12 Survey Methodology

Study Design

The National Health Survey 2004 was a national cross-sectional survey conducted between 10 September and 4 December 2004 to determine the prevalence of major non-communicable diseases such as diabetes and the associated risk factors. The reference population of the survey was the 2004 resident Singapore population aged 18 to 74 years. Only Chinese, Malay and Indian residents were recruited for the study.

The survey results were presented for the age group 18 to 69 years for purposes of comparison with that of the previous National Health Survey 1998 in which Singapore residents aged 18 to 69 years were recruited.

Sample Size Determination

The baseline prevalence of diabetes, hypertension, obesity, smoking and regular physical activity determined in the National Health Survey 1998 were used to estimate the sample size required to detect a change in prevalence levels between 1998 and 2004.

It was calculated that a sample size of 5,000 respondents would be required to detect a 10% to 15% change from the baseline measurements in most of the diseases and risk factors with 80% power. To ensure that the survey had adequate number of respondents, it was estimated that at least 11,200 household units would be required to obtain the eventual sample size of 5,000, after taking into account the estimated non-response during the sampling stage and the health screening fieldwork.

Survey Sites

For purposes of convenience and easy accessibility for the survey participants, six polyclinics were selected as the sites of the survey. They were Yishun Polyclinic, Hougang Polyclinic, Ang Mo Kio Polyclinic, Outram Polyclinic, Tampines Polyclinic and Bukit Batok Polyclinic. These polyclinics were selected because they were equipped with the necessary facilities for the survey and were geographically well spread out across Singapore. The household units in the vicinity of these polyclinics also provided a good combination of the different types of housing and the three major ethnic groups (Chinese, Malay and Indian) in Singapore.

Sample Selection

The sample selection was divided into two phases.

In phase 1, a sample of 12,700 household addresses was selected from the National Database on Dwellings in Singapore maintained by the Department of Statistics. The sample selection was based on a modified two-stage stratified design. For the first stage, sampling divisions within close proximity to the six selected polyclinics were chosen, and dwelling units of each selected sampling division were stratified by house-type and systematically selected in the second stage. The eventual sample of 12,700 addresses was representative of the house-type distribution of the whole housing population in Singapore.

All selected households were notified by post. This was followed up by house visits to enumerate all members of the households within the age group of 18 to 74 years.

In phase 2, a random sample of 7,500 persons was selected from all individuals identified in phase 1 to participate in the Survey. The sampling design was based on a disproportionate stratified sampling design, where all individuals identified in phase 1 were first stratified by age and ethnic group, and then systematically selected. The Malays and Indians were over-sampled to ensure sufficient sample size for reliable prevalence estimates for these minority groups. The ethnic composition of the sample was 59% Chinese, 26% Malays and 15% Indians.

Survey Protocol and Procedures

The procedures and protocol used in the National Health Survey 2004 closely followed that of the National Health Survey 1998. The protocol was based on the WHO recommended model protocol for diabetes and other non-communicable disease field survey *(Douse G, et al, 1992).*

Ethics and Regulatory Approval

The National Health Survey 2004 methodology, protocol and procedures were approved by the Health Promotion Board (HPB) Institutional Review Board (IRB) Ethics Committee.

Questionnaire

A structured questionnaire was used in the survey to elicit information on the demographic, socio-economic, lifestyle practices relating to the major non-communicable diseases and risk factors, health conditions, and knowledge, attitude and practices on health screening of the participants. The questionnaire, adapted from that of the National Health Survey 1998, also included elements of the instruments used in the WHO Survey on Health and Health System Responsiveness, and

the WHO STEPwise approach to Surveillance of Non-Communicable Diseases (STEPS) Instrument for Non-Communicable Diseases Risk Factors.

Invitation and Publicity

Before the start of the survey fieldwork, an invitation letter was mailed to each of the 7,500 selected survey participants. The invitation letter informed the participants of their survey appointment date, time, venue and fasting instructions. A letter addressed to their employers was also enclosed to facilitate participants who were working to take time off from work to attend the survey.

Reminder letters were sent to the participants two weeks prior to their appointment date to remind them to attend the survey. In addition, about three days before the survey appointment, nurses from the survey team telephoned the participants to remind them of their appointment and to provide them with final instructions before attending the survey.

The survey was publicised in the mass media to inform the public of the survey and to reach out to the selected participants and employers to seek their support and co-operation for the survey. A press release statement and a Frequently-Asked-Questions (FAQs) section on the survey were also posted on the website of the Ministry of Health.

Training

All survey fieldworkers were briefed extensively on the survey methodology and underwent rigorous training in the survey procedures assigned to them. This was to ensure strict compliance to the standards and procedures of the survey. Training on measurement techniques for anthropometry and blood pressure, and interviewing techniques to elicit accurate response to the survey questionnaires were conducted by the Nutrition Department of the Health Promotion Board, the National University Hospital and the Epidemiology and Disease Control Division of the Ministry of Health. Training on phlebotomy was carried out by the Department of Pathology of the Singapore General Hospital.

To sharpen the skills of the field workers and to familiarize them with the survey procedures, a one-day trial of the survey was conducted before the start of the fieldwork. A post-trial feedback session was held and all procedural hiccups were identified and suggestions for better implementation of the fieldwork procedures were evaluated. Recommendations on rectifying procedure gaps and improvement were put up for concurrence by all concerned and subsequently disseminated to all relevant fieldworkers. The methodology for each survey procedure is given in the relevant chapters in this report.

Blood Specimen Analysis

All blood specimens collected for the survey were sent to the Biochemistry Laboratory of the Department of Pathology, Singapore General Hospital for analysis on the same day. The test results, upon receipt by the Epidemiology and Disease Control Division of the Ministry of Health, were checked for completeness and consistency before being uploaded into the computer database.

The methodology for each biochemical analysis is described in detail in the specific chapters in this report.

Survey Schedule and Data Collection

The survey fieldwork was conducted on weekdays (Monday to Saturday) over a three-month period from September to December 2004. The fieldwork hours were from 0800 hours each morning to 1300 hours in the afternoon. The average workload was 60 respondents daily.

All respondents gave informed consent to participate in the survey on their actual survey day. During the survey, the participants underwent a health screening and answered structured questionnaires on their lifestyle practices, dietary patterns, and knowledge, attitude and practices on health screening. The health screening for participants involved tests for diabetes, blood lipids and urinary proteins, and measurement of blood pressure, and height and weight. The fieldwork was carried out by staff of the National Healthcare Group Polyclinics and the Research & Information Management Division of the Health Promotion Board, and fieldwork supervision were done by the Epidemiology and Disease Control Division of the Ministry of Health.

At the conclusion of each respondent's procedures, the respondent's checklist and survey questionnaire were checked for completeness. Basic results (height and weight, blood pressure, blood glucose levels, lipids, and urinary microalbumin) were sent to the respondents within three weeks of their survey participation.

Data Quality Control and Confidentiality

Survey responses recorded on each questionnaire on each survey day were manually checked by the nurse interviewers for missing values, data-entry errors and consistency at the survey sites. Data anomalies were clarified through direct verification with the respondents whenever necessary.

Data recorded on the questionnaire was entered into a formatted database. 20% of the questionnaire records that were entered into the database were then randomly selected and all data items of each questionnaire record were manually checked against that recorded on the corresponding hardcopy

questionnaire. Data entry errors were then confirmed and corrected. The resultant database was further subjected to a series of range, logic and consistency checks.

Throughout all stages of the survey, strict confidentiality on individual subject information and test results was maintained. All information from the survey was only used in aggregate form without reference to or disclosure of individual information.

Weighting of the Survey Sample

To adjust for the over sampling of the minority ethnic groups in the survey and differential response levels, the survey sample was weighted to the age, ethnic group and gender distribution of the 2004 Singapore resident population (Singapore citizens and permanent residents) estimates as at end June 2004 (Singapore Department of Statistics, 2004). This was to ensure that the survey results apply to the general population. The distribution of the survey sample after weighting would yield an age by ethnic group and gender distribution similar to the resident population estimates.

Table 12.1 shows the percentage distribution of the survey sample (unweighted) and the 2004 Singapore resident population by demographic characteristics.

Table 12.1: Distribution (%) of survey sample and the 2004 Singapore resident population aged 18 to 69 years by gender, age group and ethnic group

Characteristics	Survey Sample (Unweighted)	Singapore Resident Population (As at end June 2004)
Gender		
Males	46.5	49.6
Females	53.5	50.4
Age (years)		
18-29	20.7	22.7
30-39	23.1	24.8
40-49	30.2	25.8
50-59	17.3	17.5
60-69	8.7	9.2
Ethnic Group		
Chinese	65.0	79.3
Malay	20.1	12.6
Indian	14.9	8.1

Statistical Analysis

Statistical analyses were performed using the statistical software package, Statistical Analysis System (SAS)[1]. Age-standardisation of prevalence was calculated by the direct method, using the 2000 Census Singapore resident population as the standard. To compare changes in prevalence levels between 1992 and 1998, and 1998 and 2004, differences between the age-standardised rates for the pairwise years were computed and tested for statistical significance using the Z-test *(Armitage P. et al, 2002).*

[1] SAS Windows 9.1 + SAS Institute Inc, Cary North Carolina USA.

13 Survey Response

The sample of the National Health Survey 2004 (NHS04) comprised 7,500 Singapore Chinese, Malay and Indian residents aged 18 to 74 years. 225 persons from the original sample were ineligible for the survey for reasons such as pregnancy, recent delivery, death, and overseas sojourn during the survey period. A total of 4,168 persons out of an eventual sample of 7,275 eligible Singapore residents took part in NHS04, yielding an overall response rate of 57.3%. The overall response rate for the age group 18 to 69 years was 57.7%.

Comparison of Social-Demographic Profile between Survey Respondents and Non-Respondents

There were some differences between the social-demographic characteristics of the respondents (unweighted) and the non-respondents (unweighted). Compared with the non-respondents, the respondent sample had higher representations of females, Chinese and adults in the 40 to 69 age group. Table 13.1

Table 13.1: Social-demographic profile (%) of survey respondents and non-respondents aged 18 to 69 years, 2004

Characteristics	Respondents	Non-Respondents
Total (number)	4,084	2,994
Gender		
Males	46.5	52.1
Females	53.5	47.9
Age (years)		
18-29	20.7	28.2
30-39	23.1	24.3
40-49	30.2	23.2
50-59	17.3	15.7
60-69	8.7	8.6
Ethnic Group		
Chinese	65.0	50.3
Malay	20.1	33.6
Indian	14.9	16.1

Comparison of Social-Economic Profile between Survey Respondents and Non-Respondents

The socio-economic profile of the survey respondents (unweighted) in terms of types of housing were compared with that of the non-respondents (unweighted). The respondent sample had lower representation in the HDB 1 – 3 room house type. The proportion of respondents living in public flats (87.9%) was slightly lower than that of the non-respondents (89.6%). Table 13.2

Table 13.2: Socio-economic profile (%) of survey respondents and non-respondents aged 18 to 69 years, 2004

Types of Dwellings	Respondents	Non-Respondents
Total (number)	4,084	2,994
HDB Flats		
1-3 room	20.4	26.1
4 room	38.1	36.9
5 room	20.1	19.3
Executive flats and others	8.5	6.7
HUDC and other public flats	0.8	0.6
Condominium and private flats	6.6	5.6
Landed property and others	5.5	4.8

Comparisons between Survey Respondents and the General Population

The socio-economic profile of the survey respondents in terms of highest educational qualification attained and the types of housing were compared with that of the resident population to assess whether the survey sample was representative of the general population.

With regard to the house type distribution, the lower socio-economic group (HDB 1 – 3 room flats) was under-represented while the higher socio-economic group (condominium, private flats, landed property and others) was slightly over-represented in the survey sample.

In terms of highest educational qualifications attained, respondents with no formal education and PSLE were under-represented. Those with tertiary education (degree/professional qualification) were over-represented. Table 13.3

Table 13.3: Socio-economic profile (%) of survey respondents and the general population

Types of Dwellings	Respondents (Weighted)	General Population
House-Type[1]		
HDB Flats		
1-3 room	20.0	29.3
4 room	37.1	33.8
5 room, executive flats and others	28.3	25.0
Other public flats	0.9	0.9
Condominium and private flats	7.4	6.2
Landed property and others	6.3	4.8
Educational Qualifications[2]		
No formal education	14.1	16.1
PSLE	5.6	12.3
GCE 'O' / 'N' level	40.1	36.8
GCE 'A' level / Diploma	17.4	16.9
Degree / Professional qualification	22.8	17.9

Non-Respondent Follow-up Survey

A non-respondent follow-up survey was conducted between January and February 2005. The main objective was to find out the reasons for non-participation in the National Health Survey 2004 and to assess the potential impact of non-response on the results of the main survey.

Sample Design

The sampling design was similar to that of the main survey. All 2,994 non-respondents of the National Health Survey 2004 were stratified by sex, age and ethnic group, and a random sample of 782 persons aged 18 to 69 years was drawn.

Survey Protocol and Procedures

The survey was conducted via telephone interview by a trained interviewer using a structured questionnaire. A minimum of three attempts were made to contact each selected individual to obtain a complete interview at different times of the day or different days of the week whenever necessary. The recorded information on the questionnaires was manually checked for missing values and

[1] Estimates derived from Singapore Census of Population 2000, Statistical Release No. 5 - Households and Housing
[2] Estimates derived from Singapore Census of Population 2000, Statistical Release No. 2 - Education, Language and Religion

consistency before data entry. Data anomalies were confirmed through direct verification with the participants through telephone and subsequently amended. The resultant database was subjected to further consistency and verification checks.

Throughout the stages of the survey, strict confidentiality on individual's information was maintained. All information from the survey was only used in aggregate form without reference to or disclosure of individual information.

For analysis and reporting, the sample of participants of the follow-up survey was weighted to the age, ethnic group and gender distribution of the Singapore resident population (Singapore citizens and permanent residents) estimates as at end June 2004.

Survey Response

Of the 782 persons selected to take part in the survey, an eventual total of 603 persons participated in the survey. The response rate was 77.1%.

Main Findings

Reasons for Non-Participation in the National Health Survey 2004

Participants were asked the reason for not participating in the National Health Survey 2004. The main reasons cited were as follows:

1. "Not free" (17.3%);
2. "Busy with other commitments" (17.2%);
3. "Not interested" (15.3%);
4. "Just had health screening within the past three months" (13.6%); and
5. "Forgot appointment" (5.3%).

Reported Diabetes Mellitus Status

In order to obtain an indication of the prevalence of known diabetes mellitus among the non-respondents, participants were asked whether they had ever been told by a doctor that they had diabetes and were currently being prescribed medication for diabetes. Participants who answered "yes" to both questions were classified as having "reported diabetes". Diabetes prevalence estimates based on reported use of medication for diabetes under-estimates the actual diabetes prevalence as some of the participants would have undiagnosed diabetes.

The prevalence of reported diabetes among the participants aged 18 to 69 years of the non-respondent follow-up survey was 5.0%. This was higher than the prevalence of reported diabetes of 3.8% in the main survey. Table 13.4

A sensitivity analysis showed that based on a projected survey response of 70%, incorporating data from the non-respondents could have increased the estimated prevalence of reported diabetes in the main survey by up to 0.3%.

The overall prevalence of diabetes is the sum of the prevalence of reported diabetes and undiagnosed diabetes. About 1 in 7 participants in the non-respondent survey cited recent health screening as a reason for non-participation in the main survey. Health screening would have picked up some previously undiagnosed diabetics. Thus, there may be a lower prevalence of undiagnosed diabetes in this sub-group. Hence, the impact of non-response on the overall diabetes estimates may be even smaller.

Table 13.4: Reported diabetes mellitus status (%) of participants aged 18-69 years, by gender, 2004

Reported Diabetes Mellitus Status	Males	Females	Total
Non-respondent survey	4.9	5.1	5.0
NHS 04	4.1	3.6	3.8

Reported Hypertension Status

In order to obtain an indication of the prevalence of known hypertension among the non-respondents, participants were asked whether they had ever been told by a doctor that they had hypertension and were currently being prescribed medication for hypertension. Participants who answered "yes" to both questions were classified as having "reported hypertension". Hypertension prevalence estimates based on reported use of medication for hypertension under-estimates the actual hypertension prevalence as some of the participants would have undiagnosed hypertension.

The prevalence of reported hypertension among the participants aged 18 to 69 years of the non-respondent follow-up survey was 10.2%. This was slightly lower than the prevalence of reported hypertension of 11.2% in the main survey. Table 13.5

A sensitivity analysis showed that based on a projected survey response of 70%, incorporating data from the non-respondents could have decreased the estimated prevalence of reported hypertension in the main survey by up to 0.4%.

Table 13.5: Reported hypertension status (%) of participants aged 18-69 years, by gender, 2004

Reported Hypertension Status	Males	Females	Total
Non-respondent survey	9.6	10.8	10.2
NHS 04	11.8	10.5	11.2

Physical Activity Participation Status

Participants were asked on the kind, frequency, session duration and intensity of physical activity that they did during their leisure time. Sedentary respondents were asked their main reason for not doing any leisure physical activity.

More than one-quarter (26.9%) of the participants aged 18 to 69 years of the non-respondent follow-up survey engaged in regular physical exercise, 27.3% exercised occasionally, while 45.7% did not exercise at all. The physical activity participation status was similar to that of the respondents of the main survey. Table 13.6

Table 13.6: Physical activity participation status (%) of participants aged 18-69 years, by gender, 2004

Physical Activity Participation Status	Males	Females	Total
Regular exercise			
Non-respondent survey	30.1	23.5	26.9
NHS 04	28.8	21.0	24.9
Occasional exercise			
Non-respondent survey	31.5	22.8	27.3
NHS 04	29.8	24.2	27.0
No exercise (physically inactive)			
Non-respondent survey	38.4	53.7	45.7
NHS 04	41.4	54.8	48.1

References

References

A Seow. et al, *Trends in Cancer Incidence in Singapore 1968-2002*. Singapore Cancer Registry Report No. 6, 2004.

American College of Sports Medicine. Position stand: The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med. Sci. Sports Exerc.*, 1998, 30(6).

American Diabetes Association. Tests of glycemia in diabetes. American Diabetes Association: clinical practice recommendations 1998. *Diabetes Care,* 1998, 21 (Suppl 1).

Armitage P., Berry G. *Statistical methods in medical research*. 2nd ed., Oxford, Blackwell Scientific Publications, 1987.

Centers for Disease Control. *1998 Behaviour Risk Factor Surveillance System Questionnaire*. U.S. Department of Health and Human Services, 1998.

Dowse G., Zimmet P. A model protocol for diabetes and other non-communicable disease field survey. *World Health Statistics Quarterly*, 1992, No. 45.

Hassmen P, Koivula N & Uutela A. 2000. *Physical Exercise and Psychological Well-being: A Population Study in Finland*. Preventive Medicine 30: 17-25.

Laforge R, Rossi J, Prochaska J, Velicer W, Levesque D & McHorney C. 1999. *Stage of Regular Exercise and Health-related Quality of Life*. Preventive Medicine 28(4): 349-360.

Ministry of Health. *Clinical Practice Guidelines Diabetes Mellitus*. Singapore, MOH Clinical Practice Guidelines 4/99

Ministry of Health. *Clinical Practice Guidelines Lipids*. Singapore, MOH Clinical Practice Guidelines 7/2001

Ministry of Health. *Healthy Family Healthy Nation: Report of the Review Committee on National Health Policie*s. Singapore, Ministry of Health, 1991.

Moh-Sim Wong et al.,*The Singapore Impaired Glucose Tolerance Follow-Up Study. Does the ticking clock go backward as well as forward?* Diabetes Care 26:3024-3030, 2003

National Health Committee. 1998. *Active for Life: A Call For Action: The Health Benefits of Physical Activity*. Wellington: National Health Committee.

Rose G.A. et al. *Cardiovascular Survey Methods*. 2nd ed., WHO monograph series No. 56, Geneva, World Health Organization, 1982.

Singapore Department of Statistics. *Singapore Census of Population 2000, Statistical Release No. 2 - Education, Language and Religion.*

Singapore Department of Statistics. *Singapore Census of Population 2000, Statistical Release No. 5 - Households and Housing.*

Singapore Department of Statistics. *Yearbook of Statistics, Singapore,* 2005

U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Nutrition and Your Health: Dietary Guidelines for Americans*. 4th ed., U.S. Dept of Agriculture, U.S. Dept of Health and Human Services, 1995.

U.S. Department of Health and Human Services. 1996. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Centre for Chronic Disease Prevention and Health Promotion.

U.S. Department of Health and Human Services. *National Cholesterol Education Program: Second Report of the Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II)*. NIH Publication No. 93-3096, 1993.

WHO. *Arterial Hypertension: Report of a WHO expert committee*. WHO Technical Report Series 628, World Health Organization, 1978.

WHO. *Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Report of a WHO Consultation. World Health Organization* Department of Noncommunicable Disease Surveillance. Geneva, 1999.

WHO. *Hypertension Control: Report of a WHO expert committee*. WHO Technical Report Series 862, Geneva, World Health Organization, 1996.

WHO. *MONICA Manual*. Geneva, World Health Organization, 1990.

WHO. *Pap Cytology Screening: Most of the benefits reaped?*. WHO Press Release WHO/25, 1997.

WHO. *Prevention of Diabetes Mellitus: Report of a WHO study group*. WHO Technical Report Series 844, Geneva, World Health Organization, 1994.

WHO/FIMS Committee on Physical Activity for Health. Exercise for health. *Bulletin of the World Health Organization*, 1995, 73(2):135-136.

WHO/International Society of Hypertension (ISH) Writing Group.2003. *WHO/ISH statement on management of hypertension*, Journal of Hypertension 2003, Vol 2 (11):1983-92.

WHO (A). *Guidelines for Controlling and Monitoring the Tobacco Epidemic*. Geneva, World Health Organization, 1998.

WHO (B). *Obesity – Preventing and Managing the Global Epidemic: Report of a WHO Consultation on Obesity*. Geneva, World Health Organization, 1998.

WHO (C). *The World Health Report 1998 – Life in the 21st century: A vision for all: Report of the Director-General*. Geneva, World Health Organization, 1998.

WHO Expert Consultation. *Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies*. Lancet 2004. 363 : 157 – 163.