%
Sub-total	1 038.2	36.8%	1 786.5	63.2%	2 824.7	100.0%
Both Gender						
15 - 24	90.7	15.7%	488.8	84.3%	579.5	100.0%
25 - 34	201.7	22.6%	691.2	77.4%	892.9	100.0%
35 - 44	349.0	34.5%	661.7	65.5%	1 010.7	100.0%
45 - 54	456.8	42.2%	626.2	57.8%	1 083.0	100.0%
55 - 64	571.7	47.2%	640.6	52.8%	1 212.3	100.0%
65 - 84	581.2	49.2%	600.1	50.8%	1 181.3	100.0%
Total	2 251.1	37.8%	3 708.6	62.2%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).
Notes: * Normal: WC Male < 90 cm, Female < 80 cm.
Central obesity: WC Male ≥ 90 cm, Female ≥ 80 cm.
The rates are expressed as the percentage of its respective age/gender subgroup.
Figures may not add up to the total due to rounding.

Table 2.1.3c: Proportion of population who had central obesity as defined by waist-to-hip ratio (WHR) among persons aged 15 to 84 by age group and gender

Gender / Age group	Whether had central obesity as defined by WHR*					
	Yes		No		Total	
	No. of persons ('000)	Rate# (%)	No. of persons ('000)	Rate# (%)	No. of persons ('000)	Rate# (%)
Female						
15 – 24	21.0	7.4%	262.0	92.6%	283.0	100.0%
25 – 34	46.6	10.2%	409.6	89.8%	456.2	100.0%
35 – 44	99.9	18.2%	448.2	81.8%	548.1	100.0%
45 – 54	159.4	26.4%	445.1	73.6%	604.5	100.0%
55 – 64	307.8	48.3%	329.0	51.7%	636.8	100.0%
65 – 84	348.7	57.5%	257.7	42.5%	606.4	100.0%
Sub-total	983.3	31.4%	2 151.7	68.6%	3 135.0	100.0%
Male						
15 – 24	33.2	11.2%	263.3	88.8%	296.5	100.0%
25 – 34	53.0	12.1%	383.7	87.9%	436.7	100.0%
35 – 44	145.1	31.4%	317.5	68.6%	462.6	100.0%
45 – 54	246.2	51.4%	232.3	48.6%	478.5	100.0%
55 – 64	288.0	50.0%	287.5	50.0%	575.5	100.0%
65 – 84	362.4	63.0%	212.5	37.0%	574.9	100.0%
Sub-total	1 127.9	39.9%	1 696.8	60.1%	2 824.7	100.0%
Both Gender						
15 – 24	54.2	9.4%	525.3	90.6%	579.5	100.0%
25 – 34	99.6	11.2%	793.3	88.8%	892.9	100.0%
35 – 44	245.0	24.2%	765.7	75.8%	1 010.7	100.0%
45 – 54	405.6	37.4%	677.4	62.6%	1 083.0	100.0%
55 – 64	595.8	49.1%	616.5	50.9%	1 212.3	100.0%
65 – 84	711.1	60.2%	470.2	39.8%	1 181.3	100.0%
Total	2 111.2	35.4%	3 848.5	64.6%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * Normal: WHR Male < 0.90, Female < 0.85
Central obesity: WHR Male ≥ 0.90, Female ≥ 0.85
The rates are expressed as the percentage of its respective age/gender subgroup.
Figures may not add up to the total due to rounding.

2.2 Blood Pressure

2.2.1 Blood Pressure

Blood pressure measurements were performed in designated health examination centres under standardised procedures with standardised equipment. Blood pressure, systolic blood pressure (SBP) over diastolic blood pressure (DBP), was recorded in PHS. Measurement of blood pressure was performed using an electronic sphygmomanometer. The SBP represents the pressure on the blood vessels when the heart contracts; while the DBP represents the pressure when the heart rests between beats. Our blood pressure varies throughout the day with posture, physical activities, emotions, sleep, etc [5].

According to the protocol for blood pressure monitoring recommended by the WHO, three blood pressure measurements with at least three-minute rest between each of the measurements were taken and the mean of the second and third readings of both SBP and DBP were reported. The mean SBP for females and males aged 15-84 were 116.4 mmHg and 123.0 mmHg respectively, while the mean DBP for females and males were 76.1 mmHg and 80.5 mmHg respectively (Table 2.2.1a).

Table 2.2.1a: Distribution of blood pressure* among persons aged 15 to 84 by gender

	Female		Male		Total	
	No. of persons ('000)	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
Systolic blood pressure (mmHg)						
Below 80.0	3.2	0.1%	-	-	3.2	0.1%
80.0 - 99.9	626.6	20.0%	84.1	3.0%	710.7	11.9%
100.0 - 119.9	1 240.3	39.6%	1 229.1	43.5%	2 469.4	41.4%
120.0 - 139.9	902.5	28.8%	1 119.0	39.6%	2 021.4	33.9%
140.0 - 159.9	285.7	9.1%	318.6	11.3%	604.2	10.1%
160.0 - 179.9	70.0	2.2%	64.3	2.3%	134.3	2.3%
180.0 or above	6.8	0.2%	9.7	0.3%	16.5	0.3%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%
Mean	116.4		123.0		119.6	
Diastolic blood pressure (mmHg)						
Below 60.0	113.7	3.6%	36.8	1.3%	150.5	2.5%
60.0 - 69.9	692.8	22.1%	327.6	11.6%	1 020.5	17.1%
70.0 - 79.9	1 203.6	38.4%	961.9	34.1%	2 165.5	36.3%
80.0 - 89.9	851.3	27.2%	994.2	35.2%	1 845.5	31.0%
90.0 - 99.9	221.7	7.1%	399.7	14.2%	621.4	10.4%
100.0 - 109.9	48.8	1.6%	81.6	2.9%	130.4	2.2%
110.0 or above	3.1	0.1%	22.8	0.8%	25.9	0.4%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%
Mean	76.1		80.5		78.2	

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * Blood pressure was calculated as the mean of the second and third readings with at least three minutes rest between each measurement.

Figures may not add up to the total due to rounding.

Both the mean SBP and mean DBP increased generally with age. The mean SBP increased from 107.8 mmHg for the 15-24 age group to 133.7 mmHg for the 65-84 age group. For DBP, its mean increased from 72.0 mmHg for those aged 15-24 to 80.8 mmHg for those in the 45-54 age group and decreased to 80.2 mmHg for those aged 65-84 (Table 2.2.1b).

Table 2.2.1b: Distribution of blood pressure* among persons aged 15 to 84 by age group

	15 - 24		25 - 34		35 - 44		45 - 54		55 - 64		65 - 84		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
Systolic blood pressure (mmHg)														
Below 80.0	-	-	-	-	-	-	3.2	0.3%	-	-	-	-	3.2	0.1%
80.0 - 99.9	161.6	27.9%	209.0	23.4%	162.5	16.1%	120.9	11.2%	50.3	4.1%	6.5	0.6%	710.7	11.9%
100.0 - 119.9	335.5	57.9%	525.2	58.8%	529.9	52.4%	444.0	41.0%	428.5	35.3%	206.2	17.5%	2 469.4	41.4%
120.0 - 139.9	74.8	12.9%	151.2	16.9%	290.0	28.7%	403.3	37.2%	524.3	43.2%	577.9	48.9%	2 021.4	33.9%
140.0 - 159.9	7.6	1.3%	5.0	0.6%	22.7	2.2%	91.4	8.4%	171.0	14.1%	306.5	25.9%	604.2	10.1%
160.0 - 179.9	-	-	2.5	0.3%	5.6	0.6%	20.3	1.9%	31.8	2.6%	74.1	6.3%	134.3	2.3%
180.0 or above	-	-	-	-	-	-	-	-	6.4	0.5%	10.1	0.9%	16.5	0.3%
Total	579.5	100.0%	892.9	100.0%	1 010.7	100.0%	1 083.0	100.0%	1 212.3	100.0%	1 181.3	100.0%	5 959.7	100.0%
Mean	107.8		108.7		113.0		119.7		124.7		133.7		119.6	
Diastolic blood pressure (mmHg)														
Below 60.0	32.8	5.7%	37.1	4.2%	26.8	2.7%	22.2	2.1%	25.0	2.1%	6.5	0.6%	150.5	2.5%
60.0 - 69.9	211.5	36.5%	232.7	26.1%	188.1	18.6%	137.9	12.7%	113.7	9.4%	136.4	11.6%	1 020.5	17.1%
70.0 - 79.9	226.0	39.0%	385.1	43.1%	386.8	38.3%	357.0	33.0%	396.4	32.7%	414.2	35.1%	2 165.5	36.3%
80.0 - 89.9	86.7	15.0%	183.1	20.5%	285.0	28.2%	335.5	31.0%	510.7	42.1%	444.5	37.6%	1 845.5	31.0%
90.0 - 99.9	22.4	3.9%	47.0	5.3%	101.2	10.0%	180.5	16.7%	124.7	10.3%	145.6	12.3%	621.4	10.4%
100.0 - 109.9	-	-	5.4	0.6%	17.2	1.7%	41.6	3.8%	32.2	2.7%	33.9	2.9%	130.4	2.2%
110.0 or above	-	-	2.5	0.3%	5.6	0.6%	8.3	0.8%	9.6	0.8%	-	-	25.9	0.4%
Total	579.5	100.0%	892.9	100.0%	1 010.7	100.0%	1 083.0	100.0%	1 212.3	100.0%	1 181.3	100.0%	5 959.7	100.0%
Mean	72.0		74.4		77.6		80.8		80.3		80.2		78.2	

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * Blood pressure was calculated as the mean of the second and third readings with at least three minutes rest between each measurement.

Figures may not add up to the total due to rounding.

2.2.2 Raised Blood Pressure / Hypertension

Hypertension is a chronic disease in which the blood pressure in the blood vessels is persistently raised. It significantly increases the risk of other serious health problems, including stroke, coronary heart disease, heart failure, and kidney diseases. Globally, it is estimated that 1.28 billion adults have hypertension. There are usually no symptoms for people with hypertension unless severe hypertension occurs [6].

The prevalence of raise blood pressure / hypertension was estimated based on physical measurement, and responses collected from the questionnaires (household survey). Self-reported doctor-diagnosed hypertension was reported by 17.4% of persons (16.4% for females and 18.5% for males) aged 15-84 in household survey. However, physical measurement revealed another 12.1% of persons (9.8% for females and 14.7% for males) with no self-reported history but raised blood pressure by physical measurement, SBP $\geq$ 140 mmHg and / or DBP $\geq$ 90 mmHg according to the WHO criteria [7], giving an overall prevalence of raised blood pressure / hypertension of 29.5% (26.2% for females and 33.2% for males). The prevalence of raised blood pressure / hypertension, in general, increased with increasing age groups. (Table 2.2.2).

The age-standardised prevalence of raised blood pressure (defined as systolic blood pressure (SBP) $\geq$ 140 mmHg and / or diastolic blood pressure $\geq$ 90 mmHg disregarding of known history of hypertension) among persons aged 18-84 years was 15.0% (Crude prevalence: 19.4%). The age-standardised mean SBP among persons aged 18-84 years was 116.0 mmHg (Crude mean: 119.8 mmHg).

Table 2.2.2: Prevalence of raised blood pressure or hypertension among persons aged 15 to 84 by age group and gender (including self-reported doctor-diagnosed and no self-reported history but raised blood pressure by physical measurement)

Age group / Whether had raised blood pressure or hypertension	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 - 24						
Yes	10.5	3.7%	17.6	5.9%	28.1	4.9%
Self-reported doctor-diagnosed hypertension	*1.8*	*0.6%*	*5.9*	*2.0%*	*7.7*	*1.3%*
Measured raised blood pressure	-	-	*2.0*	*0.7%*	*2.0*	*0.3%*
Measured non-raised blood pressure	*1.8*	*0.6%*	*3.9*	*1.3%*	*5.7*	*1.0%*
*No self-reported history but raised blood pressure by physical measurement **	*8.8*	*3.1%*	*11.7*	*3.9%*	*20.5*	*3.5%*
No	272.5	96.3%	278.9	94.1%	551.4	95.1%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 - 34						
Yes	20.4	4.5%	40.3	9.2%	60.7	6.8%
Self-reported doctor-diagnosed hypertension	*5.9*	*1.3%*	*2.5*	*0.6%*	*8.4*	*0.9%*
Measured raised blood pressure	-	-	*2.5*	*0.6%*	*2.5*	*0.3%*
Measured non-raised blood pressure	*5.9*	*1.3%*	-	-	*5.9*	*0.7%*
*No self-reported history but raised blood pressure by physical measurement **	*14.6*	*3.2%*	*37.8*	*8.7%*	*52.4*	*5.9%*
No	435.8	95.5%	396.4	90.8%	832.2	93.2%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 - 44						
Yes	72.7	13.3%	86.4	18.7%	159.0	15.7%
Self-reported doctor-diagnosed hypertension	*30.3*	*5.5%*	*13.8*	*3.0%*	*44.1*	*4.4%*
Measured raised blood pressure	*9.1*	*1.7%*	*2.8*	*0.6%*	*11.9*	*1.2%*
Measured non-raised blood pressure	*21.2*	*3.9%*	*11.0*	*2.4%*	*32.3*	*3.2%*
*No self-reported history but raised blood pressure by physical measurement **	*42.3*	*7.7%*	*72.6*	*15.7%*	*114.9*	*11.4%*
No	475.4	86.7%	376.2	81.3%	851.7	84.3%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Yes	152.9	25.3%	215.8	45.1%	368.7	34.0%
Self-reported doctor-diagnosed hypertension	*91.2*	*15.1%*	*91.2*	*19.1%*	*182.3*	*16.8%*
Measured raised blood pressure	*29.4*	*4.9%*	*36.0*	*7.5%*	*65.4*	*6.0%*
Measured non-raised blood pressure	*61.8*	*10.2%*	*55.2*	*11.5%*	*117.0*	*10.8%*
*No self-reported history but raised blood pressure by physical measurement **	*61.8*	*10.2%*	*124.6*	*26.0%*	*186.4*	*17.2%*
No	451.6	74.7%	262.7	54.9%	714.3	66.0%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Yes	229.8	36.1%	235.3	40.9%	465.1	38.4%
Self-reported doctor-diagnosed hypertension	*139.7*	*21.9%*	*160.3*	*27.8%*	*300.0*	*24.7%*
Measured raised blood pressure	*46.6*	*7.3%*	*52.3*	*9.1%*	*98.9*	*8.2%*
Measured non-raised blood pressure	*93.1*	*14.6%*	*107.9*	*18.8%*	*201.1*	*16.6%*
*No self-reported history but raised blood pressure by physical measurement **	*90.1*	*14.2%*	*75.0*	*13.0%*	*165.2*	*13.6%*
No	407.0	63.9%	340.2	59.1%	747.2	61.6%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%

(To be continued)

Table 2.2.2: Prevalence of raised blood pressure or hypertension among persons aged 15 to 84 by age group and gender (including self-reported doctor-diagnosed and no self-reported history but raised blood pressure by physical measurement) (continued)

Age group / Whether had raised blood pressure or hypertension	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
65 - 84						
Yes	334.5	55.2%	343.1	59.7%	677.5	57.4%
Self-reported doctor-diagnosed hypertension	*246.0*	*40.6%*	*248.2*	*43.2%*	*494.2*	*41.8%*
Measured raised blood pressure	*99.4*	*16.4%*	*130.7*	*22.7%*	*230.2*	*19.5%*
Measured non-raised blood pressure	*146.6*	*24.2%*	*117.5*	*20.4%*	*264.0*	*22.4%*
*No self-reported history but raised blood pressure by physical measurement **	*88.5*	*14.6%*	*94.9*	*16.5%*	*183.3*	*15.5%*
No	271.9	44.8%	231.8	40.3%	503.8	42.6%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Yes	820.9	26.2%	938.3	33.2%	1 759.3	29.5%
Self-reported doctor-diagnosed hypertension	*514.8*	*16.4%*	*521.8*	*18.5%*	*1 036.6*	*17.4%*
Measured raised blood pressure	*184.5*	*5.9%*	*226.2*	*8.0%*	*410.8*	*6.9%*
Measured non-raised blood pressure	*330.3*	*10.5%*	*295.6*	*10.5%*	*625.9*	*10.5%*
*No self-reported history but raised blood pressure by physical measurement **	*306.1*	*9.8%*	*416.6*	*14.7%*	*722.6*	*12.1%*
No	2 314.1	73.8%	1 886.4	66.8%	4 200.4	70.5%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: *No self-reported history but raised blood pressure by physical measurement - SBP $\geq$ 140 mmHg and/or DBP $\geq$ 90 mmHg.

Figures may not add up to the total due to rounding.

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Chapter 3
Biochemical Testing – Blood

In this section, the prevalence of diagnosed and undiagnosed cases of diabetes, and hypercholesterolaemia were estimated by biochemical testing covering blood tests for fasting plasma glucose, HbA1c and lipid profile.

Snapshot of Biochemical Testing of the Population (for persons aged 15 to 84)

Indicator	Female	Male	Overall
Prevalence of diabetes mellitus (combine household interview and biochemical testing)	6.1%	11.1%	8.5%
• Raised blood glucose or HbA1c[§] by biochemical testing	4.8%	7.9%	6.3%
◦ Self-reported doctor-diagnosed diabetes mellitus	2.3%	4.1%	3.2%
◦ No self-reported doctor-diagnosed diabetes mellitus	2.5%	3.8%	3.1%
• Self-reported doctor-diagnosed diabetes mellitus with normal blood glucose or HbA1c by biochemical testing	1.3%	3.2%	2.2%

Indicator	Female	Male	Overall
Prevalence of raised blood cholesterol / hypercholesterolaemia (combine household interview and biochemical testing by total cholesterol (TC) [£])	51.0%	52.9%	51.9%
• Raised blood cholesterol (TC ≥ 5.2 mmol/L) by biochemical testing	44.0%	40.6%	42.4%
◦ Self-reported doctor-diagnosed high blood cholesterol	7.3%	5.1%	6.2%
◦ No self-reported doctor-diagnosed high blood cholesterol	36.7%	35.6%	36.2%
• Self-reported doctor-diagnosed high blood cholesterol but normal blood cholesterol (TC < 5.2 mmol/L) by biochemical testing	6.9%	12.3%	9.5%
Prevalence of raised LDL / self-reported doctor-diagnosed high blood cholesterol	36.4%	46.2%	41.0%
• Raised LDL (LDL ≥ 3.4 mmol/L) by biochemical testing	27.3%	32.9%	30.0%
◦ Self-reported doctor-diagnosed high blood cholesterol	5.2%	4.0%	4.7%
◦ No self-reported doctor-diagnosed high blood cholesterol	22.1%	28.8%	25.3%
• Self-reported doctor-diagnosed high blood cholesterol but normal LDL (LDL< 3.4 mmol/L) by biochemical testing	9.0%	13.3%	11.0%
Prevalence of raised TC or LDL / self-reported doctor-diagnosed high blood cholesterol	51.2%	54.5%	52.8%
• Raised TC or LDL (TC ≥ 5.2 mmol/L or LDL ≥ 3.4 mmol/L) by biochemical testing	44.2%	42.2%	43.3%
◦ Self-reported doctor-diagnosed high blood cholesterol	7.3%	5.1%	6.2%
◦ No self-reported doctor-diagnosed high blood cholesterol	36.9%	37.2%	37.1%
• Self-reported doctor-diagnosed high blood cholesterol but normal TC and LDL by biochemical testing	6.9%	12.3%	9.5%

Notes: [§] Raised blood glucose or HbA1c: fasting glucose ≥ 7.0 mmol/L or HbA1c ≥ 6.5%
[£] Hypercholesterolaemia (total cholesterol): S.I. unit ≥ 5.2 mmol/L

3.1 Biochemical Testing for Diabetes Mellitus

The PHS collected fasting blood sample for blood glucose level, which includes fasting plasma glucose (FPG) and glycated haemoglobin (HbA1c) in persons aged 15-84. The prevalence of diabetes mellitus (DM) was estimated based on blood concentration of FPG and HbA1c level, and responses collected from the questionnaire survey (household survey). The unit of blood concentration of FPG was mmol/L, while the HbA1c level was denoted in percentage.

3.1.1 Fasting Plasma Glucose

In the PHS, a respondent would be classified as having DM if her / his level of fasting plasma glucose is 7.0 mmol/L or above, although in clinical settings two FPG readings are needed for DM diagnosis in asymptomatic patients [1]. The normal range for fasting plasma glucose is defined as below 6.1 mmol/L. A fasting plasma glucose reading that is below 7.0 mmol/L but greater than or equal to 6.1 mmol/L indicates impaired fasting glucose.

The mean values of FPG for females and males aged 15-84 were 5.0 mmol/L and 5.2 mmol/L respectively. Analysed by age group, the mean values of FPG increased with age from 4.6 mmol/L for those aged 15-24 to 5.4 mmol/L for those aged 55-84. (Table 3.1.1).

Table 3.1.1: Mean fasting plasma glucose (mmol/L) among persons aged 15 to 84 by age group and gender

Age group	Female	Male	Total
15 - 24	4.6	4.6	4.6
25 - 34	4.6	4.9	4.8
35 - 44	4.8	5.1	5.0
45 - 54	4.9	5.2	5.0
55 - 64	5.3	5.5	5.4
65 - 84	5.3	5.6	5.4
15 - 84	5.0	5.2	5.1

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

3.1.2 Glycated Haemoglobin (HbA1c)

HbA1c level represents the percentage of circulating haemoglobin to which glucose is bound. It is an indicator of the average blood glucose concentration over the two to three months before the blood test. DM patients would often use the HbA1c level as a mean for diabetes control. The WHO has recommended a cut-off value of HbA1c ≥ 6.5% to diagnose diabetes [1]. However, a value of less than 6.5% does not exclude diabetes diagnosed using FPG [2].

In the PHS, a respondent would also be classified as having DM if her / his level of HbA1c level is 6.5% or above, although in clinical settings an additional HbA1c or plasma glucose test result is needed for DM diagnosis in asymptomatic patients [2]. The mean values of HbA1c for females and males aged 15-84 were 5.5% and 5.7% respectively. Analysed by age group, the mean values of HbA1c increased with age in both genders from 5.2% among those aged 15-24 to 5.9% for those aged 65-84. (Table 3.1.2).

Table 3.1.2: Mean HbA1c (%) among persons aged 15 to 84 by age group and gender

Age group	Female	Male	Total
15 – 24	5.2%	5.2%	5.2%
25 – 34	5.2%	5.3%	5.3%
35 – 44	5.3%	5.6%	5.4%
45 – 54	5.4%	5.7%	5.6%
55 – 64	5.8%	5.9%	5.8%
65 – 84	5.8%	6.0%	5.9%
15 – 84	5.5%	5.7%	5.6%

Base: All respondents aged 15 - 84 who had participated in the health examination with valid HbA1c results (N=5 957 800).

3.1.3 Raised Blood Glucose / Diabetes Mellitus

Diabetes mellitus (DM) is a chronic disease caused by insufficient insulin production by the pancreas, or the insulin cannot be effectively used in the body [3]. It is the tenth commonest cause of mortality in Hong Kong in 2020 [4].

The overall prevalence of DM among persons aged 15-84 was estimated as the proportion of those self-reported doctor-diagnosed DM or those with no self-reported history but raised blood glucose or HbA1c (fasting plasma glucose $\geq$ 7.0 mmol/L or HbA1c $\geq$ 6.5%) by biochemical testing.

Among those aged 15-84, 8.5% had DM including 5.4% self-reported doctor-diagnosed DM and 3.1% with no self-reported history but raised blood glucose or HbA1c by biochemical testing. 1.6% of persons aged 15-84 had impaired fasting glucose (IFG), defined by biochemical testing as FPG between 6.1 and 6.9 mmol/L. Analysed by gender, a higher proportion of males (11.1%) than females (6.1%) had DM. The proportions of self-reported doctor-diagnosed DM were 3.6% and 7.3% for females and males respectively, while the proportions with no self-reported history but raised blood glucose or HbA1c by biochemical testing were 2.5% and 3.8% for females and males respectively. 1.3% females and 3.2% males (overall 2.2%) self-reported doctor-diagnosed diabetes mellitus had normal blood glucose or HbA1c by biochemical testing. The corresponding proportions of IFG were 1.3% and 2.0% for females and males respectively (Table 3.1.3a).

The age-standardised prevalence of raised blood glucose / diabetes (defined as fasting plasma glucose concentration $\geq$ 7.0 mmol/L or on medication for raised blood glucose disregarding known history of diabetes or raised blood sugar but not on medication for these conditions) among persons aged 18-84 years was 4.6% (Crude prevalence: 6.9%).

Table 3.1.3a: Prevalence of diabetes mellitus (including those self-reported doctor-diagnosed DM and those with no self-reported history but raised blood glucose or HbA1c by biochemical testing) and impaired fasting glucose (IFG) among persons aged 15 to 84 by gender

Whether had DM	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
DM	192.5	6.1%	312.5	11.1%	505.0	8.5%
Self-reported doctor-diagnosed DM	*114.3*	*3.6%*	*205.9*	*7.3%*	*320.2*	*5.4%*
Raised blood glucose or HbA1c by biochemical testing	*72.7*	*2.3%*	*116.4*	*4.1%*	*189.1*	*3.2%*
Non-raised blood glucose or HbA1c by biochemical testing	*41.6*	*1.3%*	*89.5*	*3.2%*	*131.1*	*2.2%*
*No self-reported history but raised blood glucose or HbA1c by biochemical testing **	*78.2*	*2.5%*	*106.6*	*3.8%*	*184.8*	*3.1%*
Non-DM	2 942.5	93.9%	2 512.2	88.9%	5 454.7	91.5%
IFG §	*39.9*	*1.3%*	*55.6*	*2.0%*	*95.5*	*1.6%*
Non IFG	*2 902.6*	*92.6%*	*2 456.7*	*87.0%*	*5 359.3*	*89.9%*
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * No self-reported history but raised blood glucose or HbA1c by biochemical testing: fasting glucose ≥ 7.0 mmol/L or HbA1c ≥ 6.5%

§ Impaired fasting glucose (IFG): fasting plasma glucose 6.1-6.9 mmol/L

Figures may not add up to the total due to rounding.

The prevalence of DM increased with age from 0.6% for persons aged 15-24 to 19.0% for those aged 65-84. The prevalence of self-reported doctor-diagnosed DM increased with age (increased from 0% among those aged 15-24 to 14.3% among those aged 65-84). Similar trend was observed for those who were not aware of their DM (no self-reported history but raised blood glucose or HbA1c by biochemical testing) (increased from 0.6% among those aged 15-34 to 6.3% among those aged 55-64 and dropped to 4.7% among those aged 65-84) (Table 3.1.3b).

Table 3.1.3b: Prevalence of diabetes mellitus (including those self-reported doctor-diagnosed DM and those with no self-reported history but raised blood glucose or HbA1c by biochemical testing) and impaired fasting glucose (IFG) among persons aged 15 to 84 by age group

	15 - 24		25 - 34		35 - 44		45 - 54		55 - 64		65 - 84		Total	
Whether had DM	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
DM	3.7	0.6%	8.0	0.9%	31.4	3.1%	57.4	5.3%	180.4	14.9%	224.1	19.0%	505.0	8.5%
Self-reported doctor-diagnosed DM	*-*	*-*	*2.5*	*0.3%*	*17.4*	*1.7%*	*28.1*	*2.6%*	*103.5*	*8.5%*	*168.6*	*14.3%*	*320.2*	*5.4%*
*No self-reported history but raised blood glucose or HbA1c by biochemical testing **	*3.7*	*0.6%*	*5.5*	*0.6%*	*14.0*	*1.4%*	*29.2*	*2.7%*	*76.9*	*6.3%*	*55.5*	*4.7%*	*184.8*	*3.1%*
Non-DM	575.8	99.4%	884.9	99.1%	979.3	96.9%	1 025.6	94.7%	1 031.9	85.1%	957.2	81.0%	5 454.7	91.5%
IFG §	*-*	*-*	*2.5*	*0.3%*	*11.4*	*1.1%*	*15.2*	*1.4%*	*25.4*	*2.1%*	*40.9*	*3.5%*	*95.5*	*1.6%*
Non IFG	*575.8*	*99.4%*	*882.4*	*98.8%*	*967.9*	*95.8%*	*1 010.4*	*93.3%*	*1 006.5*	*83.0%*	*916.3*	*77.6%*	*5 359.3*	*89.9%*
Total	579.5	100.0%	892.9	100.0%	1 010.7	100.0%	1 083.0	100.0%	1 212.3	100.0%	1 181.3	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * No self-reported history but raised blood glucose or HbA1c by biochemical testing: fasting glucose ≥ 7.0 mmol/L or HbA1c ≥ 6.5%

§ Impaired fasting glucose (IFG): fasting plasma glucose 6.1-6.9 mmol/L

Figures may not add up to the total due to rounding.

3.2 Biochemical Testing for Hypercholesterolaemia

The PHS 2020-22 collected biochemical information on lipid profile, including blood concentrations of total cholesterol (TC), high density lipoprotein (HDL), low density lipoprotein (LDL) and triglyceride. Cholesterol is an essential component of our cells, bile and hormones. It is transported in our blood by combining with lipoprotein. HDL cholesterol is known as the "good cholesterol" that helps prevent the blockage of blood vessels and reduce the risk of cardiovascular diseases. On the other hand, LDL cholesterol is known as the "bad cholesterol" that promotes fat deposition in blood vessels, which narrows the lumen of the vessel and increases the risk of having cardiovascular diseases. Total cholesterol measures the sum of all cholesterol including both HDL cholesterol and LDL cholesterol [5]. An increase of total cholesterol level is not desirable. If the level of cholesterol in blood is higher than normal range, it can be referred as hypercholesterolaemia.

3.2.1 Lipids and Lipoproteins

Among persons aged 15-84, the mean concentrations of total cholesterol were 5.1 mmol/L and 5.0 mmol/L for females and males respectively. The mean concentrations of HDL were 1.7 mmol/L and 1.4 mmol/L for females and males respectively. The mean LDL concentrations were 2.9 mmol/L for females and 3.0 mmol/L for males. The mean triglyceride concentrations were 1.1 mmol/L for females and 1.4 mmol/L for males. Generally, the mean concentrations of total cholesterol, LDL and triglyceride increased with age, while the mean concentrations of HDL were stable across the age groups (Table 3.2.1a).

Table 3.2.1a: Mean lipid and lipoproteins concentrations among persons aged 15 to 84 by age group and gender

	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
Age group	**Total cholesterol* (mmol/L)**			**HDL* (mmol/L)**			**LDL* (mmol/L)**			**Triglyceride† (mmol/L)**		
15 – 24	4.5	4.4	4.5	1.7	1.4	1.5	2.5	2.6	2.5	0.8	0.9	0.9
25 – 34	4.7	5.0	4.8	1.7	1.4	1.5	2.6	3.1	2.8	0.9	1.3	1.1
35 – 44	4.8	5.3	5.1	1.6	1.3	1.5	2.8	3.2	3.0	1.0	1.6	1.3
45 – 54	5.3	5.3	5.3	1.7	1.3	1.5	3.1	3.2	3.2	1.1	1.6	1.3
55 – 64	5.6	5.0	5.4	1.7	1.4	1.5	3.3	3.0	3.2	1.4	1.4	1.4
65 – 84	5.2	4.7	4.9	1.6	1.4	1.5	2.9	2.7	2.8	1.4	1.3	1.4
15 – 84	5.1	5.0	5.0	1.7	1.4	1.5	2.9	3.0	3.0	1.1	1.4	1.2

Bases: * All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).
† All respondents aged 15 - 84 who had participated in the health examination with valid triglyceride results (N=5 956 900).

Total Cholesterol (TC)

Among persons aged 15-84, 42.4% (44.0% for females and 40.6% for males) had total cholesterol at a borderline high or above level (total cholesterol ≥ 5.2 mmol/L). In general, the proportion who had total cholesterol at borderline high or above level increased with age from 15.0% for those aged 15-24 to 57.4% for those aged 55-64 and decreased to 40.5% for those aged 65-84 (Table 3.2.1b).

Table 3.2.1b: Level of total cholesterol among persons aged 15 to 84 by age group and gender

Age group / Total cholesterol level	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 - 24						
Borderline high or above *	41.8	14.8%	44.8	15.1%	86.7	15.0%
Normal †	241.2	85.2%	251.7	84.9%	492.8	85.0%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 - 34						
Borderline high or above *	110.2	24.2%	171.7	39.3%	281.9	31.6%
Normal †	346.0	75.8%	265.0	60.7%	611.0	68.4%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 - 44						
Borderline high or above *	169.4	30.9%	253.6	54.8%	423.1	41.9%
Normal †	378.7	69.1%	209.0	45.2%	587.6	58.1%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Borderline high or above *	315.2	52.1%	246.3	51.5%	561.5	51.8%
Normal †	289.3	47.9%	232.2	48.5%	521.5	48.2%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Borderline high or above *	437.8	68.7%	258.2	44.9%	696.0	57.4%
Normal †	199.0	31.3%	317.3	55.1%	516.3	42.6%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 84						
Borderline high or above *	305.3	50.3%	173.0	30.1%	478.3	40.5%
Normal †	301.1	49.7%	401.9	69.9%	703.0	59.5%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Borderline high or above *	1 379.8	44.0%	1 147.7	40.6%	2 527.5	42.4%
Normal †	1 755.2	56.0%	1 677.0	59.4%	3 432.2	57.6%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).
Notes: * Borderline high or above: Total cholesterol in S.I. unit ≥ 5.2 mmol/L
† Normal: Total cholesterol in S.I. unit < 5.2 mmol/L
Figures may not add up to the total due to rounding.

High density lipoprotein (HDL)

Among persons aged 15-84, 15.8% had low HDL concentration (i.e. HDL < 1.3 mmol/L for females and HDL < 1.0 mmol/L for males), while 45.6% reached the desirable level of HDL (i.e. HDL > 1.5 mmol/L for both genders). Analysed by gender, while more females (19.4%) had low HDL concentration than males (11.8%), desirable HDL level was also more common in females (61.7%) than in males (27.7%) (Table 3.2.1c).

Table 3.2.1c: Level of high density lipoprotein (HDL) among persons aged 15 to 84 by age group and gender

Age group / HDL level	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 – 24						
Low *	45.5	16.1%	17.6	5.9%	63.1	10.9%
Normal †	47.1	16.6%	183.4	61.9%	230.6	39.8%
Desirable ^	190.4	67.3%	95.5	32.2%	285.9	49.3%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 - 34						
Low *	72.6	15.9%	45.5	10.4%	118.1	13.2%
Normal †	75.5	16.5%	280.1	64.1%	355.5	39.8%
Desirable ^	308.1	67.5%	111.1	25.4%	419.2	47.0%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 - 44						
Low *	121.2	22.1%	61.3	13.2%	182.5	18.1%
Normal †	87.9	16.0%	295.4	63.8%	383.2	37.9%
Desirable ^	339.0	61.9%	106.0	22.9%	445.0	44.0%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Low *	104.2	17.2%	52.7	11.0%	156.9	14.5%
Normal †	113.7	18.8%	329.2	68.8%	442.8	40.9%
Desirable ^	386.6	64.0%	96.7	20.2%	483.3	44.6%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Low *	120.8	19.0%	75.6	13.1%	196.4	16.2%
Normal †	121.1	19.0%	307.2	53.4%	428.3	35.3%
Desirable ^	394.9	62.0%	192.8	33.5%	587.6	48.5%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 84						
Low *	143.0	23.6%	82.0	14.3%	225.0	19.0%
Normal †	147.3	24.3%	313.5	54.5%	460.8	39.0%
Desirable ^	316.0	52.1%	179.4	31.2%	495.5	41.9%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Low *	607.4	19.4%	334.6	11.8%	942.0	15.8%
Normal †	592.5	18.9%	1 708.7	60.5%	2 301.2	38.6%
Desirable ^	1 935.1	61.7%	781.4	27.7%	2 716.5	45.6%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * Low: HDL in S.I. unit < 1.0 mmol/L (male) or < 1.3 mmol/L (female).

† Normal: HDL in S.I. unit ≥ 1.0 mmol/L and ≤ 1.5 mmol/L (male) or ≥ 1.3 mmol/L and ≤ 1.5 mmol/L (female).

^ Desirable: HDL in S.I. unit > 1.5 mmol/L.

Figures may not add up to the total due to rounding.

Low density lipoprotein (LDL)

Among persons aged 15-84, 30.0% had LDL at borderline high or above level (i.e. LDL ≥ 3.4 mmol/L). Analysed by gender, 27.3% of females and 32.9% of males were at borderline high or above level of LDL. Analysed by age group, the proportion of LDL at borderline high or above level generally increased with age from 9.7% for those aged 15-24 to 42.6% for those aged 55-64 and then decreased to 27.8% for those aged 65-84 (Table 3.2.1d).

Table 3.2.1d: Level of low density lipoprotein (LDL) among persons aged 15 to 84 by age group and gender

Age group / LDL level	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 - 24						
Borderline high or above *	21.0	7.4%	35.0	11.8%	56.0	9.7%
Normal †	262.0	92.6%	261.5	88.2%	523.5	90.3%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 - 34						
Borderline high or above *	63.7	14.0%	143.9	33.0%	207.6	23.3%
Normal †	392.5	86.0%	292.8	67.0%	685.3	76.7%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 - 44						
Borderline high or above *	99.8	18.2%	195.0	42.2%	294.9	29.2%
Normal †	448.3	81.8%	267.6	57.8%	715.8	70.8%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Borderline high or above *	178.6	29.5%	204.9	42.8%	383.4	35.4%
Normal †	425.9	70.5%	273.6	57.2%	699.6	64.6%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Borderline high or above *	310.2	48.7%	205.9	35.8%	516.1	42.6%
Normal †	326.6	51.3%	369.6	64.2%	696.2	57.4%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 84						
Borderline high or above *	184.0	30.3%	143.8	25.0%	327.8	27.8%
Normal †	422.4	69.7%	431.1	75.0%	853.5	72.2%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Borderline high or above *	857.3	27.3%	928.6	32.9%	1 785.9	30.0%
Normal †	2 277.7	72.7%	1 896.1	67.1%	4 173.8	70.0%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).
Notes: * Borderline high or above: LDL in S.I. unit ≥ 3.4 mmol/L
† Normal: LDL in S.I. unit < 3.4 mmol/L.
Figures may not add up to the total due to rounding.

Triglyceride

Among persons aged 15-84, 18.6% had triglyceride concentration at borderline high or above level (i.e. triglyceride ≥ 1.7 mmol/L). Analysed by gender, more males (22.2%) had their triglyceride at borderline high or above level than females (15.3%). Analysed by age group, in general, the proportion of triglyceride at borderline high or above level increased with age from 3.9% for those aged 15-24 to 23.5% for those aged 55-64 and then decreased to 21.5% for those aged 65-84 (Table 3.2.1e).

Table 3.2.1e: Level of triglyceride among persons aged 15 to 84 by age group and gender

Age group / Triglyceride level	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 - 24						
Borderline high or above *	8.8	3.1%	13.7	4.6%	22.5	3.9%
Normal †	274.2	96.9%	282.8	95.4%	557.0	96.1%
Unknown / missing	-	-	-	-	-	-
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 - 34						
Borderline high or above *	37.7	8.3%	85.9	19.7%	123.6	13.8%
Normal †	418.5	91.7%	350.8	80.3%	769.3	86.2%
Unknown / missing	-	-	-	-	-	-
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 - 44						
Borderline high or above *	39.5	7.2%	131.0	28.3%	170.5	16.9%
Normal †	508.6	92.8%	328.8	71.1%	837.4	82.8%
Unknown / missing	-	-	2.8	0.6%	2.8	0.3%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Borderline high or above *	94.4	15.6%	157.8	33.0%	252.2	23.3%
Normal †	510.1	84.4%	320.7	67.0%	830.8	76.7%
Unknown / missing	-	-	-	-	-	-
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Borderline high or above *	167.7	26.3%	117.7	20.4%	285.4	23.5%
Normal †	469.1	73.7%	457.8	79.6%	926.9	76.5%
Unknown / missing	-	-	-	-	-	-
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 84						
Borderline high or above *	132.3	21.8%	121.1	21.1%	253.4	21.5%
Normal †	474.1	78.2%	453.8	78.9%	927.9	78.5%
Unknown / missing	-	-	-	-	-	-
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Borderline high or above *	480.5	15.3%	627.2	22.2%	1 107.7	18.6%
Normal †	2 654.5	84.7%	2 194.7	77.7%	4 849.2	81.4%
Unknown / missing	-	-	2.8	0.1%	2.8	<0.05%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * Borderline high or above: Triglyceride in S.I. unit ≥ 1.7 mmol/L.

† Normal: Triglyceride in S.I. unit < 1.7 mmol/L

Figures may not add up to the total due to rounding.

3.2.2 Raised Blood Cholesterol / Hypercholesterolaemia

In the PHS, a respondent would be classified as hypercholesterolaemia if their total cholesterol (TC) measured was ≥ 5.2 mmol/L in the biochemical testing.

Using TC as the indicator, among persons aged 15-84, the overall prevalence of raised blood cholesterol / hypercholesterolaemia was 51.9%, including 36.2% of persons aged 15-84 who were unaware of their high TC level (no self-reported history but raised blood cholesterol (TC ≥ 5.2 mmol/L) by biochemical testing) and 15.7% self-reported doctor diagnosed high blood cholesterol. The prevalence of raised blood cholesterol / hypercholesterolaemia was higher in males (52.9%) than in females (51.0%) among persons aged 15-84. The proportions of persons who had raised blood cholesterol / hypercholesterolaemia but were unaware of it were higher in females (36.7%) than in males (35.6%). Analysed by age group, the prevalence of raised blood cholesterol / hypercholesterolaemia generally increased with age, with the highest prevalence (72.1%) among those aged 55-64. 9.5% had self-reported doctor-diagnosed high blood cholesterol but normal blood cholesterol (TC < 5.2 mmol/L) by biochemical testing (Table 3.2.2a).

Among persons aged 18-84 years, the age-standardised prevalence of raised total cholesterol (defined as total cholesterol ≥ 5.0 mmol/L disregarding known history of high blood cholesterol) was 45.0% (Crude prevalence: 49.7%). The age-standardised mean total cholesterol was 5.0 mmol/L (Crude mean total cholesterol: 5.1 mmol/L).

Table 3.2.2a: Prevalence of hypercholesterolaemia defined by total cholesterol (TC) level among persons aged 15 to 84 by age group and gender

Age Group / Whether had hypercholesterolaemia (defined by total cholesterol level)	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 – 24						
Hypercholesterolaemia	41.8	14.8%	44.8	15.1%	86.7	15.0%
Self-reported doctor-diagnosed high blood cholesterol	*-*	*-*	*1.9*	*0.7%*	*1.9*	*0.3%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*41.8*	*14.8%*	*42.9*	*14.5%*	*84.7*	*14.6%*
Non-hypercholesterolaemia	241.2	85.2%	251.7	84.9%	492.8	85.0%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 – 34						
Hypercholesterolaemia	113.1	24.8%	179.2	41.0%	292.3	32.7%
Self-reported doctor-diagnosed high blood cholesterol	*5.8*	*1.3%*	*20.1*	*4.6%*	*25.8*	*2.9%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*107.3*	*23.5%*	*159.1*	*36.4%*	*266.5*	*29.8%*
Non-hypercholesterolaemia	343.1	75.2%	257.5	59.0%	600.6	67.3%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 – 44						
Hypercholesterolaemia	178.5	32.6%	264.7	57.2%	443.2	43.8%
Self-reported doctor-diagnosed high blood cholesterol	*18.1*	*3.3%*	*27.7*	*6.0%*	*45.8*	*4.5%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*160.4*	*29.3%*	*237.0*	*51.2%*	*397.3*	*39.3%*
Non-hypercholesterolaemia	369.6	67.4%	197.9	42.8%	567.5	56.2%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 – 54						
Hypercholesterolaemia	331.4	54.8%	290.5	60.7%	621.9	57.4%
Self-reported doctordiagnosed high blood cholesterol	*55.3*	*9.1%*	*74.7*	*15.6%*	*130.0*	*12.0%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*276.1*	*45.7%*	*215.8*	*45.1%*	*492.0*	*45.4%*
Non-hypercholesterolaemia	273.1	45.2%	188.0	39.3%	461.1	42.6%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 – 64						
Hypercholesterolaemia	487.6	76.6%	385.9	67.0%	873.5	72.1%
Self-reported doctor-diagnosed high blood cholesterol	*142.7*	*22.4%*	*179.7*	*31.2%*	*322.4*	*26.6%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*344.9*	*54.2%*	*206.1*	*35.8%*	*551.0*	*45.5%*
Non-hypercholesterolaemia	149.2	23.4%	189.6	33.0%	338.8	27.9%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 – 84						
Hypercholesterolaemia	444.9	73.4%	329.6	57.3%	774.5	65.6%
Self-reported doctor-diagnosed high blood cholesterol	*224.1*	*37.0%*	*186.0*	*32.4%*	*410.1*	*34.7%*
*No self-reported history but raised blood cholesterol by biochemical testing**	*220.7*	*36.4%*	*143.6*	*25.0%*	*364.3*	*30.8%*
Non-hypercholesterolaemia	161.5	26.6%	245.3	42.7%	406.8	34.4%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%

(To be continued)

Table 3.2.2a: Prevalence of hypercholesterolaemia defined by total cholesterol (TC) level among persons aged 15 to 84 by age group and gender (continued)

Age Group / Whether had hypercholesterolaemia (defined by total cholesterol level)	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 – 84						
Hypercholesterolaemia	1 597.3	51.0%	1 494.6	52.9%	3 091.9	51.9%
Self-reported doctor-diagnosed high blood cholesterol	*446.0*	*14.2%*	*490.1*	*17.3%*	*936.1*	*15.7%*
Raised blood cholesterol by biochemical testing	*228.5*	*7.3%*	*143.1*	*5.1%*	*371.6*	*6.2%*
Normal blood cholesterol by biochemical testing	*217.5*	*6.9%*	*346.9*	*12.3%*	*564.5*	*9.5%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*1 151.3*	*36.7%*	*1 004.5*	*35.6%*	*2 155.8*	*36.2%*
Non-hypercholesterolaemia	1 537.7	49.0%	1 330.1	47.1%	2 867.8	48.1%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).
Notes: * No self-reported history but raised blood cholesterol by biochemical testing: total cholesterol ≥ 5.2 mmol/L.
Figures may not add up to the total due to rounding.

Other than total cholesterol, low-density lipoprotein (LDL) may also be used for defining high blood cholesterol.

Using self-reported history or LDL ≥ 3.4 mmol/L as the indicator, 41.0% persons aged 15-84 had raised LDL / self-reported doctor-diagnosed high blood cholesterol. 25.3% of persons aged 15-84 were unaware of their high LDL level (no self-reported history but raised LDL by biochemical testing). The prevalence was higher in males (46.2%) than in females (36.4%) among persons aged 15-84, and higher proportion of males (28.8%) than females (22.1%) were unaware of their raised LDL. Analysed by age group, the prevalence of raised LDL / self-reported doctor-diagnosed high blood cholesterol generally increased with age, with the highest prevalence (58.8%) among those aged 55-64. 11.0% had self-reported doctor-diagnosed high blood cholesterol but normal LDL by biochemical testing. (Table 3.2.2b).

Table 3.2.2b: Prevalence of raised LDL / self-reported doctor-diagnosed high blood cholesterol among persons aged 15 to 84 by age group and gender

Age Group / Whether had raised LDL / self-reported doctor-diagnosed high blood cholesterol	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 – 24						
Raised LDL	21.0	7.4%	37.0	12.5%	57.9	10.0%
Self-reported doctor diagnosed high blood cholesterol	*-*	*-*	*1.9*	*0.7%*	*1.9*	*0.3%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*21.0*	*7.4%*	*35.0*	*11.8%*	*56.0*	*9.7%*
Non-raised LDL	262.0	92.6%	259.5	87.5%	521.6	90.0%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 – 34						
Raised LDL	66.6	14.6%	151.4	34.7%	218.0	24.4%
Self-reported doctor diagnosed high blood cholesterol	*5.8*	*1.3%*	*20.1*	*4.6%*	*25.8*	*2.9%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*60.8*	*13.3%*	*131.3*	*30.1%*	*192.2*	*21.5%*
Non-raised LDL	389.6	85.4%	285.3	65.3%	674.9	75.6%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 – 44						
Raised LDL	111.9	20.4%	214.4	46.3%	326.3	32.3%
Self-reported doctor diagnosed high blood cholesterol	*18.1*	*3.3%*	*27.7*	*6.0%*	*45.8*	*4.5%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*93.8*	*17.1%*	*186.7*	*40.4%*	*280.5*	*27.8%*
Non-raised LDL	436.2	79.6%	248.2	53.7%	684.4	67.7%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 – 54						
Raised LDL	207.9	34.4%	254.6	53.2%	462.5	42.7%
Self-reported doctor diagnosed high blood cholesterol	*55.3*	*9.1%*	*74.7*	*15.6%*	*130.0*	*12.0%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*152.6*	*25.2%*	*180.0*	*37.6%*	*332.5*	*30.7%*
Non-raised LDL	396.6	65.6%	223.9	46.8%	620.5	57.3%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 – 64						
Raised LDL	375.6	59.0%	336.8	58.5%	712.4	58.8%
Self-reported doctor diagnosed high blood cholesterol	*142.7*	*22.4%*	*179.7*	*31.2%*	*322.4*	*26.6%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*232.9*	*36.6%*	*157.0*	*27.3%*	*389.9*	*32.2%*
Non-raised LDL	261.2	41.0%	238.7	41.5%	499.9	41.2%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 84						
Raised LDL	356.7	58.8%	310.2	54.0%	666.9	56.5%
Self-reported doctor diagnosed high blood cholesterol	*224.1*	*37.0%*	*186.0*	*32.4%*	*410.1*	*34.7%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*132.6*	*21.9%*	*124.2*	*21.6%*	*256.8*	*21.7%*
Non-raised LDL	249.7	41.2%	264.7	46.0%	514.4	43.5%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%

(To be continued)

Table 3.2.2b: Prevalence of raised LDL / self-reported doctor-diagnosed high blood cholesterol among persons aged 15 to 84 by age group and gender (continued)

Age Group / Whether had raised LDL / self-reported doctor-diagnosed high blood cholesterol	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 – 84						
Raised LDL	1 139.7	36.4%	1 304.4	46.2%	2 444.0	41.0%
Self-reported doctor diagnosed high blood cholesterol	*446.0*	*14.2%*	*490.1*	*17.3%*	*936.1*	*15.7%*
Raised blood cholesterol by biochemical testing	*163.7*	*5.2%*	*114.3*	*4.0%*	*278.0*	*4.7%*
Normal blood cholesterol by biochemical testing	*282.3*	*9.0%*	*375.8*	*13.3%*	*658.1*	*11.0%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*693.6*	*22.1%*	*814.3*	*28.8%*	*1 507.9*	*25.3%*
Non-raised LDL	1 995.3	63.6%	1 520.3	53.8%	3 515.7	59.0%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).
Notes: * No self-reported history but raised blood cholesterol by biochemical testing: LDL ≥ 3.4 mmol/L.
Figures may not add up to the total due to rounding.

Using total cholesterol (TC) and low-density lipoprotein (LDL) as the indicator, i.e. TC ≥ 5.2 mmol/L or LDL ≥ 3.4 mmol/L, among persons aged 15-84, 52.8% had raised TC or LDL / self-reported doctor-diagnosed high blood cholesterol, including 37.1% who were unaware of their high TC / LDL level (no self-reported history but TC ≥ 5.2 mmol/L or LDL ≥ 3.4 mmol/L by biochemical testing). The prevalence was higher in males (54.5%) than in females (51.2%) among persons aged 15-84, and higher proportion of males (37.2%) than females (36.9%) were unaware of it. Analysed by age group, the prevalence of raised TC or LDL / self-reported doctor-diagnosed high blood cholesterol generally increased with age, with the highest prevalence (72.8%) among those aged 55-64. 9.5% had self-reported doctor-diagnosed high blood cholesterol but normal TC and LDL by biochemical testing (Table 3.2.2c).

Table 3.2.2c: Prevalence of raised TC or LDL / self-reported doctor-diagnosed high blood cholesterol among persons aged 15 to 84 by age group and gender

Age Group / Whether had raised TC or LDL / self-reported doctor-diagnosed high blood cholesterol	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 – 24						
Raised TC or LDL	41.8	14.8%	48.7	16.4%	90.6	15.6%
Self-reported doctor diagnosed high blood cholesterol	*-*	*-*	*1.9*	*0.7%*	*1.9*	*0.3%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*41.8*	*14.8%*	*46.8*	*15.8%*	*88.6*	*15.3%*
Non-raised TC and LDL	241.2	85.2%	247.8	83.6%	488.9	84.4%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 – 34						
Raised TC or LDL	113.1	24.8%	184.3	42.2%	297.3	33.3%
Self-reported doctor diagnosed high blood cholesterol	*5.8*	*1.3%*	*20.1*	*4.6%*	*25.8*	*2.9%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*107.3*	*23.5%*	*164.2*	*37.6%*	*271.5*	*30.4%*
Non-raised TC and LDL	343.1	75.2%	252.4	57.8%	595.6	66.7%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 – 44						
Raised TC or LDL	178.5	32.6%	270.2	58.4%	448.7	44.4%
Self-reported doctor diagnosed high blood cholesterol	*18.1*	*3.3%*	*27.7*	*6.0%*	*45.8*	*4.5%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*160.4*	*29.3%*	*242.5*	*52.4%*	*402.9*	*39.9%*
Non-raised TC and LDL	369.6	67.4%	192.4	41.6%	562.0	55.6%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 – 54						
Raised TC or LDL	331.4	54.8%	298.8	62.4%	630.2	58.2%
Self-reported doctor diagnosed high blood cholesterol	*55.3*	*9.1%*	*74.7*	*15.6%*	*130.0*	*12.0%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*276.1*	*45.7%*	*224.1*	*46.8%*	*500.3*	*46.2%*
Non-raised TC and LDL	273.1	45.2%	179.7	37.6%	452.8	41.8%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 – 64						
Raised TC or LDL	490.7	77.1%	392.4	68.2%	883.1	72.8%
Self-reported doctor diagnosed high blood cholesterol	*142.7*	*22.4%*	*179.7*	*31.2%*	*322.4*	*26.6%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*348.0*	*54.6%*	*212.6*	*36.9%*	*560.6*	*46.2%*
Non-raised TC and LDL	146.1	22.9%	183.1	31.8%	329.2	27.2%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 – 84						
Raised TC or LDL	448.6	74.0%	346.0	60.2%	794.6	67.3%
Self-reported doctor diagnosed high blood cholesterol	*224.1*	*37.0%*	*186.0*	*32.4%*	*410.1*	*34.7%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*224.4*	*37.0%*	*160.0*	*27.8%*	*384.5*	*32.5%*
Non-raised TC and LDL	157.8	26.0%	228.9	39.8%	386.7	32.7%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%

(To be continued)

Table 3.2.2c: Prevalence of raised TC or LDL / self-reported doctor-diagnosed high blood cholesterol among persons aged 15 to 84 by age group and gender (continued)

Age Group / Whether had raised TC or LDL / self-reported doctor-diagnosed high blood cholesterol	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
15 – 84						
Raised TC or LDL	1 604.1	51.2%	1 540.4	54.5%	3 144.5	52.8%
Self-reported doctor diagnosed high blood cholesterol	*446.0*	*14.2%*	*490.1*	*17.3%*	*936.1*	*15.7%*
Raised blood cholesterol by biochemical testing	*228.5*	*7.3%*	*143.1*	*5.1%*	*371.6*	*6.2%*
Normal blood cholesterol by biochemical testing	*217.5*	*6.9%*	*346.9*	*12.3%*	*564.5*	*9.5%*
*No self-reported history but raised blood cholesterol by biochemical testing **	*1 158.1*	*36.9%*	*1 050.3*	*37.2%*	*2 208.4*	*37.1%*
Non-raised TC and LDL	1 530.9	48.8%	1 284.3	45.5%	2 815.2	47.2%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination (N=5 959 700).

Notes: * No self-reported history but raised blood cholesterol by biochemical testing: TC ≥ 5.2 mmol/L or LDL ≥ 3.4 mmol/L.
Figures may not add up to the total due to rounding.

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Chapter 4
Biochemical Testing – Urine

Sodium and potassium are essential nutritional elements that can be found in a variety of food. However, excessive sodium intake and low potassium intake can be risk factors of hypertension, which increases the risk of cardiovascular diseases [1]. Dietary salt, which is the major source of sodium intake, is widely used as seasoning or in processing of food. During the processing procedures, the amount of potassium is also reduced [1].

In this section, salt and potassium intake were estimated by collection of 24-hour urine tests for sodium and potassium excretion.

Snapshot of Biochemical Testing of the Population (for persons aged 15 to 84)

Indicator	Female	Male	Overall
Mean population intake of salt (g[I]) per day	7.4g	9.5g	8.4g
Proportion of population with salt intake ≥ 5 g[I] per day	77.1%	91.5%	83.9%
Proportion of population with potassium intake < 3.5 g[I] per day	92.6%	88.9%	90.9%

Note: [I] g stands for gram

4.1 Biochemical Testing for Sodium Intake

The WHO recommends adults to consume less than 2 grams (g) of sodium or below 5 g of salt (also known as sodium chloride) per day. A reduction of sodium intake helps to reduce blood pressure and the risk of related NCDs [2]. Sodium intake was estimated from 24-hour urine samples in the PHS. 24-hour urine collection is an accurate method to estimate dietary sodium intake [3].

Among persons aged 15-84, the mean 24-hour urinary sodium excretion was 127.0 mmol and 162.9 mmol for females and males respectively. Analysed by age group, the mean 24-hour sodium excretion was the highest at 138.4 mmol for females in the 25-34 age group and at 174.4 mmol for males in the 35-44 age group (Table 4.1a).

Table 4.1a: Mean 24-hour urinary sodium excretion (mmol) among persons aged 15 to 84 by age group and gender

Age group	Female	Male	Total
15 – 24	124.4	161.2	143.2
25 – 34	138.4	168.5	153.1
35 – 44	137.1	174.4	154.1
45 – 54	136.5	165.9	149.5
55 – 64	118.3	168.3	142.1
65 – 84	109.9	142.2	125.7
15 – 84	127.0	162.9	144.0

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urinary sodium results (N=5 929 300).
Note: One mmol of sodium (Na) is equivalent to 0.0585 grams of salt (NaCl).

In this survey, the amount of 24-hour urinary sodium excretion in mmol was converted into salt intake in gram by multiplying a factor 0.0585 (one mmol of sodium is equivalent to 0.0585 g of salt in sodium content) [4]. Therefore, approximately 17.1 mmol of sodium excretion is equivalent to intake of 1.0 g of salt in sodium content.

Among persons aged 15-84, the mean values of dietary salt intake were estimated at 7.4 g per day and 9.5 g per day for females and males respectively. For females, the highest mean daily salt intake was in the 25-34 age group (8.1 g per day), while the lowest mean daily salt intake was in the 65-84 age group (6.4 g per day). For males, the highest mean daily salt intake was in the 35-44 age group (10.2 g per day), while the lowest mean daily salt intake was in the 65-84 age group (8.3 g per day) (Table 4.1b).

The age-standardised mean intake of salt (sodium chloride) among persons aged 18-84 years was 8.5 g per day (Crude mean: 8.4 g per day).

Table 4.1b: Mean daily salt intake (gram) among persons aged 15 to 84 by age group and gender

Age group	Female	Male	Total
15 – 24	7.3	9.4	8.4
25 – 34	8.1	9.9	9.0
35 - 44	8.0	10.2	9.0
45 - 54	8.0	9.7	8.7
55 - 64	6.9	9.8	8.3
65 - 84	6.4	8.3	7.4
15 - 84	7.4	9.5	8.4

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urinary sodium results (N=5 929 300).

Among persons aged 15-84, 83.9% had dietary salt intake above the WHO recommended daily limit (i.e. less than 5 g per day). Analysed by gender, 77.1% of females and 91.5% of males aged 15-84 had dietary salt intake at 5 g or more per day. Analysed by age group, the proportion of persons who had dietary salt intake at 5 g or more per day was the lowest at 79.1% for the 65-84 age group and the highest at 89.7% for the 35-44 age group (Table 4.1c).

Table 4.1c: Level of salt intake among persons aged 15 to 84 by age group and gender

	Female		Male		Total	
Age group / Salt intake level	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
15 - 24						
Salt intake ≥ 5g per day	226.8	80.1%	262.4	88.5%	489.2	84.4%
Salt intake < 5g per day	56.2	19.9%	34.1	11.5%	90.3	15.6%
Unknown / missing	-	-	-	-	-	-
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 - 34						
Salt intake ≥ 5g per day	372.2	81.6%	397.6	91.0%	769.7	86.2%
Salt intake < 5g per day	84.0	18.4%	36.6	8.4%	120.6	13.5%
Unknown / missing	-	-	2.6	0.6%	2.6	0.3%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 - 44						
Salt intake ≥ 5g per day	467.1	85.2%	439.4	95.0%	906.5	89.7%
Salt intake < 5g per day	77.9	14.2%	20.3	4.4%	98.3	9.7%
Unknown / missing	3.1	0.6%	2.9	0.6%	5.9	0.6%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Salt intake ≥ 5g per day	481.4	79.6%	446.8	93.4%	928.2	85.7%
Salt intake < 5g per day	119.7	19.8%	31.7	6.6%	151.4	14.0%
Unknown / missing	3.4	0.6%	-	-	3.4	0.3%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Salt intake ≥ 5g per day	454.5	71.4%	517.1	89.9%	971.6	80.1%
Salt intake < 5g per day	179.2	28.1%	58.4	10.1%	237.6	19.6%
Unknown / missing	3.2	0.5%	-	-	3.2	0.3%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 84						
Salt intake ≥ 5g per day	414.2	68.3%	520.1	90.5%	934.3	79.1%
Salt intake < 5g per day	180.4	29.7%	51.2	8.9%	231.6	19.6%
Unknown / missing	11.8	1.9%	3.6	0.6%	15.4	1.3%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Salt intake ≥ 5g per day	2 416.2	77.1%	2 583.3	91.5%	4 999.5	83.9%
Salt intake < 5g per day	697.5	22.2%	232.3	8.2%	929.8	15.6%
Unknown / missing	21.4	0.7%	9.0	0.3%	30.4	0.5%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urine test (N=5 959 700).
Note: Figures may not add up to the total due to rounding.

Analysed by frequency of eating-out for breakfast, lunch or dinner among persons aged 15-84, the proportion of high salt intake (5 g or more per day) increased with increasing frequency of eating-out from 80.6% for persons eating out less than once per week with mean salt intake of 7.6 g per day to 88.5% for persons eating out six times or more per week with mean salt intake of 9.3 g per day (Table 4.1d).

Table 4.1d: Level of salt intake among persons aged 15 to 84 by frequency of eating-out

	Eating-out less than once per week		Eating-out 1-3 times per week		Eating-out 4-5 times per week		Eating-out 6 times or more per week		Total	
Salt intake level	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
Salt intake ≥ 5g per day	1 117.3	80.6%	1 016.1	80.5%	671.3	83.8%	2 194.8	88.5%	4 999.5	84.3%
Salt intake < 5g per day	268.1	19.4%	246.9	19.5%	129.7	16.2%	285.1	11.5%	929.8	15.7%
Total	1 385.5	100.0%	1 262.9	100.0%	801.0	100.0%	2 479.9	100.0%	5 929.3	100.0%
Mean (g per day)	7.6		7.7		8.3		9.3		8.4	

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urinary sodium results (N=5 929 300).

Note: Figures may not add up to the total due to rounding.

Analysed by frequency of consuming preserved vegetables, the mean salt intake increased from 8.2 g per day among persons consuming less than once per month to 8.6 g per day among those consuming 4 times or more per month (Table 4.1e).

Table 4.1e: Level of salt intake among persons aged 15 to 84 by frequency of consuming preserved vegetables

	<1 time per month / do not eat		1-3 (times) per month		4 times or more per month		Total	
Salt intake level	**No. of Persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
Salt intake ≥ 5g per day	1 989.0	83.8%	1 873.1	84.2%	1 137.4	85.5%	4 999.5	84.3%
Salt intake < 5g per day	385.8	16.2%	350.6	15.8%	193.3	14.5%	929.8	15.7%
Total	2 374.8	100.0%	2 223.7	100.0%	1 330.7	100.0%	5 929.3	100.0%
Mean (g per day)	8.2		8.6		8.6		8.4	

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urinary sodium results (N=5 929 300).

Note: Figures may not add up to the total due to rounding.

Analysed by frequency of consuming processed meat, the mean salt intake increased from 7.7 g per day among persons consuming less than once per month to 9.0 g per day among those consuming 4 times or more per month (Table 4.1f).

Table 4.1f: Level of salt intake among persons aged 15 to 84 by frequency of consuming processed meat

	<1 time per month / do not eat		1-3 (times) per month		4 times or more per month		Total	
Salt intake level	**No. of Persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
Salt intake ≥ 5g per day	1 093.3	79.3%	1 497.7	84.1%	2 405.1	86.9%	4 996.1	84.3%
Salt intake < 5g per day	284.9	20.7%	282.5	15.9%	362.4	13.1%	929.8	15.7%
Total	1 378.2	100.0%	1 780.2	100.0%	2 767.4	100.0%	5 925.9	100.0%
Mean (g per day)	7.7		8.2		9.0		8.4	

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urinary sodium results and valid answer on frequency of consuming processed meat (N=5 925 900).
Note: Figures may not add up to the total due to rounding.

Analysed by frequency of consuming snacks with high-salt content, the mean salt intake among persons consuming less than once per month, 1-3 times per month and 4 times or more per month was 8.1 g per day, 8.8 g per day and 8.6 g per day respectively (Table 4.1g).

Table 4.1g: Level of salt intake among persons aged 15 to 84 by frequency of consuming snacks with high-salt content

	<1 time per month / do not eat		1-3 (times) per month		4 times or more per month		Total	
Salt intake level	**No. of Persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
Salt intake ≥ 5g per day	2 222.7	83.3%	1 368.8	85.0%	1 408.0	85.3%	4 999.5	84.3%
Salt intake < 5g per day	445.2	16.7%	241.5	15.0%	243.1	14.7%	929.8	15.7%
Total	2 667.8	100.0%	1 610.3	100.0%	1 651.1	100.0%	5 929.3	100.0%
Mean (g per day)	8.1		8.8		8.6		8.4	

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urinary sodium results (N=5 929 300).
Note: Figures may not add up to the total due to rounding.

4.2 Biochemical Testing for Potassium Intake

The WHO recommends an increase in potassium intake from food to reduce blood pressure and risk of cardiovascular disease, stroke, and coronary heart disease in adults. The WHO suggests a potassium intake of at least 90 mmol per day (3.5 g per day) for adults [5]. Potassium intake level is also estimated by 24-hour urinary samples. In the PHS 2020-22, the average daily intake of potassium was estimated through measurement of 24-hour urinary potassium excretion using the conversion factor of 1.3 (one mmol of potassium = 0.039 g of potassium and daily potassium intake = 24-hour urinary potassium excretion × 1.3) [5].

Among persons aged 15-84, the estimated mean daily potassium intake were 2.1 g and 2.4 g for females and males respectively. When compared to other age groups, persons aged 55-64 had a relatively higher mean daily potassium intake of 2.4 g (Table 4.2a).

Table 4.2a: Mean daily potassium intake (gram) among persons aged 15 to 84 by age group and gender

Age group	Female	Male	Total
15 – 24	1.7	2.0	1.9
25 – 34	2.0	2.3	2.1
35 – 44	2.2	2.4	2.3
45 – 54	2.3	2.4	2.3
55 – 64	2.3	2.5	2.4
65 – 84	2.2	2.4	2.3
15 – 84	2.1	2.4	2.3

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urine test (N=5 959 700).

Most of the population (90.9%) aged 15-84 had an average potassium intake below the WHO recommended amount of 3.5 g per day. Analysed by gender, 92.6% of females and 88.9% of males had potassium intake less than 3.5 g per day. Analysed by age group, the proportion of inadequate potassium intake (i.e., less than 3.5 g per day) was the highest among persons aged 15-24 (95.9%) (Table 4.2b).

Table 4.2b: Level of potassium intake among persons aged 15 to 84 by age group and gender

	Female		Male		Total	
Age group / Potassium intake level	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
15 – 24						
Potassium intake < 3.5g per day	281.2	99.3%	274.3	92.5%	555.5	95.9%
Potassium intake ≥ 3.5g per day	1.8	0.7%	22.2	7.5%	24.0	4.1%
Sub-total	283.0	100.0%	296.5	100.0%	579.5	100.0%
25 – 34						
Potassium intake < 3.5g per day	435.4	95.4%	387.3	88.7%	822.7	92.1%
Potassium intake ≥ 3.5g per day	20.8	4.6%	49.4	11.3%	70.2	7.9%
Sub-total	456.2	100.0%	436.7	100.0%	892.9	100.0%
35 – 44						
Potassium intake < 3.5g per day	488.9	89.2%	407.7	88.1%	896.6	88.7%
Potassium intake ≥ 3.5g per day	59.2	10.8%	54.9	11.9%	114.1	11.3%
Sub-total	548.1	100.0%	462.6	100.0%	1 010.7	100.0%
45 - 54						
Potassium intake < 3.5g per day	554.6	91.7%	415.2	86.8%	969.8	89.5%
Potassium intake ≥ 3.5g per day	49.9	8.3%	63.3	13.2%	113.2	10.5%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Potassium intake < 3.5g per day	591.9	93.0%	510.6	88.7%	1 102.5	90.9%
Potassium intake ≥ 3.5g per day	44.9	7.0%	64.9	11.3%	109.8	9.1%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 84						
Potassium intake < 3.5g per day	552.2	91.1%	516.3	89.8%	1 068.5	90.5%
Potassium intake ≥ 3.5g per day	54.2	8.9%	58.6	10.2%	112.8	9.5%
Sub-total	606.4	100.0%	574.9	100.0%	1 181.3	100.0%
15 - 84						
Potassium intake < 3.5g per day	2 904.1	92.6%	2 511.5	88.9%	5 415.6	90.9%
Potassium intake ≥ 3.5g per day	230.9	7.4%	313.2	11.1%	544.1	9.1%
Total	3 135.0	100.0%	2 824.7	100.0%	5 959.7	100.0%

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urine test (N=5 959 700).
Note: Figures may not add up to the total due to rounding.

Analysed by level of average daily fruit and vegetables intake, the proportion of adequate potassium intake (3.5 g or more per day) generally increased with increasing level of average daily fruit and vegetables intake (from 7.3% among those consuming less than 2 servings a day to 10.8% among those consuming 5 servings or more a day). The corresponding mean values of daily potassium intake increased from 2.1 g per day to 2.4 g per day for those consuming less than 2 servings a day and those consuming 5 servings or more a day respectively (Table 4.2c).

Table 4.2c: Level of potassium intake among persons aged 15 to 84 by level of fruit and vegetables intake

	Less than 2 servings a day		**2 - < 3 servings a day**		**3 - < 4 servings a day**		**4 - < 5 servings a day**		**5 servings or more a day**		**Total**	
Potassium intake level	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
Potassium intake < 3.5g per day	2 003.7	92.7%	2 069.4	90.1%	849.9	90.6%	326.7	86.4%	165.9	89.2%	5 415.6	90.9%
Potassium intake ≥ 3.5g per day	157.8	7.3%	226.8	9.9%	87.7	9.4%	51.6	13.6%	20.2	10.8%	544.1	9.1%
Total	2 161.5	100.0%	2 296.2	100.0%	937.6	100.0%	378.3	100.0%	186.1	100.0%	5 959.7	100.0%
Mean (g per day)	2.1		2.3		2.3		2.5		2.4		2.3	

Base: All respondents aged 15 - 84 who had participated in the health examination with valid urine test (N=5 959 700).
Note: Figures may not add up to the total due to rounding.

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Chapter 5
Risk of Cardiovascular Disease

Cardiovascular diseases (CVDs) refer to a group of heart and blood vessels disorders. They include diseases that affect blood supply to the heart (coronary heart disease (CHD) which can be presented with angina or myocardial infarction (also known as heart attack), diseases that affect blood supply to the brain (cerebrovascular diseases commonly known as stroke), diseases that affect blood supply to arms and legs (peripheral arterial diseases), diseases that form blood clots (such as deep vein thrombosis or pulmonary embolism), diseases that affect the aorta (aortic diseases), diseases that damage the heart muscles or structure (rheumatic heart diseases), heart valve diseases, disorders of heart rhythm, and heart failure [1, 2]. In 2021, CVD accounted for about one in every five deaths in Hong Kong.

Typical metabolic risk factors of CVDs include raised blood pressure, raised blood glucose level, and raised blood lipid levels. Moreover, behavioural practices including unhealthy diet, physical inactivity, tobacco use, and harmful use of alcohol are also important risk factors of CVDs [1]. In some settings, CVD risk models are used to assess the CVD risk of individuals based on their risk factors. This would allow early treatment, often in primary care setting, and prevent development or worsening of the CVD. In the PHS 2020-22, the Framingham risk model was adopted to predict CVD risk over the next 10 years in population aged 30-74.

Snapshot of Risk of Cardiovascular Disease (CVD) of the Population (for persons aged 30 to 74)

Indicator	Female	Male	Overall
CVD risk † ≥ 20% over the next 10 years predicted by the Framingham risk model *	3.9%	26.8%	14.5%

Notes: † CVD events include coronary heart diseases (CHD), such as angina and myocardial infarction, stroke, peripheral artery disease and heart failure.
* All respondents aged 30-74 who had participated in the health examination (N=4 611 000).

5.1 Risk of Cardiovascular Disease over 10 Years Predicted by Framingham Risk Model

The Framingham Risk Model developed from the Framingham Heart Study in the United States is a multivariable logistic model commonly used to stratify individuals' 10-year CVD risk into three categories. It incorporates different risk factors including age, sex, smoking status, cholesterol level, diabetes status and blood pressure (with adjustment in treated and untreated by antihypertensive). However, the risk model was developed based on data of the general population in the United States [3]. Different validation studies concluded that the Framingham Risk Model may overestimate CVD risk in Hong Kong population and requires further calibration [4-6]. Therefore, the results of this section should be interpreted with caution.

Among persons aged 30-74, the mean CVD risk over the next 10 years predicted by the Framingham risk model was 11.4%. That is, on average, for every 1 000 persons aged 30 to 74, 114 persons would develop CVDs covered by the Framingham risk model over the next 10 years. The corresponding mean CVD risks for females and males were 6.4% and 17.0% respectively. The mean CVD risks increased with age from 1.4% among females aged 30-44 to 14.8% among females aged 65-74, and from 4.7% among males aged 30-44 to 36.7% among males aged 65-74 (Table 5.1a).

Table 5.1a: Mean Framingham 10-year cardiovascular disease risk among persons aged 30 to 74 by age group and gender

Age group	Female	Male	Total
30 - 44	1.4%	4.7%	2.9%
45 - 54	4.4%	12.9%	8.1%
55 - 64	8.9%	21.2%	14.8%
65 - 74	14.8%	36.7%	25.5%
30 - 74	6.4%	17.0%	11.4%

Base: All respondents aged 30-74 who had participated in the health examination (N=4 611 000).

The risk of cardiovascular events over the next 10 years is classified into low-risk (CVD risk < 10%), medium-risk (CVD risk ≥ 10% and < 20%) and high-risk (CVD risk ≥ 20%) groups. Among the persons aged 30-74, 14.5% were classified as high-risk, 19.2% medium-risk and 66.3% low-risk according to the Framingham risk model. Analysed by gender, 3.9% of females and 26.8% of males were classified as high-risk. Analysed by age group, the proportion of persons classified as high-risk increased with age in each

sex from 0% among females aged 30-44 to 14.9% among females aged 65-74, and from 0.9% among males aged 30-44 to 75.8% among males aged 65-74 (Table 5.1b).

Table 5.1b: Framingham 10-year cardiovascular disease risk level among persons aged 30 to 74 by age group and gender

	Female		Male		Total	
Age group / Risk level	**No. of Persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
30 - 44						
Low risk	787.0	99.6%	658.9	95.8%	1 445.9	97.8%
Medium risk	2.9	0.4%	23.2	3.4%	26.0	1.8%
High risk	-	-	5.9	0.9%	5.9	0.4%
Sub-total	789.9	100.0%	687.9	100.0%	1 477.8	100.0%
45 - 54						
Low risk	591.3	97.8%	250.8	52.4%	842.1	77.8%
Medium risk	10.0	1.6%	177.3	37.1%	187.3	17.3%
High risk	3.2	0.5%	50.4	10.5%	53.6	4.9%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 - 64						
Low risk	468.9	73.6%	117.4	20.4%	586.2	48.4%
Medium risk	139.9	22.0%	248.4	43.2%	388.3	32.0%
High risk	28.0	4.4%	209.8	36.5%	237.8	19.6%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 - 74						
Low risk	174.4	40.6%	8.0	2.0%	182.5	21.8%
Medium risk	191.4	44.5%	90.9	22.3%	282.3	33.7%
High risk	63.9	14.9%	309.2	75.8%	373.1	44.5%
Sub-total	429.8	100.0%	408.1	100.0%	837.9	100.0%
30 - 74						
Low risk	2 021.7	82.1%	1 035.1	48.1%	3 056.8	66.3%
Medium risk	344.2	14.0%	539.7	25.1%	883.9	19.2%
High risk	95.2	3.9%	575.2	26.8%	670.3	14.5%
Total	2 461.0	100.0%	2 150.0	100.0%	4 611.0	100.0%

Base: All respondents aged 30-74 who had participated in the health examination (N=4 611 000).

Notes: Definition of cardiovascular disease risk levels over the next 10 years based on the Framingham risk model for CVD risks-

Low risk: CVD risk < 10% over the next 10 years;
Medium risk: CVD risk ≥ 10% and < 20% over the next 10 years; and
High risk: CVD risk ≥ 20% over the next 10 years.

Figures may not add up to the total due to rounding.

Analysed by household income, 22.2% of those with a monthly household income of less than $5,000 were classified as high-risk, as compared to the corresponding proportion of 10.7% among those with a monthly household income of $50,000 or above (Table 5.1c).

Table 5.1c: Framingham 10-year cardiovascular disease risk level among persons aged 30 to 74 by monthly household income

	Less than $5,000		$5,000 - $9,999		$10,000 - $19,999		$20,000 - $29,999		$30,000 - $39,999		$40,000 - $49,999		$50,000 or above		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
Risk level																
Low risk	104.2	44.2%	132.1	43.7%	382.5	56.8%	599.6	65.8%	529.1	75.7%	343.1	69.9%	966.2	74.4%	3 056.8	66.3%
Medium risk	79.4	33.6%	87.5	28.9%	162.0	24.0%	165.0	18.1%	105.5	15.1%	91.0	18.6%	193.5	14.9%	883.9	19.2%
High risk	52.4	22.2%	83.0	27.4%	129.0	19.2%	146.0	16.0%	64.5	9.2%	56.4	11.5%	139.0	10.7%	670.3	14.5%
Total	235.9	100.0%	302.6	100.0%	673.5	100.0%	910.6	100.0%	699.1	100.0%	490.5	100.0%	1 298.8	100.0%	4 611.0	100.0%
Mean risk	16.8%		18.3%		13.6%		11.1%		8.8%		9.2%		10.0%		11.4%	

Base: All respondents aged 30-74 who had participated in the health examination (N=4 611 000).

Notes: Definition of cardiovascular disease risk levels over the next 10 years based on the Framingham risk model for CVD risks-

Low risk: CVD risk < 10% over the next 10 years;
Medium risk: CVD risk ≥ 10% and < 20% over the next 10 years; and
High risk: CVD risk ≥ 20% over the next 10 years.

Figures may not add up to the total due to rounding.

5.2 Prevent Heart Attacks and Strokes through Drug Therapy and Counselling

The "Towards 2025: Strategy and Action Plan to prevent and control NCDs in Hong Kong" (SAP) is a framework in alignment with the WHO's Global NCD Action Plan and aims to reduce the NCD burdens in Hong Kong. The SAP Target 8 focuses on preventing heart attacks and strokes through drug therapy and counselling. According to the WHO, at least 50% of eligible people aged 40 years and older should receive drug therapy and counselling to prevent heart attack or strokes [1]. Information related to receiving drug therapy (such as drugs for raised blood pressure, raised blood glucose or cholesterol level or aspirin/ anti-platelet agents) and counselling on respondents aged 40-74 with the Framingham CVD risk ≥ 20% ("high risk") was collected. In this section, results in relation to the risk of cardiovascular disease among aged 40-74 years old and prevention through drug therapy and counselling will be presented.

5.2.1 Risk of Cardiovascular Disease among Aged 40-74 Years

Among the persons aged 40-74, 18.4% were classified as high-risk, 24.1 % medium-risk and 57.5 % low-risk according to the Framingham risk model. Analysed by gender, 4.9% of females and 34.0% of males were classified as high-risk (Table 5.2.1).

The age-standardised prevalence of high CVD risk, defined by the Framingham Risk Model as ≥ 20%, among person aged 40-74 was 14.7%.

Table 5.2.1: Framingham 10-year cardiovascular disease risk level among persons aged 40 to 74 by age group and gender

	Female		Male		Total	
Age group / Risk level	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**	**No. of persons ('000)**	**%**
40 – 44						
Low risk	277.0	99.0%	207.4	89.8%	484.4	94.8%
Medium risk	2.9	1.0%	17.6	7.6%	20.5	4.0%
High risk	-	-	5.9	2.5%	5.9	1.1%
Sub-total	279.9	100.0%	230.9	100.0%	510.8	100.0%
45 – 54						
Low risk	591.3	97.8%	250.8	52.4%	842.1	77.8%
Medium risk	10.0	1.6%	177.3	37.1%	187.3	17.3%
High risk	3.2	0.5%	50.4	10.5%	53.6	4.9%
Sub-total	604.5	100.0%	478.5	100.0%	1 083.0	100.0%
55 – 64						
Low risk	468.9	73.6%	117.4	20.4%	586.2	48.4%
Medium risk	139.9	22.0%	248.4	43.2%	388.3	32.0%
High risk	28.0	4.4%	209.8	36.5%	237.8	19.6%
Sub-total	636.8	100.0%	575.5	100.0%	1 212.3	100.0%
65 – 74						
Low risk	174.4	40.6%	8.0	2.0%	182.5	21.8%
Medium risk	191.4	44.5%	90.9	22.3%	282.3	33.7%
High risk	63.9	14.9%	309.2	75.8%	373.1	44.5%
Sub-total	429.8	100.0%	408.1	100.0%	837.9	100.0%
40 – 74						
Low risk	1 511.7	77.5%	583.6	34.5%	2 095.3	57.5%
Medium risk	344.2	17.6%	534.2	31.6%	878.4	24.1%
High risk	95.2	4.9%	575.2	34.0%	670.3	18.4%
Total	1 951.0	100.0%	1 693.0	100.0%	3 644.0	100.0%

Base: All respondents aged 40-74 who had participated in the health examination (N= 3 644 000).

Notes: Definition of cardiovascular disease risk levels over the next 10 years based on the Framingham risk model for CVD risks-

Low risk: CVD risk < 10% over the next 10 years;
Medium risk: CVD risk ≥ 10% and < 20% over the next 10 years; and
High risk: CVD risk ≥ 20% over the next 10 years.

Figures may not add up to the total due to rounding.

5.2.2 Drug Therapy and Counselling for Cardiovascular Disease

Drug therapy is defined as receiving medication(s) for the control of participant's health conditions that are considered as CVD risk factors (such as drugs for raised blood pressure, raised blood glucose or cholesterol level or aspirin / anti-platelet agents). Counselling is defined as receiving lifestyle advice from doctors, healthcare workers or trained volunteers that is relevant to lifestyle risk factors for CVD (such as smoking, alcoholism, diet, physical activity). For prevention of heart attack and stroke, relevant drug therapy and counselling should be received among person at high risk.

Among respondents aged 40-74 with CVD risk defined by the Framingham Risk Model as "high risk" (≥ 20%), 64.1% (82.8% for females and 61.0% for males) received drug therapies because of their CVD risk. 45.3% (48.5% for females and 44.8% for males) received counselling for their CVD risk. Among respondents aged 40-74 with CVD risk defined by the Framingham Risk Model as "high risk" (≥ 20%), 37.6% (48.5% for females and 35.8% for males) received both drug therapy and counselling (including glycaemic control) to prevent heart attacks and strokes (Table 5.2.2).

Table 5.2.2: Proportion of respondents aged 40-74 with CVD risk ≥ 20% who received drug therapy and / or counselling regarding their CVD risk

	Female		Male		Total	
	No. of persons ('000)	%	No. of persons ('000)	%	No. of persons ('000)	%
Received drug therapy						
Yes	*78.8*	*82.8%*	*350.9*	*61.0%*	*429.8*	*64.1%*
No	*16.3*	*17.2%*	*224.2*	*39.0%*	*240.6*	*35.9%*
Received counselling						
Yes	*46.2*	*48.5%*	*257.8*	*44.8%*	*304.0*	*45.3%*
No	*49.0*	*51.5%*	*317.4*	*55.2%*	*366.4*	*54.7%*
Received drug therapy or counselling						
Both	*46.2*	*48.5%*	*205.6*	*35.8%*	*251.8*	*37.6%*
Drug therapy only	*32.6*	*34.3%*	*145.3*	*25.3%*	*177.9*	*26.5%*
Counselling only	-	-	*52.1*	*9.1%*	*52.1*	*7.8%*
None	*16.3*	*17.2%*	*172.1*	*29.9%*	*188.4*	*28.1%*
Total	95.2	100.0%	575.2	100.0%	670.3	100.0%

Base: Respondents aged 40-74 who had participated in the health examination with CVD risk defined by the Framingham Risk Model as "high risk" (≥ 20%) (N=670 300).
Note: Figures may not add up to the total due to rounding.

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Limitations

The PHS 2020-22 was a cross-sectional survey, which might only reflect respondents' lifestyles or health status at a particular time-point. The survey adopted a random sample design to minimise potential sampling bias. Each individual household was selected by a systematic replicated sampling method and was invited through an invitation letter. Noteworthy, non-response bias could exist if the subject refused to participate. It was possible that those willing to participate might have different health status or lifestyles than those refused. Despite the overall response rate in the survey was relatively high (73.3%), the response rate of private housing (65.1%) was notably lower than the average.

The household interview of this survey mainly relied on self-reported data. The prevalence of diseases and health-related behaviours under study can thus be affected by reporting bias, and recall bias. For example, respondents might be more willing to disclose behaviour or lifestyle practice that were regarded as desirable by the public, but less likely to disclose socially undesirable practices. As respondents were asked to recall some of their behaviours or health status in the past, this would introduce recall bias if the respondents failed to remember the details or the exact time point.

Respondents of household survey were further invited to consent for participating the health examination. The profile of health status, including prevalence rates for some self-reported doctor-diagnosed chronic diseases and health-related behaviours, between household interview respondents and health examination participants are generally comparable at aggregate levels. Differences may arise for a particular disease, or when analysed by detailed gender and age group. The overall participation rate for health examination was 55.2%.

Hong Kong was affected by the COVID-19 pandemic during the fieldwork period. To safeguard the health of the enumerators and respondents and minimise social contact, apart from face-to-face interview, different interviewing approaches were adopted such as telephone interviews outside the sampled living quarters (Please see Chapter 1 of the Part I Report for more details). This could lead to differences in interviewing quality. To reduce the risk transmission of infection between the enumerators and respondents during face-to-face interviews, the precautionary measures adopted such as use of surgical masks and safety googles for enumerators, and social distancing might also affect the interviewing quality. For example, the respondents might not be able to hear the questions clearly, and some non-verbal cues including facial expressions might not be observed. In addition, the Government appealed to members of the public to reduce the flow of people and social contacts in the community and also to employers to allow their staff

members to work from home. Therefore, participants with higher health awareness might be more likely to refuse a face-to-face interview or health examination.

In parallel, COVID-19 anti-pandemic policies, which aimed to minimise social contact including prohibition of gathering, closure of sports stadium and public facilities, have changed the way of living of the population during the pandemic. It was probable that lifestyles, health status and social activities of the population were altered by these policies. In fact, studies have shown that there were health-related behavioral or health status changes among the Hong Kong population, including health service utilization [1], metal health status [2], diet and exercise [3] and use of tobacco and alcohol [4] during the pandemic. The significant changes observed in PHS 2020-22 as compared to PHS 2014/15 might be the results of, to certain extent, the impacts of COVID-19 on population health.

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Appendix

Reliability of the Estimates

The coefficient of variation (CV) is used for comparing the precision of the estimates of various variables. The CV is obtained by expressing the standard error (SE) as a percentage of the estimate to which it refers. In turn, the SE is computed according to a formula which is established on the basis of statistical theory. Generally speaking, the SE is related to the variability of the elements in the population, the size of the sample and the sample design adopted for the survey. The smaller the CV or SE, the more precise is the estimate. For illustration, the estimates and the corresponding CVs of the selected variables presented in this report (Part II) are given below:

Variable	Estimate	CV (%)
1. Prevalence of overweight and obesity (by physical measurement)	54.6%	2.1
2. Prevalence of raised blood pressure / hypertension (combine household interview and physical measurement)	29.5%	3.7
3. Prevalence of diabetes mellitus (combine household interview and physical measurement)	8.5%	7.9
4. Prevalence of raised blood cholesterol / hypercholesterolaemia (combine household interview and biochemical testing by total cholesterol)	51.9%	2.2
5. Mean daily salt intake in grams	8.4g	1.0