ORIGINAL ARTICLE

Screening for Blood Pressure, Cholesterol and Glucose During National Heart Weeks 1992 - 1994

K L Khoo, FRCP, H Tan, PhD, J S Sambhi, FRCOG, A M Aljafri, FRCS, A Hatijah, BA,
Heart Foundation Malaysia, (Yayasan Jantung Malaysia), 4th Floor, 17-19 Jalan Medan Tuanku,
53000 Kuala Lumpur

Summary

This paper presents results of the National Heart Week health screening programme conducted in Kuala Lumpur, Penang and Kuantan during 1992-94. A total of 2670 participants from Chinese, Malay, Indian and other ethnic groups of both genders aged between 10 to 86 years old were involved in the screening programme for blood pressure, cholesterol and glucose. From this study, the following findings were obtained:

1) The mean values for serum total cholesterol (TC), non-fasting (random) blood glucose (GL), systolic (SBP) and diastolic (DBP) blood pressures were 5.27 mmol/l, 5.71 mmol/l, 127.8 mmHg and 79.2 mmHg respectively.
2) There was a rising trend for TC, GL, SBP and DBP with age.
3) Males generally had higher mean values of TC, GL, SBP and DBP than females.
4) Malaysian Chinese appeared to have slightly lower TC and GL values as compared to the Malays and Indians.
5) Among the participants screened, 17.5% had raised TC (6.20 mmol/l as cut-off value); 3.3% had raised GL (11.00 mmol/l as cut-off value); 29.6% had raised SBP (140 mmHg as cut-off value) and 23.2% had raised DBP (90 mmHg as cut-off value). Participants with raised TC, GL, SBP and DBP also increased with age.
6) Participants from Kuala Lumpur had a slightly higher mean TC than those from Penang and Kuantan.
7) There was a gradual rise in mean TC values from 1992 to 1994.
8) Positive associations between GL and SBP or DBP were detected.

The implications of the above findings were discussed.

Key Words: Cholesterol, Blood pressure, Blood glucose, Hypercholesterolaemia, Diabetes mellitus, Hypertension

Introduction

Cardiovascular Disease is the main cause of death in Malaysia since 1975[1]. The main cause is probably due to increased affluence, changing lifestyle and dietary habits, elimination of infectious diseases and increased longevity.

The National Heart Foundation since its inception in 1981 has focussed its attention and resources to help people afflicted with heart disease, to fund research projects associated with combating heart disease and to educate the public in preventive measures for reducing coronary heart disease (CHD).

The Annual Heart Weeks organised by the National Heart Foundation has been associated with the education of the public on the risk factors and methods for the reduction of cardiovascular disease particularly CHD.

Herewith, we report the results of our Health Screening Programmes held during Annual Heart Weeks 1992 - 1994.

Methods

Participants attending the National Heart Foundation Heart Week Exhibition in Kuala Lumpur, Seremban, Kuantan and Penang were screened for coronary risk factors. These subjects were from the general public. Announcements of the Heart Week were made in the newspapers, radio and posters put up in public places.

The screening parameters offered at the exhibition were body mass index (weight in kg/height in m^2), electrocardiogram (ECG), blood pressure, total cholesterol and glucose. However the data on height, weight and ECG were not available for inclusion in the present study.

Blood pressure was measured with a mercury sphygomanometer in a resting state in a sitting position. Normally, the mean of two readings was used but in abnormal or suspect cases a third reading was included.

Blood cholesterol and blood glucose were measured in the non-fasting state using the Reflotron and Accutrend analytical instruments (Boehinger Mannhein Co) respectively. These instruments were employed because of their portability, reliability and convenience.

In both the above tests the whole blood was collected via a finger prick in appropriate reagent carriers in the case of Reflotron for total cholesterol determination and in an Accutrend Glucose test strip for blood glucose determination. The samples were then subject to the procedures as outlined in the manuals of the respective instruments. Readings of total cholesterol and the blood glucose were then obtained and recorded.

The test principle for total cholesterol determination was based on the enzymic CHOD-PAP method from Boehringer Mannhein and was described by Braun *et al*[2]. The blood glucose measurement was based on the enzymic glucose oxidase reaction as described by Muller *et al*[3].

Statistical Methods

Group data were expressed as means, standard deviations and ranges (minimum and maximum values). Analyses of variance were carried out to test the significance of the group data by year, location, age, sex and ethnic groups. The significance of the group means were carried out using Duncan's multiple range tests or Student t-tests.

For inter-relationship studies, simple correlation analyses were performed on the parameters measured. In some cases, the Chi-square tests were also carried out.

The above analyses were done using selected procedures of SAS software packages[4,5] (SAS Institute Inc., Cary, NC, USA.).

Results

Sample Studied

A total of 2670 participants had been recorded for the 1992-1994 National Heart Weeks Health Screening Programme. 87.6% (n=2340) of the sample came from Kuala Lumpur, 10.0% (n=266) from Penang and 2.4% (n=64) from Kuantan. 63.6% of the sample were males and 36.4% were females. Of these the majority were Chinese (65.3%) followed by Malays (20.4%), Indians (10.1%) and other ethnic groups (4.1%). The mean age of the participants was 40.6 years with a range of 10 years to 86 years. The majority (91.8%) were in the 20 - 60 age group.

Means of Cholesterol, Blood Glucose and Blood Pressure

Table I presents the mean values for the various parameters measured for the participants involved in the 1992-94 National Heart Weeks Health Screening Programme. The mean values of total cholesterol (TC), random blood glucose (GL), systolic (SBP) and diastolic

Table I
General statistics for parameters measured for participants during the 1992-1994 National Heart Weeks

Parameter	Unit	Sample size	Mean	Standard deviation	Minimum	Maximum
Total Cholesterol	mmol/l	2195	5.27	1.14	2.59	12.88
Blood glucose	mmol/l	651	5.71	2.16	2.70	20.90
Systolic blood pressure	mmHg	281	127.70	20.80	80.00	193.00
Diastolic blood pressure	mmHg	281	79.20	13.20	40.00	133.00

Table II
Means and standard deviations for different parameters of participants measured during the 1992-1994 National Heart Weeks by age group

Age group (year)	Parameters	Total cholesterol (mmol/l)	Blood glucose (mmol/l)	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)
19 & below	Mean ± SD	4.39 ± 1.12	5.00 ± 1.00	116.3 ± 17.1	72.3 ± 15.0
	Min-Max	2.59 - 6.09	4.00 - 6.30	98.0 - 138.0	53.0 - 89.0
	N	12	5	4	4
20 - 29	Mean ± SD	4.83 ± 1.07	5.10 ± 1.10	120.6 ± 17.4	75.7 ± 14.2
	Min-Max	2.59 - 12.88	3.20 - 8.20	82.0 - 154.0	40.0 - 107.0
	N	385	92	40	40
30 - 39	Mean ± SD	5.15 ± 1.09	5.40 ± 1.80	121.3 ± 16.9	78.3 ± 10.9
	Min-Max	2.59 - 9.77	2.70 - 14.80	80.0 - 169.0	45.0 - 106.0
	N	745	175	78	78
40 - 49	Mean ± SD	5.45 ± 1.09	5.60 ± 1.70	126.9 ± 21.7	78.7 ± 14.4
	Min-Max	2.59 - 10.13	2.70 - 13.20	84.0 - 193.0	40.0 - 115.0
	N	565	150	75	75
50 - 59	Mean ± SD	5.61 ± 1.10	6.40 ± 3.30	135.3 ± 20.5	83.2 ± 12.3
	Min-Max	2.59 - 9.17	3.40 - 20.20	97.0 - 184.0	50.0 - 110.0
	N	321	94	42	42
60 - 69	Mean ± SD	5.64 ± 1.41	6.10 ± 2.90	139.5 ± 18.5	81.4 ± 10.4
	Min-Max	2.59 - 12.69	3.20 - 20.20	106.0 - 165.0	66.0 - 109.0
	N	122	47	32	32
70 - 79	Mean ± SD	5.66 ± 1.06	7.50 ± 4.80	147.3 ± 27.6	84.2 ± 21.4
	Min-Max	2.98 - 8.14	4.10 - 20.90	90.0 - 191.0	50.0 - 133.0
	N	32	14	10	10
80 & above	Mean ± SD	5.89 ± 1.63	-	-	-
	Min-Max	3.98 - 7.95	-	-	-
	N	4	-	-	-

Table III
Means and standard deviations for parameters of participants measured during the 1992-1994 National Heart Weeks by sex group

Parameter	Statistics	Male	Female	t-Test
Total cholesterol (mmol/l)	Mean ± SD	5.32 ± 1.11	5.18 ± 1.19	2.71**
	Min – Max	2.59 – 12.88	2.59 – 12.70	
	N	1401	792	
Blood glucose (mmol/l)	Mean ± SD	5.93 ± 2.32	5.26 ± 1.75	4.05***
	Min – Max	3.20 – 20.90	2.70 – 20.20	
	N	347	243	
Systolic blood pressure (mmHg)	Mean ± SD	131.8 ± 20.5	122.5 ± 20.1	3.78***
	Min – Max	84 – 193	80 – 170	
	N	157	123	
Diastolic blood pressure (mmHg)	Mean ± SD	81.9 ± 12.6	75.8 ± 13.2	1.92***
	Min – Max	43 – 133	40 – 110	
	N	157	123	

***, ***: P ≤ 0.01 and 0.001 respectively*

(DBP) blood pressures are respectively 5.27 mmol/l (range: 2.59 - 12.88 mmol/l), 5.71 mmol/l (range: 2.70 - 20.90 mmol/l), 127.7 mmHg (range: 80 - 193 mmHg) and 79.2 mmHg (range: 40 - 133 mmHg).

There is a rising trend of total cholesterol, glucose, systolic and diastolic blood pressures with advancing age (Table II). Males tend to have a higher value as compared with females (Table III).

There is no significant difference in the parameters between the major ethnic groups though the Chinese appeared to have a lower value for total cholesterol and blood glucose compared to the Malays and Indians (Table IV).

Table V summarises simple statistics for the various parameters measured for participants in the 1992-94 National Heart Week Health Screening Programme by location and year (see also Appendix 1). Significant differences were observed amongst the participants in Kuala Lumpur, Kuantan and Penang with respect to their total cholesterol and glucose. The mean values of TC and GL for participants in Kuala Lumpur were slightly higher than that in Penang and Kuantan. No statistical significance was detected for the parameters of the participants from Penang and Kuantan during the 1994 National Heart Week.

There seems to be a rising trend in cholesterol values of the participants in Kuala Lumpur from 1992 to 1994.

Prevalence of Abnormality

Based on the National Cholesterol Education Programme Expert Panel[6,7] the total cholesterol is said to be desirable if it is below 5.20 mmol/l, high if it is equal or above 6.20 mmol/l and borderline high if it is between the two values. The sample (N=2186) studied showed that 51.2% of the subjects possessed blood cholesterol values that exceeded the desirable value of 5.20 mmol/l and 17.5% had cholesterol levels that were above the high value of 6.20 mmol/l (Table VI). The prevalence of lipid abnormality appeared to increase with advancing age.

With regard to blood glucose, 3.3% of the 577 volunteers screened were found to be equal or above the cut-off value of 11.00 mmol/l for random blood glucose which according to World Health

Table IV
Means and standard deviations for parameters of participants measured during the 1992-1994 National Heart Weeks by ethnic group

Parameter	Statistics	Chinese	Malay	Indian	Others
Total cholesterol (mmol/l)	Mean ± SD	5.20 ± 1.12	5.42 ± 1.14	5.37 ± 1.17	5.24 ± 1.33
	Min - Max	2.59 - 12.88	2.59 - 7.15	2.59 - 9.77	2.80 - 9.17
	N	1392	471	228	99
	Grouping*	a	a	a	a
Blood glucose (mmol/l)	Mean ± SD	5.61 ± 2.02	5.96 ± 2.48	6.08 ± 2.94	7.51 ± 3.02
	Min - Max	2.70 - 20.90	3.2 - 17.60	3.50 - 20.20	4.20 - 12.00
	N	499	88	44	8
	Grouping	b	b	b	a
Systolic blood pressure (mmHg)	Mean ± SD	127.8 ± 20.5	127.5 ± 20.4	129.7 ± 25.5	115.8 ± 20.3
	Min - Max	80.0 - 193.0	82.0 - 164.0	89.0 - 167.0	98.0 - 145.0
	N	226	36	15	4
	Grouping	a	a	a	a
Diastolic blood pressure (mmHg)	Mean ± SD	79.1 ± 13.0	80.7 ± 13.3	80.8 ± 16.4	70.3 ± 12.1
	Min - Max	40.0 - 133.0	43.0 - 110.0	49.0 - 111.0	53.0 - 80.0
	N	226	36	15	4
	Grouping	a	a	a	a

** Mean values in the same row having the same letter are not significantly different, based on Duncan Multiple Range Test*

Organisation[8] is a basis for the detection of diabetes mellitus. As for blood pressure measurements, 29.6% of the participants had systolic blood pressure that exceeded 140 mmHg and 23.2% had diastolic blood pressure above 90 mmHg while 15.7% of the participants had systolic blood pressure above 150 mmHg and 5.1% had diastolic blood pressure above 100 mmHg.

Inter-Relationship of Parameters

From the small sample studied in Kuantan and Penang in 1994 where total cholesterol, glucose, systolic blood pressure and diastolic blood pressure were measured (Table VII), positive correlations were found between age and the measured parameters i.e. total cholesterol, glucose, systolic blood pressure and diastolic blood pressure. There was also a positive correlation between blood glucose and blood pressure. A strong positive correlation between SBP and DBP was noted as expected. No correlations between total cholesterol with glucose, systolic blood pressure and diastolic blood pressure were however detected.

The significance of Chi-square test between blood pressures (systolic and diastolic blood pressures) and glucose levels with reference to normal and abnormal groups using cut-off values of 140 mmHg, 90 mmHg and 11.00 mmol/l for systolic blood pressure, diastolic blood pressure and blood glucose respectively was detected. Participants with raised blood pressures tended to have a higher frequency of abnormal (high) glucose level (Table VIII).

Discussion

In view that the Health Screening Programme is known to attract only the health conscious individuals, this sample of voluntary participants, therefore, cannot be regarded as a representative of our population in this country. Nevertheless, it could represent a cross section of a sample of our health-conscious public drawn from the major ethnic groups. Accordingly, the status of coronary heart disease risk factors of the population documented should be regarded as reflective of this specific group of the population.

Table V
Means and standard deviations for parameters of participants measured during the 1992-1994 National Heart Weeks by location and year

Location	Year	Statistics	Total cholesterol (mmol/l)	Blood glucose (mmol/l)	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)
Kuala Lumpur	1992	Mean ± SD	5.17 ± 1.17	–	–	–
		Min – Max	2.80 – 10.13	–	–	–
		N	479	–	–	–
	1993	Mean ± SD	5.24 ± 0.97	–	–	–
		Min – Max	2.59 – 8.45	–	–	–
		N	620	–	–	–
	1994	Mean ± SD	5.40 ± 1.14	5.93 ± 2.09	–	–
		Min – Max	2.59 – 12.88	3.10 – 20.20	–	–
		N	799	358	–	–
	1992-94	Mean ± SD	5.29 ± 42.36	5.93 ± 2.09	–	–
		Min – Max	2.59 – 12.88	3.10 – 20.20	–	–
		N	1898	358	–	–
Kuantan	1994	Mean ± SD	4.97 ± 1.06	5.35 ± 1.38	124.4 ± 18.3	78.1 ± 11.1
		Min – Max	2.59 – 8.19	2.40 – 9.50	100.0 – 180.0	40.0 – 90.0
		N	63	59	34	34
Penang	1994	Mean ± SD	5.19 ± 1.44	5.47 ± 2.40	128.2 ± 21.1	79.4 ± 13.5
		Min – Max	2.59 – 12.70	2.70 – 20.90	80.0 – 193.0	40.0 – 133.0
		N	234	234	247	247

Table VI
Per cent distribution of participants with abnormal values of parameters measured during the 1992 – 1994 National Heart Weeks

Age group (year)	Total cholesterol				Blood glucose		Systolic blood pressure				Diastolic blood pressure			
	N	AI (%)	AII (%)	AI&II (%)	N	AI (%)	N	AI (%)	AII (%)	AI&II (%)	N	AI (%)	AII (%)	AI&II (%)
19 & below	12	16.7	0.0	16.7	5	0.0	4	0.0	0.0	0.0	4	0.0	0.0	0.0
20 – 29	385	23.9	8.1	31.0	92	0.0	40	15.0	2.5	17.5	40	12.5	2.5	15.0
30 – 39	745	31.5	15.3	48.8	175	2.3	78	9.0	6.4	15.4	78	15.4	2.6	18.0
40 – 49	565	41.8	19.3	61.1	150	1.3	75	12.0	16.0	25.3	75	18.7	6.7	25.3
50 – 59	321	34.6	27.4	62.0	94	8.5	42	21.4	23.8	45.2	42	28.6	7.1	35.7
60 – 69	122	36.9	26.2	63.1	47	4.3	32	12.5	37.5	50.0	32	18.8	6.3	25.0
70 – 79	32	40.6	25.0	65.6	14	21.4	10	40.0	40.0	80.0	10	20.0	10.0	30.0
80 & above	4	50.0	25.0	75.0	0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Total	2186	33.7	17.5	51.2	577	3.3	281	13.9	15.7	29.6	281	18.1	5.1	23.2

Cut-off values				
AI	*5.20 – 6.19 mmol/l*	*≥ 11.00 mmol/l*	*140 – 149 mmHg*	*90 – 99 mmHg*
AII	*≥ 6.20 mmol/l*	–	*≥ 150 mmHg*	*≥ 100 mmHg*
AI&II	*≥ 5.20 mmol/l*	–	*≥ 140 mmHg*	*≥ 90 mmHg*

A: Abnormality

Table VII
Simple correlation coefficients among parameters of participants measured during the 1994 National Heart Week in Kuantan and Penang

Parameter	AG	TC	GL	SBP	DBP
Age (AG)	1.00 (330)	0.32 *** (297)	0.25 *** (293)	0.36 *** (281)	0.16 ** (281)
Total cholesterol (TC)		1.00 (297)	-0.03 ns (297)	0.08 ns (259)	0.02 ns (259)
Blood glucose (GL)			1.00 (254)	0.26 *** (254)	0.15 * (254)
Systolic blood pressure (SBP)				1.00 (281)	0.69 *** (281)
Diastolic blood pressure (DBP)					1.00 (281)

ns : Not significant at p < 0.05
, **, * : Significant at p < 0.05, 0.01 and 0.001 respectively*
Bracketed figures refer to number of paired observations

Table VIII
Per cent abnormality of blood glucose levels among subjects with normal and raised blood pressures

Blood pressure	Reading mmHg	No. of subjects	Percentage with raised blood glucose
Systolic	< 140	174	0.6
	≥ 140	80	10.0
Diastolic	< 90	240	2.9
	≥ 90	14	14.3

Random blood glucose levels of 11.00 mmol/l and above are considered abnormal

The mean value of total cholesterol of 5.27 mmol/l in the present study is close to that reported by Khoo[9] of 5.18 mmol/l. 17.5% of the sample studied showed total blood cholesterol values higher than 6.20 mmol/l. Ng *et al*[10], in a coronary risk profile screening during National Heart Week in Singapore in 1986, reported the mean total cholesterol level of 5.60 mmol/l. Teo *et al*[11], in a lipid screening of a volunteer population during Singapore National Heart Week in 1988, obtained a mean cholesterol value of 5.47 mmol/l. These two values were slightly higher than those found for Malaysians in the present study. Prevalence of hypercholesterolaemia was also found to be higher in Singaporeans[10,11] (21.1% - 23.1%) compared to their Malaysian counterparts (17.5%), based on 6.20 mmol/l as cut-off value.

The mean random blood glucose of 5.71 mmol/l in our study was very close to the 5.83 mmol/l reported in Singapore[10]. Similarly, 3.3% of the 577 participants screened in this study had blood glucose above 11.00 mmol/l as compared to 3.8% of the 1441 participants screened in Singapore.

The systolic (127.8 mmHg) and diastolic (79.2 mmHg) blood pressures were also found to be within the range of the previous studies on blood pressure in this country. Liew *et al*[12], who reviewed various papers on blood pressures and hypertension studies in the country, reported the mean systolic and diastolic blood pressures to be 130.3 mmHg (range: 122.5 - 137.7 mmHg) and 81.5 mmHg (range: 76.9 - 81.8 mmHg) respectively. The prevalence of hypertension was 16% (range: 10.4 - 25.6%) and 4.2% when 140/90 mmHg and 150/95 mmHg were taken as cut-off values. Our present screening results showed that prevalence of hypertension was 29.6% and 15.7% using 140 mmHg and 150 mmHg systolic pressure as cut-off points while 23.2% and 5.1% were obtained when 90 mmHg and 100 mmHg diastolic pressure were used for detection of hypertension. These figures appeared to be on the higher end of the range in the hypertension studies in this country. However a higher prevalence found in this study is not surprising because participants who had hypertension history were also included in the screening programme. In Singapore, Ng *et al*[10] reported the mean systolic blood pressure of 126.4 mmHg which was about the same level as in this study. In another study, Lee *et al*[13] reported a higher prevalence of hypertension of 22% and 14% in Singapore based on 150/90 mmHg and 160/95 mmHg as cut-off points respectively.

The present study together with the findings of other workers indicated lower mean values and prevalence of abnormalities for total cholesterol and blood pressures for Malaysians than for Singaporeans. Perhaps, the highly industrialized and urbanized nature in Singapore, where high stress exists as compared to Malaysia could explain the differences.

From this study the following points are noteworthy:

- There is an increase of cardiovascular risk factor with increasing age. Hence, screening of these risk factors should be done more frequently with advancing age.
- There seems to be a rising trend in the total cholesterol level from 1992 to 1994 signalling an alarming feature which needs further attention.
- Participants residing in a big city like Kuala Lumpur seemed to have higher total cholesterol values than those living in towns like Penang and Kuantan. This would mean that public health education in a big city (or town) should be given priority.

There are some common findings arising from this study compared to another reported previously[10]. These include: (i) levels of total cholesterol, random blood glucose and blood pressures increase with advancing age, (ii) prevalence of hypercholesterolaemia, hypertension, diabetes mellitus increases with age, (iii) males appears to have higher values for the mean of total cholesterol, blood glucose and blood pressures than females, (iv) ethnic differences for total cholesterol, blood glucose and blood pressures are generally not obvious although the Chinese appeared to have a relatively lower value for total cholesterol and blood glucose than the Indians and the Malays and (v) positive association between blood glucose and blood pressure was noted.

From the statistics, the number of participants increased from 1992 to 1994. This shows that recent publicity has attracted the attention of the Malaysian public to cardiovascular risk factors and to the increase in health consciousness as well. This Heart Week Health Screening Programme will be expanded to other states in this country with increasing workforce and fund allocation.

Over the past few years, the data collected during National Heart Week have not been systematically addressed and analyzed. This paper represents a first attempt to make use of the data available so far and to document the results of the study. From the experience gained during the last three years more organised programmes can be planned for the coming Heart Week Health Screening Project. Information on the family history, personal data and coronary risk factors (eg.

BMI, lipid profile, blood glucose, ECG and blood pressure) should be properly collected and studied.

It is hoped that the results obtained from such yearly Health Screening Programmes will provide some basis for the planning of preventive programmes to ensure a healthy population in meeting the challenges of a fully industrialized nation by the year 2020.

Conclusion

The National Heart Foundation's Heart Week Screening Programme has attracted increasing public attention. The number of individuals screened has increased from 479 in 1992 to 1094 in 1994. We expect the numbers to increase further in the future and in particular, at venues in Kuala Lumpur, Penang, Kuching and Malacca in 1995. We have increased the screening parameters, i.e. blood glucose and blood pressure in 1994 and we will intensify ECG tests in 1995.

The mean serum cholesterol found was 5.27 mmol/l. 17.5% screened had total cholesterol of 6.20 mmol/l and above. The mean random glucose was 5.71 mmol/l. 3.3% individuals had random blood sugar above 11.00 mmol/l.

The mean systolic blood pressure was 127.8 mmHg and diastolic, 79.2 mmHg. 29.6% had systolic blood pressure above 140 mmHg and 23.2% had diastolic blood pressure above 90 mmHg.

Malaysian Chinese appeared to have slightly lower values of total cholesterol and blood glucose levels than Indians and Malays. Participants from Kuala Lumpur had a slightly higher mean total cholesterol than those from Penang and Kuantan.

A gradual rising trend in total cholesterol values from 1992 to 1994 was noted.

Blood glucose was associated with blood pressures, a common feature found in diabetes.

References

1. Khoo KL, Tan H, Khoo TH. Cardiovascular mortality in Peninsular Malaysia 1959-1989. Med J Malaysia 1991;46(1) : 7-20.
2. Braun HP, Carstensen CA, Ritterodors U. Analytical performance *et al.* Clin Chem 1984;30 : 990-1.
3. Muller P, Hunrichs HR, Lembe CH, Miedema K, Wahl P. Accutrend: Evaluation of a new non-wipe system for self-monitoring of blood glucose. Poster Presented at the National Meeting of AACC, Chicago, July 19-23 : 1992.
4. SAS Institute Inc. SAS Users Guide: Basics, Version 5 Edition. Cary, N.C.: SAS Institute Incorporated 1985 : 1290 pp.
5. SAS Institute Inc. SAS/STAT. Guide for Personal Computers, Version 6 Edition. Cary N.C.: SAS Institute Incorporated 1987 : 1028 pp.
6. The Expert Panel. Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults. Arch Intern Med 1988;148 : 36-69.
7. The Expert Panel. Summary of the Second Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II). JAMA 1992; 269(23) : 3015-23.
8. World Health Organisation. Diabetes mellitus. Report of a WHO study group. WHO Technical report series, 727, Geneva 1985.
9. Khoo KL. Studies on Lipid Abnormalities in Peninsular Malaysia. MD Thesis, University of Singapore 1980;294 pp.
10. Ng ASH, Chee TS, Wong WM, Aw TC, Quek SSS, Tan, ATH, Arulanandan S. Coronary risk profile screening during National Heart Week 1986. Annals Acad Med 1990;19(1) : 30-3.
11. Teo WS, Ng ASH, Chee TS, Chua TS, Yan P. Lipid screening in a volunteer population in Singapore. Ann Acad Med Singapore 1992;21(1) : 5-9.
12. Liew YM, Tan H, Khoo KL. A review of blood pressure profile and hypertension studies in Malaysia. The Family Physician 1994;6(2) : 36-45.
13. Lee HP, Seah CS, Yik TK, *et al.* An epidemiological survey of blood pressures in Singapore 1974. J Chron Dis 1977;30 : 793-802.

Appendix I

Student t-Test between means of parameters measured during the 1992-1994 National Heart Weeks by year and location

a. t-test for different years for total cholesterol measured in Kuala Lumpur

Years	1992/93	1992/94	1993/94
t-value	1.10 ns	3.45 **	2.82 **
df	1097	1276	1417

b. t-test for locations in the year 1994

Locations	Statistics	TC	GL	SBP	DBP
Kuala Lumpur/ Penang	t-value	1.99 *	2.08 *	–	–
	df	1039	590		
Kuala Lumpur/ Kuantan	t-value	3.09 **	2.34 *	–	–
	df	860	415		
Kuantan/ Penang	t-value	1.38 ns	0.42 ns	1.11 ns	0.62 ns
	df	295	291	279	279

ns : not significant at $p \leq 0.05$
**, **: $p \leq 0.05$ and 0.01 respectively*