Waist to Height Ratio: An alternative anthropometric indicator for early detection of health risk for Malaysia Health and Morbidity Survey (NHMS)

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NMMR-14-1064-21877

Introduction

Waist-to-height ratio (WHtR) recently received much attention as an indicator for early health risk (diabetes, hypertension and cardiovascular) .Many Asian countries such as India, China, and Korea have proposed that WHtR 0.5 be used for screening in other population. The data also confirmed that the cut off value of WHtR 0.5 for increased risk is appropriate across age, gender and ethnic population in adults. The purpose of this study was to identify the prevalence of adults who are at risk by WHtR but missed by BMI screening from the Malaysia NMHS 2015 Study. It is also to investigate whether WHtR is an independent anthropometric predictor for diabetes, hypercholesterolemia, high systolic and diastolic blood pressure.

Materials and Methods

Recent data of the Malaysia National Health and Morbidity Survey (NHMS) 2015 was used. The sampling design used two staged stratified random sampling. WHtR is defined as waist circumference in centimetres divided by height in centimetres. Data collection was from Mac 2015 till June 2015. A descriptive analysis for socioeconomic and anthropometric variables was carried out. Correlations between the variables BMI, WHtR, systolic blood pressure(SBP), diastolic blood pressure (DBP), Total cholesterol and Diabetes were checked using Pearson correlation test. The analysis of ROC curve (receiver operating characteristics) was used to assess the accuracy of BMI,WC and WHtR as early health risk indicators for diabetes, high systolic and diastolic blood pressure, and high cholesterol.
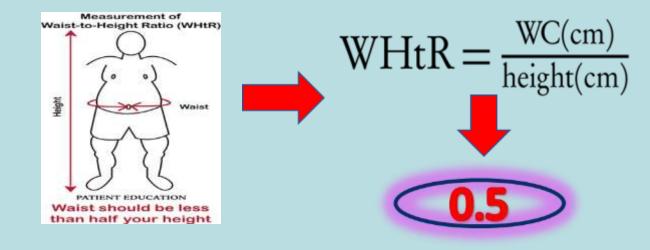
Results

A total of 20767 adults were recruited for this study. 18373 selected after considering exclusion criteria. Data from Table 1 shows the summary of anthropometry data of the study. Results from NHMS 2015 reported a mean ration for WHtR of 0.53 for Malaysian population regardless of gender, ethnicity and age. Findings from this study (Table 2) showed 19.4% (1 in 5) of adults with 'normal weight by BMI' have WHtR greater than 0.5 and therefore are at health risk.

Table 1 : Demographic and anthropometric characteristics of study

Variable	Estimated population	n	%	95%CI Lower	95%CI Upper
Socio-demographic					
Sex					
Male	9765343	8858	52.5	51.57	53.42
Female	8835734	9515	47.5	46.58	48.43
Age group (years)					
18 - 24	3518522	2522	18.9	17.98	19.89
25 - 44	8543657	7275	45.9	44.62	47.25
45 - 64	5087543	6438	27.4	26.38	28.34
65+	1451354	2138	7.8	7.23	8.41
Ethnicity					
Malay	9118586	11375	49	46.29	51.76
Chinese	4227623	2867	22.7	20.37	25.27
Indian	1272586	1305	6.8	5.89	7.93
Others Bumiputras	2069963	1655	11.1	9.61	12.85
Others	1912319	1171	10.3	8.68	12.14
Locality					
Urban	14090521	10557	75.8	74.67	76.8
Rural	4510555	7816	24.2	23.2	25.33
Household income group (RM)					
Less than RM1000	2498054	2946	13.4	12.47	14.45
RM1000 - 1999	3079301	3364	16.6	15.49	17.68
RM2000 - 2999	3034378	3119	16.3	15.09	17.61
RM3000 - 3999	2388824	2333	12.8	11.8	13.96
RM4000 - 4999	1830483	1651	9.8	8.9	10.87
RM5000 - 5999	1471458	1287	7.9	7.04	8.88
RM6000 - 6999	954462	873	5.1	4.42	5.95
RM7000 - 7999	754222	711	4.1	3.46	4.75
RM8000 - 8999	625671	547	3.4	2.77	4.08
RM9000 - 9999	334183	292	1.8	1.39	2.31
RM10000 and above	1630041	1250	8.8	7.45	10.28
Metabolic health risk					
Diabetes					
Normal	12391858	11553	66.7	65.32	68.07
Impaired fasting glucose	1642471	1723	8.8	8.24	9.49
Diabetic	4541325	5053	24.4	23.32	25.61
Cholesterol					
desirable	9507549	8627	53.5	52.19	54.88
borderline high	4580190	4586	25.8	24.89	26.71
high	3670635	4362	20.7	19.67	21.71
Systolic					
normal	6176794	5199	33.8	32.7	34.94
pre hypertension	8130197	8016	44.5	43.38	45.63
stage 1	2786609	3299	15.3	14.53	16
stage 2	856108	1054	4.7	4.3	5.11
hypertension crisis	318714	444	1.7	1.51	2.01
Diastolic					
normal	10107434	9327	55.9	54.69	57.18
Pre hypertension	5360932	5514	29.7	28.63	30.73
Stage 1	1851249	2056	10.2	9.62	10.91
Stage 2	534421	605	3	2.66	3.29
Hypertension crisis	213559	257	1.2	1	1.4

Variable	Estimated population	n	Median	Interquartile Q1	Interquartile Q3
Anthropometric indicator					
Weight	18601077	18373	63.60	54.50	74.30
Height	18601077	18373	160.20	154.00	166.80
Body Mass Index (BMI)	18601077	18373	24.70	21.58	28.42
Waist circumference	18601077	18373	85.00	76.00	93.00
WHtR (waist to height ratio)	18601077	18373	0.53	0.48	0.58

Table 2 : Adults misclassified by BMI revealed by WHtR

BMI Group	WHtR ≤0.5 Estimate population	WHtR ≤0.5 Count	WHtR ≤0.5 Prevalence %	WHtR >0.5 Estimate population	WHtR >0.5 Count	WHtR >0.5 Prevalence %	Percentage of each sex at risk by WHtR but missed by BMI screening	Percentage of each sex at risk by BMI but not at risk by WHtR
Men								
Normal	3555045	2912	68	1670430	1636	32	(1636/ 8858) =18.5 %	(272/8858) =3.1 %
Overweight & obese	324777	272	7.2	4215091	4038	92.8		
Women								
Normal	2709405	2365	60.2	1792537	1922	39.8	(1922/9515) =20.2 %	(264/9515) =2.8 %
Overweight & obese	229312	264	5.3	4104480	4964	94.7		
All adults								
Normal	6264450	5277	63.8	3462967	3558	35.6	(3558/18373) =19.4 %	(536/18373) =2.9 %
Overweight & obese	554089	536	6.2	8319572	9002	93.8		
Total	6818539	5813	36.7	11782539	12560	63.3		

Measurement of Waist-to-Height Ratio (WHtR)
$$WHtR = \frac{WC(cm)}{height(cm)}$$
0.5
Waist should be less than half your height

ROC Curves for diabetes, systolic, diastolic and cholesterol

Figure 1: Diagnostic accuracy of diabetes based on anthropometric indicators
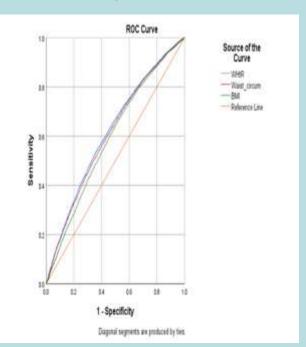

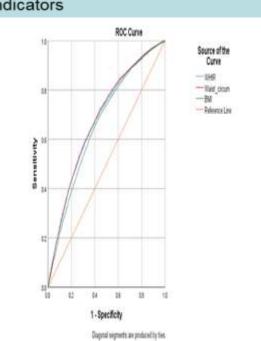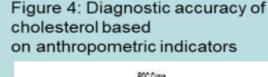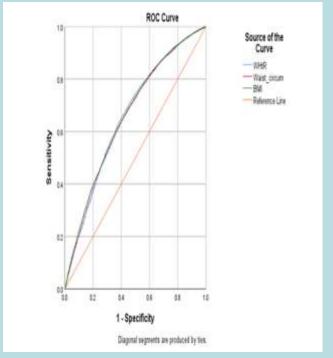Figure 2: Diagnostic accuracy of systolic based on anthropometric indicators

Figure 3: Diagnostic accuracy of diastolic based on anthropometric indicators
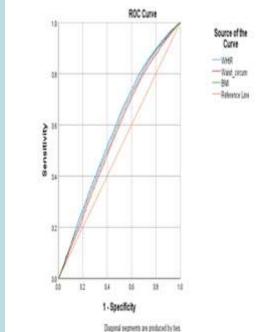

Figure 4: Diagnostic accuracy of cholesterol based on anthropometric indicators

Table 4 : WHtR,WC and BMI comparison in terms of ethnicity

Variable	Malay	Chinese	Indian	Other Bumiputra	Others
Men					
BMI	23.7	24.4	23.3	NA	NA
WC	82.9	82.9	86.2	NA	NA
WHtR	0.5	0.5	0.5	0.5	0.5
Women					
BMI	24.9	23.9	24.6	NA	NA
WC	79.8	78.7	82.1	NA	NA
WHtR	0.5	0.5	0.5	0.5	0.5

Table 3 : WHtR and Age Group

Age Group (years)	WHtR No Risk (n /%)	WHtR Risk (n/%)
18-24	1415 (59)	983(41)
25-44	2227(32)	4742(68)
45-64	886(15.9)	5230(84.1)
> 65	344(16.6)	1730(83.4)

Discussion / Conclusion

This study showed that there were certain percentage of Malaysian population that were missed by BMI screening but found to be at risk by WHtR.

Areas under ROC curve showed WHtR was the predictor for the best performance for diabetes and high cholesterol but not systolic pressure and diastolic pressureLimitation of this study was that three blood pressure measurements were taken almost simultaneously. In view of considering NHMS 2015 survey as one of the largest population-based survey, it can be concluded that a cut-off point of 0.5 for WHtR should be sufficient and acceptable to indicate Malaysian population that are at risk or increased health risk regardless of ethnicity, gender and age.

References

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