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Rural communities in nutritional transition: emergence of obesity, hypertension and hypercholesterolemia as public health problems in three kampungs in Bagan Datoh, Perak

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ABSTRACT

This paper highlights the marked presence of nutritional disorders in a sample (190 males, 237 females, aged 18-80 years) obtained from the adult population in three kampungs i.e. Pasang Api, Sungai Nipah Baroh and Sungai Balai Darat, in the Mukim of Bagan Datoh, Perak in 1992. All subjects (except pregnant females) were measured for blood pressure, weight, height, waist circumference, and hip circumference from which the body mass index (BMI) and waist-hip ratios (WHR) were calculated. A random blood sample was obtained by finger-prick from each subject and analysed for total cholesterol (TC) and glucose, using the Reflotron compact analyser. Elevated means for BMI and WHR indicated that obesity (BMI ≥30.0) was a serious public health problem in these three kampungs, affecting about 5% of males and 14% of females. Another 24% of males and 46% of females had an overweight problem (BMI 25.0-29.9), indicating that on the average, about half the adult population in these kampungs were either overweight or obese. This contrasted with the situation a decade ago in similar-type kampungs in the Peninsula where underweight was the major nutritional disorder in adults, especially males. Overall, there was a shift of an underweight problem to one of overweight, as exemplified by increments of 2.0 to 3.0 BMI units in the adult population, with the phenomenon being more marked in the females. Hypertension (21%) and hyperglycaemia (6.5%) affected the males and females approximately equally. Female adults had higher mean plasma TC compared to males (204 versus 199 mg/dl); these means were some 20 mg/dl (0.52 mmol/L) higher than the corresponding means for adults in similar rural communitites in the early eighties, and approximate the corresponding means for present-day urban adults. The above findings serve to emphasise the nutritional transition undergoing in the rural communities in the Peninsula, viz, the marked emergence in these rural communities of nutritional disorders normally associated with affluent populations.

INTRODUCTION

Early comprehensive work on the nutritional status of Malaysian populations was carried out by the Interdepartmental Committee on Nutrition for National Defences (ICNND) which focussed on military and civilian populations in the country (ICNND, 1964).

Subsequently, the Institute for Medical Research (IMR) carried out a nutrition survey in impoverished kampungs of four states in the Peninsula from 1979-1983 and the findings on the nutritional status of these rural communities were published in the Bulletin of the IMR (Chong *et al,* 1984).

In 1992, about a decade after the above four-state nutrition survey, the IMR in collaboration with the Universiti Pertanian Malaysia (UPM) and the Health Division of the Ministry of Health Malaysia (MOH), embarked on a four-year project to compare the nutritional status of the major 'functional groups' in Peninsular Malaysia. Initially, the study focussed on the rural poor comprising mainly households involved in agricultural activities such as rice, rubber and coconut cultivation, and in the final year, the urban population shall be investigated (Anon., 1993).

It was during the first year of the study when coconut cultivation was the functional group of concern, that the Mukim of Bagan Datoh, Hilir Perak, was selected as it was recognised as one of the few remaining areas in the country where coconut cultivation was an important economic activity.

This communication reports on the emergence of obesity, hypertension, hypercholesterolemia and diabetes, as reflected by selected anthropometric and biochemical indices, of the adult population in three selected kampungs in the Mukim of Bagan Datoh, and compares these survey findings with the corresponding data on closely-similar impoverished communities reported by Chong *et al.* a decade ago (1984), as well as that for an urban adult group (Ng, 1995).

MATERIALS AND METHODS

Selection of the kampungs and households

Eighteen of the total 22 kampungs in Mukim Bagan Datoh were identified as having substantial acreage devoted to coconut-growing from census data obtained from the Ministry of Agriculture. From these 18 kampungs, three, namely Kampung Pasang Api, Kampung Sungai Nipah Baru and Kampung Sungai Balai Darat were ramdomly selected for the study.

In each of the kampungs selected, 'coconut households' were identified based on the following criteria: at least one member of the household owning or working in a coconut farm. All coconut households were visited by the IMR household teams during which socio-economic, nutrition and health data were obtained using a structured questionnaire. Whenever time permitted, other non-coconut households were also interviewed on a random basis.

The 210 households interviewed in the three kampungs in Bagan Datoh consisted of 957 people (48.1% males, 51.9% females) with the following demographic profile:

0.0-6.9 yr	: 15.0%
7.0-12.9 yr	: 20.3%
13.0-17.9 yr	: 11.6%
≥18.0 yr	: 53.1%

A total of 1034 subjects were examined at three different work stations (one in each kampung) during 7 consecutive days in December 1992. Of these subjects, 427 or 41.3% were adults (190 males, 237 females; aged 18-80 years). From the population census data provided by the local authorities, about 40-45% of the total population in the three kampungs studied were examined

at the survey work stations (Table 1), with ample representation from the other age groups below 18 years.

The data set of Chong *et al.* (1984) consisted of 1525 adults (≥18.0 yr; 528 males and 997 females) who formed 43% of all subjects examined at the survey work stations of the 14 kampungs studied in the four states. This earlier data set is similar to the present 1992 study in that: a) adults formed about 50% of the household demographic profile, b) the proportion of adult females was slightly higher than that of males, and c) adults formed about 41-44% of the total subjects examined at the work stations during the survey concerned.

Urban adult group

This group comprised 455 male and 172 female adults, aged 18.0 to 79 years, belonging to the three major Malaysian ethnic groups-Malays, Chinese and Indians. During their visits to a private clinic for routine medical examination by a cardiologist (KKL) in 1994-95, they were found to be normotensive, possessed a normal/exercise electrocardiogram (EGG) and had no history of coronary heart disease or diabetes.

Table 1. Household and population census of the three kampungs studied

Kampung	Total population	Total Households	Households interviewed	Number of people examined	
				Total*	Adults
Pasang Api	538	120	56	261	113
Sg Nipah Baruh	630	135	80	370	157
Sg Balai Darat	476	95	74	408	157
Total:	1644	350	210	1039	427

*All ages

Anthropometric and biochemical measurements

All members of households who were visited by the IMR Household Teams were instructed to go to the survey work station (eg. village community hall, school, kindergarten, etc) in the kampung for an abbreviated medical examination and anthropometric and biochemical assessments. Individuals of all age groups calling at the work station were registered according to household and each subject was given a card on which all measurements and assessments done at the centre were recorded.

Anthropometric measurements (eg. Weight, height, waist circumference and hip circumference) for adults i.e. subjects with ages 18.0 years and above, were recorded by the usual standard procedures described by Jelliffe (1966) and Gibson (1990). An average of 0.5 kg allowance was made for the weight of the clothing of the adults and this was substracted from the gross weight of the adults recorded on the subject cards. Waist circumference was measured at the point just above the navel, while hip circumference was taken at the point of maximum circumference at the buttocks. The BMI and WHR were calculated for all adults except pregnant females who formed <5% of the female subjects.

Random blood samples were obtained by finger-prick and analysed immediately for plasma TC and glucose with the Reflotron compact analyser (Boehringer Mannheim). The time of the last meal recorded on the card of each subject indicated that blood samples of less than 2-hours postprandial formed only about 20% of total specimens.

Quality control (QC) and system checks were performed on the Reflotron in the morning prior to the examination of subjects, and a QC check was again done immediately after the lunch break. The analytical performance of the Reflotron system under the field conditions encountered during the study was generally satisfactory, giving a precision of 4.0%-5.0% and a negative bias of about 4.0% for the TC assays.

Criteria used for anthropometric and biochemical assessments

The following criteria were used in nutritional assessment:

BMI (modified from Garrow, 1981 and Health Welfare Canada, 1988):
Underweight = BMI <19.0
Desirable
bodyweight = BMI 19.0-24.9
Overweight = BMI 25.0-29.9
Obese = BMI ≥30.0

W-H ratio (Jones *et al.*, 1986):
Increase risk to CHD and related deaths
Males = >0.95
Females = >0.85

Other indices:
Hypercholesterolemia:
= TC >240 mg/dl
('high risk': NCEP, 1988)

Hyperglycaemia
= plasma glucose >140 mg/dl
(modified from WHO, 1994)

Hypertension (WHO, 1994)
= systolic pressure >140 mm Hg/diastolic pressure >90 mm Hg

Statistical analysis

Between group comparisons were performed by the Student's t-test, using a level of significance of $p = 0.05$.

RESULTS AND DISCUSSION

The anthropometric and biochemical findings of the adult subjects in the three kampungs studied are summarised in Table 2.

Overweight and Obesity

The data in Table 2 indicates that overweight (BMI 25.0-29.9) was a common public health problem in the rural communities studied. There was a marked gender effect, with 18.3% of males and 32.4% of females being overweight and another 5.2% of males and 13.6% of females were obese (BMI ≥30.0). Overall, 23.5% of the male and 46.0% of the female adult subjects had an overweight problem equivalent to the Grades 1 plus 2 forms of obesity according to Garrow (1981). These findings serve to exemplify that the mild to moderate forms of obesity have reached alarming proportions in rural adult populations, affecting particularly the females.

Table 2. Prevalence of selected nutritional disorders in the adult population of three kampungs in Bagan Datoh

Indices	Kampungs selected for study							
	Pasang Api		Nipah Datoh		Balai Darat		3 kampungs combined	
	M (48)*	F (64)	M (71)	F (86)	M (70)	F (87)	M (190)	F (237)
BMI:								
% Underweight	20.4	20.3	28.2	14.0	24.2	9.2	24.5	14.0
% Desirable wt	55.1	32.8	47.9	47.7	52.9	47.1	52.0	40.0
% Overweight	14.3	28.1	19.7	30.2	20.0	28.8	18.3	32.4
% Obese	10.2	18.8	4.2	8.1	2.9	14.9	5.2	13.6
Mean	23.3	24.5	22.4	24.1	22.2	24.4	22.6	24.3
& SD	4.9	5.1	4.0	4.9	4.1	4.8	4.3	4.4
W-H RATIO:								
% High risk	8.2	37.5	7.0	43.0	5.7	20.7	6.8	33.3
Mean	0.87	0.84	0.86	0.84	0.85	0.81	0.86	0.83
& SD	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06
BLOOD PRESSURE:								
% Hypertensive	20.4	10.9	28.2	24.4	21.4	19.5	23.7	19.0
TC:								
Mean	193	200	205	206	198	206	199	204
& SD	41	43	38	40	43	46	41	43
%> 240 mg/dl	14.3	20.0	14.1	19.8	17.1	24.1	15.3	21.5
BLOOD GLUCOSE:								
%> 140 mg/dl	8.2	18.5	7.0	4.7	5.7	4.6	6.2	6.8
%> 180 mg/dl	1.0	13.8	2.8	2.3	1.4	2.3	2.1	5.5
Mean	108	134	110	109	108	103	109	114
& SD	23	77	31	37	27	29	27	51

*Values in parentheses refer to number of subjects

The above problem of obesity and the susceptibility of females, was supported by the data on W-R ratios which indicated that 6.8% of male and 33.3% of female subjects had high W-H ratios (>0.95 and >0.85, respectively).

It is interesting to note that when the BMI values of the present adult subjects were compared with those of adults from similar socio-economic rural communities examined by Chong *et. al.,* (1984) a decade ago, there was an apparent swing from a predominant problem of underweight to one of overweight in these rural adults (Table 3). The magnitude of this anthropo-metric shift was represented by significant ($p<0.05$) bodyweight increments of about 3.0 kg in males and 5.0 kg in females, equivalent to BMI increments of 2.0 and 3.0, respectively.

The above findings on BMI values for the Bagan Datoh adults contrasted with that obtained for urban Malays (Ismail, *et al.,* 1995) and the mixed-ethnic urban group of Ng *et al* (1995). In these urban groups, the problem of Grades I and II obesity was more marked in the males. Ng *et al.'s* data set particularly, suggested that urban women paid more attention to achieving a desirable bodyweight compared to their rural counterparts; the proportion of overweight plus obese women in the urban group (25%) was only about one-half that in the rural group (46%). This emphasises that besides gender, social-cultural factors also influenced bodyweight, and thus BMI, achievements.

Table 3. Comparison of BMI and TC of four populations of adult subjects 18 years and above

Indices	Poverty kampungs (Chong et al, 1984)	Perak Tengak (Chong et al., 1984)	Bagan Datoh (Present study: 1992)	Urban Group (Ng. 1995)
BMI				
Males:				
n	522	216	190	455
% Underweight	45.0	40.0	24.5	2.0
% Desirable wt	50.0	53.5	52.0	60.0
% Overwt + Obese	5.0	6.5	23.5	38.0
Mean ± SD	20.5 ± 2.8^{a}	20.9 ± 3.3^{a}	22.6 ± 4.3^{b}	24.5 ± 3.2^{c}
PT				
Females:				
n	965	346	237	172
% Underweight	31.0	30.0	14.0	10.0
% Desirable Wt	54.0	52.5	40.0	65.0
% Overwt + Obese	15.0	17.5	46.0	25.0
Mean ± SD	20.9 ± 3.4^{d}	21.2 ± 3.8^{d}	24.3 ± 4.4^{e}	23.1 ± 3.6^{e}
PLASMA TC				
Males				
n	246	50	190	455
Mean ± SD	175 ± 38^{f}	194 ± 34^{g}	199 ± 41^{gh}	207 ± 40^{h}
Females				
n	530	114	237	172
Mean ± SD	186 ± 38^{i}	198 ± 36^{j}	204 ± 43^{j}	208 ± 39^{j}

Within row values with different superscripts are significantly different at $p < 0.05$.

The major caveat in the present analysis was that the Bagan Datoh data was not obtained from a longitudinal study but rather based on two sets of data obtained from cross-sectional studies conducted a decade apart on adjacent rural communities with closely similar social, economic and cultural settings. However, the major defence of the present comparison was the marked similarities observed for anthropometric data, and to a lesser extent, biochemical data, among impoverished rural communities in the Peninsula, as was recorded in the data set of Chong *et al* (1984) as well as for the present three kampungs in Bagan Datoh.

Hypercholesterolemia

The mean serum TC values of the adult female subjects, as shown in Table 3, were marginally higher compared to that for the males (204 vs 199 mg/dl). A similar-type gender difference in serum TC was also apparent in the survey data of Chong *et al.* (1984), as well as in the younger population (7-17 year olds) of the present three communities (171 vs 159 mg/dl, $p<0.001$).

The proportion of adults with hypercholesterolemia [TC >240 mg/dl (>6.5 mmol/L) in the three kampungs was closely similar with 15.3% of the males and 21.5% of the females affected. The cut-off selected for 'hypercholesterolemia' here coincides with that for 'high risk' according to the classification provided by the National Cholesterol Education Programme (NCEP) of the USA (1987).

Of interest, both adult means for serum TO in the present study were some 20 mg/dl (0.52 mmol/L) higher ($p<0.05$) than the corresponding means for rural adults in Chong et al's data set (1984) obtained a decade ago. However, the 'secular' increase in serum TC when Bagan Datoh was compared to Perak Tengah appears marginal and less dramatic than that observed for BMI mentioned earlier.

It was unlikely that the overall 'secular' differences observed in serum TC for the two data set compared could be attributed to analytical variation as serum TC assays in both the studies were performed by the same laboratory which had previously served as the reference laboratory for lipid analyses in the country, as well as having been accredited by the Centre for Disease Control (CDC), Atlanta, USA for accuracy and precision in serum TC and TG assays for the period 1976-1984. Random blood specimens were utilised in both studies and this was not expected to influence significantly the serum TC levels (European Atherosclerosis Society, 1987; NCEP, 1988; Ng, 1993).

Also, the mean ages of the two adult populations compared were closely similar and therefore age was unlikely to confound the TC results observed.

Hyperglycaemia

It was found that 6.2-6.8% of the adult subjects had capillary plasma glucose levels ≥140 mg/dl (7.8 mmol/L), the cut-off for diabetes mellitus (WHO, 1994) for fasting samples. This prevalence level is probably an overestimation since no attempt was made to obtain fasting blood

samples during the field surveys. About 20% of the adult subjects had their last meal or snack within two hours of their blood collection.

In view of the above, the use of a renal threshold cut-off of 180 mg/dl (Murray *et al.,* 1990) indicated that the problem of diabetes in the three communities averaged 2.1% for males and 5.5% for females, figures which approximate the levels of NIDDM ranging from 2.8% to 7.7% reported for rural Malays previously (Osman *et al,* 1993; Ngan, 1995).

There were some disparities in the prevalence of this disorder in the three kampungs studied with the female adults in Kampung Pasang Api being particularly affected, viz. 13.8% of the females had blood glucose levels above the renal threshold value. This finding, however, correlates well with the observation that obesity was also highest in the Pasang Api adult females.

The use of glucose tolerance tests, which would have provided a better assessment of the problem of diabetes in the above communities, were not performed in the study.

Hypertension

Table 2 shows that hypertension affected the male and female adults in the three kampungs in Bagan Datoh approximately equally, with an overall prevalence of 23.7% and 19.0%, respectively.

Among the hypertensive subjects, 41% in Kg Pasang Api, 27% in Kg Nipah Baroh and 48% in Kg Balai Darat, also had some serious overweight problem (BMI >27.0), underscoring the recognised relationship between these two forms of morbidity.

As with obesity and hyperlipidaemia, there is evidence of inter-individual variations in susceptibility to hypertension, but the long term interactions with dietary factors are less easy to discern (WHO, 1990). However, the consensus of the scientific community with regard to hypertension, emphasises a primary preventive approach which stresses limiting the development of obesity with increased physical activity, and restricting the intake of salt and alcohol; the last factor of which was not in operation in these predominantly Muslim subjects.

CONCLUSION

During the period from 1980 to 1992, there was an apparent swing from a major underweight problem in kampungs in the proximity of Bagon Datoh, Perak to one of overweight, affecting about 40-50% of adults with the phenomenon being particularly marked in the females.

Mean plasma TC levels in these rural adults appeared to have increased over the years, with current levels being some 20 mg/dl (0.52 mmol/L) higher than what they were a decade ago, and fast approaching “urban values”. Hypercholesterolemia (>240 mg/dl) affected 15% of the male, and 21% of the female, adults.

Other 'chronic disorders' such as diabetes (2.1-5.5%) and hypertension (19-24%) affected the male and female subjects about equally.

The emergence in the three kampungs studied of nutritional disorders frequently associated with overnutrition and non-active affluent lifesyles, provide an example of the phenomenon of rapid nutritional transition undergoing in rural communities in the Peninsula. These findings serve to emphasize the shift in health care needs of the general rural population in the country.

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REFERENCES

Anon. (1993). A study of the nutritional status of the major functional groups in Malaysia. *Proc Nutr Soc Mal* 8: 109-111.

Chong YH, Tee ES, Ng TKW, Kandiah M, Hanis H, Teo PH & Siti Mizura S (1984). Status of community nutrition in poverty kampungs, *Bulletin No. 22* Institute for Medical Research, Kuala Lumpur, ISSN: 0127-273X.

Chong YH & Khoo KL (1975). Serum lipid levels and the prevalence of hyperlipidaemia in Malaysia. *Clin Chim Acta* 65: 143-148.

European Atherosclerosis Society (1987). Strategies for the prevention of coronary heart disease. *European Heart J* 6:77-88.

Garrow JS (ed) (1981). Treat Obesity Seriously: A Clinical Manual. London: Churchill Livingstone.

Gibson RS (ed) (1990). Principles of nutritional assessment. p178, 195, New York, Oxford University Press.

Health and Welfare Canada (1988). Promoting healthy weights: a discussion paper. Health Services and Promotion Branch, Health and Welfare, Ottawa.

Interdepartmental Committee on Nutrition for National Defence (1964). Federation of Malaya. Nutrition Survey September-October 1962; 355pp.

Ismail MN, Zawiah H, Chee SS & Ng KK (1995). Prevalence of obesity and chronic energy deficiency (CED) in adult Malaysians. *Mal J Nutr* 1:1-9.

Jelliffe DB (1966). The assessment of the nutritional status of the community, *WHO Monograph No. 53* World Health Organisation, Geneva.

Jones PRM, Hunt MJ, Brown TP & Norgan NG (1986). Waist-hip circumference ratio and its relation to age and overweight in British men. *Human Nutrition: Clinical Nutrition* 40C:239-247.

Murray RK, Granner DK, Mayes PA & Rodwell VW (eds) (1990). Harper's Biochemistry, 22nd edition. p187, California, Appleton and Lange.

NCEP (1988). Report of the National Cholesterol Education Programme Expert Panel on detection, evaluation and treatment of high blood cholesterol in adults. *Arch Intern Med* 148:36-39.

Ngan A (1995). Non-insulin dependent diabetes in Malaysia. *Proceedings of the Conference on "Current trends in nutrition: an international perspective"* April 7, 1995, Kuala Lumpur. The NutraSweet Company, USA: pp87-96.

Ng TKW (1993). Blood cholesterol screening: influence of fasting state, biological variation and the single cholesterol assay on total cholesterol level. *Med J Malaysia* 48(1): 12-16.

Ng TKW, Khoo KL, Gan SC, Zakiah I, Rush Z & Liew YM (1995). Serum lipoprotein(a) in the assessment of coronary heart disease risk in Malaysian. AOCS Press, USA (in press).

Osman A, Khalid BAK, Tan TT, Wu LL, Sakinah O & Ng ML (1993). Prevalence of NIDDM and impaired glucose tolerance in Aborigines and Malays and their relationship to socio-demographic, health and nutritional factors. *Diabetes Care* 16: 68-75.

WHO (1990) Diet, nutrition, and the prevention of chronic diseases. *Technical Report Series* 797 WHO, Geneva.

WHO (1994). Prevention of Diabetes Mellitus. *Report of a WHO Study Group* WHO, Geneva, 1994; pg 17.