

主論文の要旨

**Association of anthropometric indices of obesity with
hypertension among public employees in northern
Ethiopia: findings from a cross-sectional survey**

肥満に関する身体計測指標と高血圧の関連：
エチオピア北部地方の公務員における横断研究

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【Introduction】

The burden of hypertension is increasing in low-income countries, including Ethiopia. Obesity is widely known to be associated with hypertension, but different anthropometric indices of obesity might differ in association with hypertension, which is largely unknown in northern Ethiopia.

【Methods】

We conducted a cross-sectional epidemiological survey of NCD risk factors between October 2015 and February 2016, targeting public employees between 25 and 64 years of age in a regional capital city in northern Ethiopia. In total, 1527 participants (869 men and 658 women) partook in the study. Excluding pregnant women (n=22), individuals younger than 25 years old (n=98), and individuals whose age or sex was unknown (n=27), the data of 1380 participants (823 men and 557 women) were statistically analysed.

Age-adjusted proportion (%) of sociodemographic and behavioural variables, estimated using the general linear model, was demonstrated according to BMI, waist circumference and waist–hip ratio categories according to sex. The binomial logistic regression model was applied to explore the relationship of different anthropometric indices with hypertension. The logistic regression models for three anthropometric variables were initially adjusted for age (continuous) only. Subsequently, further adjustment was done for the following covariates for each anthropometric variable: income, marital status, smoking, *khat* chewing, alcohol drinking and fruit and vegetable intake. For the analyses of waist circumference and waist–hip ratio analyses, continuous BMI was also adjusted on top of the aforementioned covariates. The area under the curve (AUC) was presented along with the 95% CI to aid our comparison among three anthropometric variables.

【Results】

The mean age was 39.5 years (mean age \pm SD: 39.5 \pm 9.4). The mean SBP was 119.6 mm Hg (mean SBP \pm SD: 119.6 \pm 16.7), and the mean DBP was 80 mm Hg (mean DBP \pm SD: 79.9 \pm 9.9). The overall prevalence of hypertension was 19.6% (22.4% in men and 15.3% in women).

BMI, waist circumference and waist–hip ratio were significantly associated with hypertension both in men and women. In men, BMI was linearly associated with hypertension (OR for 1 SD BMI: 1.45, p=0.001) significantly, and the OR of having hypertension was 2.92 (95% CI 1.46 to 5.83) in the highest BMI category compared with the lowest BMI category (multivariable adjusted model). Similarly, waist circumference was linearly associated with hypertension (OR for 1 SD increase in waist circumference:

1.67, $p < 0.001$), and the association was independent of BMI (OR for 1 SD waist circumference: 1.74, $p = 0.002$). The waist–hip ratio was also linearly associated with hypertension (OR for 1 SD increase in the waist–hip ratio: 1.56, $p < 0.001$). The association was also significant after further adjustment for BMI (OR for 1 SD increase in the waist–hip ratio: 1.46, $p < 0.001$).

In women, BMI was also linearly associated with hypertension (OR for 1 SD BMI: 1.41, $p = 0.011$). The OR of having hypertension in the highest BMI category was 3.68 (95% CI 1.62 to 8.39) compared with the lowest category in multivariable adjusted model. Waist circumference was linearly associated with hypertension (OR for 1 SD increase in waist circumference was 1.70, $p = 0.001$). This association was also independent of BMI (OR for 1 SD increase in waist circumference: 1.57, $p = 0.029$). The waist–hip ratio was linearly associated with hypertension only in the age-adjusted model (OR for 1 SD increase in the waist–hip ratio: 1.31, $p = 0.030$). The association was obscured after adjustment for variables in multivariable adjusted model (OR for 1 SD waist–hip ratio: 1.31, $p = 0.056$), and after further adjustment for BMI (OR for 1 SD waist–hip ratio: 1.25, $p = 0.13$) in multivariable adjusted and continuous BMI adjusted model.

The AUC for BMI was 0.64 in men and 0.67 in women. AUC for waist circumference was 0.69 both in men and women, and AUC for the waist–hip ratio was 0.70 in men and 0.64 in women.

【Discussion】

This study examined the association of obesity measured by anthropometric indices with hypertension among public employees in northern Ethiopia. BMI, waist circumference and waist–hip ratio were associated with hypertension independent of socioeconomic and behavioural variables in men. Waist circumference was associated with hypertension independent of BMI both in men and women; however, the waist–hip ratio was associated with hypertension independent of BMI only in men but not women. As far as we know, this is the first study to investigate the difference of anthropometric indices of obesity in association with hypertension in northern Ethiopia.

Similar to our findings, BMI and waist circumference were associated with hypertension in southern Ethiopia, China, Iran and England. Our study showed that the waist–hip ratio was significantly associated with hypertension only in men independent of BMI. In women, BMI, not waist–hip ratio was associated with hypertension in that model, which might be consistent with a previous study in Japan that reported sex differences in the association of abdominal obesity with hypertension.

This study found that abdominal obesity measured by waist circumference was

associated with hypertension independent of BMI while BMI was not significantly associated with hypertension after adjusted for waist circumference (data not shown). We also found that the AUC of waist circumference was higher than the AUC of BMI both in men and women, although the difference was not so much. These findings indicated that waist circumference could be a better predictor of hypertension than BMI consistent with previous studies.

Our study found that waist circumference was significantly associated with hypertension after adjustment for BMI. This indicates that changes in waist circumference should be monitored during the hypertension control interventions, such as diet management and physical exercise, rather than just monitoring body weight. Waist circumference can be measured even in a resource-poor setting in developing countries. Also, regular screening of BMI and waist circumference would be useful to predict risks of hypertension.

The limitation of this study is that due to the nature of a cross-sectional study, causal relationships could not be identified. Another limitation is that there might be interobserver errors in measuring waist circumference and hip circumference. However, anthropometric indices were measured by well-trained data collectors following the WHO standard protocol, so such errors were likely to be minimum.

【Conclusion】

In conclusion, the current study showed that the association of waist circumference with hypertension was independent of BMI among northern Ethiopian public employees. Abdominal obesity measured by waist circumference could be a good predictor of hypertension in this population.