CAN WAIST/HIP RATIO BE USED AS A SIMPLE MEASURE OF CARDIOVASCULAR RISK IN THE ARMED FORCES : RESULTS FROM A FIELD EPIDEMIOLOGICAL STUDY

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ABSTRACT

A cross-sectional analytical epidemiologic study was undertaken in the community setting, on 1080 army personnel in a field formation, to study the association between waist/hip ratio (WHR) and certain physiological and biochemical parameters of cardiovascular risk. The study revealed that Junior Commissioned Officers, personnel aged 35 years and above, and personnel from *Services* had an increased probability of having higher WHR. WHR was consistently, linearly and significantly associated with increasing mean values of serum cholesterol, blood sugar and blood pressure. The optimum cut-off point of WHR from the findings of this study seems to be 0.91 and above. Beyond this value of WHR, the cardiovascular risk increases significantly and becomes more dramatic at WHR values of 0.96 and above.

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KEYWORDS : Cardio-vascular risk; Central adiposity; Obesity; Waist/hip ratio.

Introduction

During recent years, increasing interest has been shown by epidemiologists and clinicians in the utility of waist/hip ratio (WHR) as a simple indicator of various non-communicable chronic diseases like ischaemic heart disease (IHD), hypertension and diabetes mellitus (I). While obesity is well recognised as a risk factor for various chronic diseases, central adiposity as assessed by an increasing WHR is being thought of as an even more specific correlate of the overall cardiovascular and metabolic risk [2-7]. However, there is hardly any study available which has evaluated the relationship between WHR and certain important indicators of cardiovascular risk in Indian Army. The issue becomes more relevant when we consider the fact that non-communicable diseases have established themselves as a leading cause of mortality and morbidity in Indian Army.

It was against the above backdrop that the present study was undertaken to study the association of WHR with serum cholesterol, blood sugar, and blood pressure and to decide an optimum cut off point for this parameter for operational use in public health practice.

Material and Methods

The study was conducted in the general setting of the community of army personnel, in a field formation, on the lines of a cross

sectional analytical epidemiological design. Minimum sample size required on the basis of conventional type I and type II errors, worked out to approximately 1000. This study included all officers, junior commissioned officers (JCOs) and other ranks (ORs) who reported for annual/half yearly medical examination during the study period.

Measurements included recording of blood pressure which was undertaken as per the latest WHO recommendations [8]. Waist and hip measurement were made at levels of umbilicus and greater trochanters respectively, as has been recommended by earlier workers and WHO [9,10]. Blood samples for sugar and cholesterol were analysed at a hospital laboratory. Random blood sugar samples, as recommended by WHO for field epidemiological studies were taken. Statistical procedures included descriptive statistics on trends, ANOVA for multiple group comparisons, and linear trend chi square analysis for ordinal, categorical data.

Results

(a) General description of study population :

A total of 1080 subjects were studied. These included 97 Officers (9%), 195 Junior Commissioned Officers (JCOs) (18.1%) and 788 other ranks (ORs) (72.9%). Out of officers and JCOs a large majority were more than 35 years old (77.3% and 92.3% respectively). On the other hand, a large majority of ORs were less than 35 years old (85.4%).

(b) Linear relationship of the average WHR with age, military rank and military occupation :

It was observed that the average WHR was minimum among ORs from *Arms* who were less than 35 years old (Mean=0.826). On the other hand, JCOs aged > 35 years from *Services* had the highest average values (0.977). Overall, age less than 35 years was found to be associated with lower values of WHR. ORs had the

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minimum values, while JCOs had the highest values, with officers coming in between. *Services* had consistently higher values of WHR as compared to *Arms* in all categories of age and rank (excepting for the JCOs category). The difference was found to be statistically significant by ANOVA ($P < 0.05$).

(c) Association of WHR with Arms/Services, Stratified on Rank :

A linear trend analysis of the ordinal relationship between grades of WHR and *Arms/Services*, stratified on military rank was undertaken and the results are presented in Table 1. After adjusting (controlling) for the effect of military rank, the overall trend was highly significant. The probability of persons from *Arms* to be having higher values of WHR, was much lower as compared to *Services*. It was also seen that this trend was most marked among ORs. However, in case of Officers and JCOs, the chances of centrally obese persons belonging to either *Arms* or *Services* were not statistically significantly different.

On the basis of results of para (a) above and Table 1, it seems that JCOs and personnel aged 35 years and above may be the target group for obesity control measures, with an even greater emphasis to be placed on personnel from *Services*.

(d) Linear relationship of WHR with average serum cholesterol levels (Fig 1) :

It was seen that a typical linearly increasing trend of mean serum cholesterol values were observed with increasing categories of WHR. Statistically, the difference in the various means was

Fig. 1 : Linear relationship of WHR with average serum cholesterol levels.

found to be significant by ANOVA ($P < 0.05$). It was also observed that the average values maintained at reasonably low values till the WHR of 0.9. However, the average values of serum cholesterol rise dramatically once the WHR is more than 0.9, from 183.3 for the WHR category 0.86 to 0.9, to 200.6 for the WHR category 0.9 to 0.95. Thereafter also, for every increasing category of WHR, the serum cholesterol levels continue to rise significantly. It therefore seems that a WHR level of 0.9 and below is safe, while a value of 0.91 and above is likely to predict a high risk profile as far as serum cholesterol is concerned.

(e) Association between WHR and blood sugar levels (Fig 2) :

There was a consistent, linearly increasing rise in random blood sugar levels with increasing values of WHR. The relationship was found to be statistically significant by ANOVA ($P < 0.05$). While the values showed little linear rise till the WHR level of 0.95, WHR levels of more than 0.95 were associated with significant increase in mean random blood sugar. For purpose of random blood sugar, therefore, WHR values of more than 0.95 predict a high risk.

(f) Association between WHR and blood pressure :

The linear relationship between WHR and diastolic BP (DBP), according to the two major age groups is depicted in Fig 3 while its relationship with systolic BP (SBP) is presented in Fig 4. It is seen that both systolic as well as diastolic blood pressures rise consistently with increasing values of WHR, in both the age

Fig. 2 : Linear relationship of WHR with average random blood sugar levels.

TABLE 1

Linear trend analysis of the relation of WHR with *Arms/Services* differential, stratified on rank

WHR category	Stratum - 1 : Officers				Stratum-2 : JCOs				Stratum-3 : ORs			
	Arms	Services	Total	Stratum Odds ratio	Arms	Services	Total	Stratum Odds ratio	Arms	Services	Total	Stratum Odds ratio
Up to 0.85	7	3	10	1.00	11	7	18	1.00	194	101	295	1.00
0.86 to 0.95	37	23	60	0.69	65	41	106	1.01	213	231	444	0.48
0.96 & above	17	10	27	0.73	28	43	71	0.73	23	26	49	0.46
Total	61	36	97		104	91	195		430	358	788	

Linear trend chi square : stratum-1 : 0.06, $p > 0.05$; stratum-2 : 1.67, $p > 0.05$; stratum-3 : 20.4, $p < 0.001$

Overall linear trend chi square for the relationship between WHR and *Arms/Services* difference, adjusted for the confounding effect of rank = 25.52, $p < 0.001$

Adjusted stratum specific odds ratio : Stratum-1 = 1.00, Stratum-2 = 0.52, Stratum-3 = 0.47.

Fig. 3 : Linear relationship between WHR and diastolic BP as per age groups

groups, i.e. below 35 years as well as above 35 years group. This difference in the mean SBP and DBP values for different WHR categories were found to be statistically significant ($P < 0.05$). It is also observed from Fig 4 and 5 that the optimum cut off point of WHR at which SBP as well as DBP start rising in a remarkable fashion is a WHR of >0.9 , which is particularly evident for >35 years age group.

Discussion

The present study has clearly brought out the fact that an increasing WHR is consistently and significantly associated with increase in cardiovascular risk as assessed in terms of blood pressure, serum cholesterol and blood sugar, which are all known to be important markers of risk [1-3,5,6]. The present study has clearly brought out the following findings :

(a) That increasing WHR is consistently associated with increase in blood pressure, serum cholesterol and blood sugar.

(b) That the risk of elevation of blood pressure, blood sugar and cholesterol becomes significantly remarkable when the WHR is >0.9 , and very outstanding when it is >0.95 .

(c) That JCOs, as well as all personnel aged 35 years and above, especially those from Services are at a significantly higher risk of having higher WHR values.

In view of the above mentioned conclusions, it is recommended that measurement of Waist and Hip (and calculation of WHR) may be incorporated as a routine measure in all medical examinations in the Army. A value of WHR between 0.91 to 0.95 should be taken as a "borderline zone" wherein persons should be properly advised regarding diet and physical activity and a watch kept on them. WHR values of 0.96 and above should prompt further clinical and di-

Fig. 4 : Linear relationship between WHR and systolic BP as per age groups.

agnostic work up. In addition personnel who are aged 35 years and above, particularly JCOs and those from Services, should be "targetted" for general health promotional activities for control of obesity.

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