CHAPTER 5

Conclusion

5.1 Conclusion

In our study, HWDI is the new simplest measurement which can be used for screening obesity status. There are still very limited data regarding the Prior-HWDI. The main objective of this study is to propose a New-HWDI for each age group by gender, considering BF% as gold standard. We found the New-HWDI for screening obesity status are <98 in men and <90 in women age between 18-39; <96 in men and <94 in women age between 40-59; and <100 in men and <90 in women age ≥ 60. The obese prevalence as defined by New-HWDI was 36% in men and 25% in women. The kappa statistics for New-HWDI and BF% was 0.23 in men and 0.18 in women.

While BF% is considered to be the most accurate obesity evaluation tool, it is a more expensive method and more difficult to measure than the others. Therefore we tried to the relationship between HWDI and BF% and to find a BF% prediction model in relation to age group and gender. The study present HWDI and BF% to be inversely related in that (r = -0.200 for men and r= -0.473 for women) with a tendency towards a linear relationship. Results of a multivariate linear regression analysis, which included HWDI and age as variables in the model, predicted BF% to be 34.508 - 0.159 (HWDI) + 0.161 (Age) for men and 53.35 - 0.265 (HWDI) + 0.132 (Age) for women.

5.2 Discussion

This study which is divided into two parts as 1) finding the New-HWDI and 2) relationship between HWDI and BF% are explained as follows:

New criterion of HWDI (New-HWDI) for screening obesity status

Our study provides the New-HWDI for screening obesity status in adults based on measures obtained from a large number of enrolled healthy Thai volunteer participants. For the first time, we can establish the New-HWDI for different groups age and gender, so that it will be more accurate for evaluation of obesity. A criterion for selecting the optimum threshold value for the New-HWDI cutoffs was Youden's index, which give underestimated value similar to when using BMI. This shows that New-HWDI is an effective index of screening obesity in adults.

Although the mechanisms leading to increasing fatness with age are not fully understood, our analysis clearly shows the significant impact of age and also gender on the screening obesity status. Our findings are consistent with other studies showing that age and gender are significantly different in impact to obesity using BMI (77). However, in the absence of comparative data among other potential independent variables such as ethnicity, it is impossible to evaluate the deficit in the New-HWDI for establishing an international obesity status.

In this study, BF% value from BIA was used as a gold standard in diagnosing obesity condition due to its reliability in comparison to other index values because it is capable of depicting fat levels which are the cause of obesity. Furthermore, the previously used BMI index was found to have limitations in categorizing and diagnosing obesity (79). Despite its popularity, BMI index does not reflect important elements inside the body such as fat level and muscle volume which were used to categorize and diagnose obesity. This is consistent with a study by Romero-Coral et al. (78) which found the BMI cannot distinguish the individual who is of normal weight and height but has high fat level (77,79,80) It is also consistent with studies by Habib et al. (81) and Wang et al. (82) which indicate that BMI still has some limitations for giving accurate data about the prevalence of obesity. Hence, BF% is a better alternative to BMI for diagnosing obesity (81).

In our study, the obese prevalence as defined by BMI, by BF% and by Prior-HWDI were 31%, 37% and 4% in men and 33%, 10% and 7% in women, respectively, while the obese prevalence was defined by New-HWDI was 36% in men and 25% in women. When compared with other research, New-HWDI yields higher obese prevalence than those utilizing BF% index or BMI such as Akmal et al. (83) in Malaysia and Goonasegaran et al. (84) in Singapore.

In this study, it was found that the kappa value of BF% and BMI was low (kappa=0.14 in men and 0.14 in women) which is different from the studies by Habib et al. [21] (kappa=0.41 in men and 0.53 in women) and Wang et al. (82) (kappa=0.21 in men and 0.32 in women). The discrepancy may be caused by the difference in nationality, age of sample group, muscle volume, genetics, as well as the method and tool that was used to measure BF% value (82, 85-87).

The kappa value of BF% with New-HWDI in this study was found to be kappa=0.23 in men and 0.18 in women. However, when comparing the kappa value of New-HDWI with BMI using BF% as gold standard, it was found that New-HDWI can distinguish obesity condition in men and in women better than BMI value. (underestimate value of New-HWDI is lower in every age-range of both gender in comparison to BMI value)

In conclusion, our results showing the New-HWDI could be used as a simplified and effective index for screening obesity in adults. It will help Thai adults to realize their health status and avoid the risk of obesity and related diseases.

Relationship between HWDI and BF%

In this study, we evaluated the relationship between HWDI and BF% with respect to gender. Our results show that obesity was proportionately higher in women than men, which is in accordance with previous studies which showed a higher risk of obesity in women both globally and in Asia (88-91). This may be due to differences in eating and exercising behaviors from men, as well as physical attributes, hormones, and metabolism (92-94).

The HWDI, a relatively new obesity measurement tool, was used in this research and was found to have an inverse relationship with BF% in both men and women. However, the Pearson's correlation coefficients was found to be low (r = 0.20 for men and r = 0.47 for women) when compared to previous studies that utilized other obesity evaluation tools with BF% (77, 85, 95). In 1996, Gallagher et al. studied the relationship between BMI and BF% and reported values of r = 0.58 for men and r = 0.72 for women. Later, Ranasinghe et al. (2013) have reported r = 0.75 for men and r = 0.82 for women and, more recently, Ilman et al. (2016) have reported r = 0.85 for men and r = 0.83 for women. Each study described a distinct BF% prediction model. It had been previously reported that, besides age and gender, other variables such as nationality, ethnicity, and religion can also help improve the accuracy of a BF% prediction model (77, 85, 95-98).

A multivariate linear regression analysis showed that age and gender were statistically significant variables contributing to changes in BF%, which supports the results of previous studies (85, 99-101). However, many of those studies used BMI as an independent variable along with the others mentioned above in constructing a BF% prediction model and found that the use of BMI introduced some limitations. For example, BMI cannot distinguish between an obese or overweight individual when a group consists of a population with normal bodyweight but high BF%. This may result in an underestimation of the number of individuals in a population with obesity (78). Because of that limitation, HWDI was used in the model in this study instead of BMI.

Statistical modeling was depended on the distribution of data or the assumption of linear regression between independent and dependent variable (103). This study aimed to find an appropriate model to predict obesity in several cases, such as linear model, non-linear model, and also for data transformation to apply in other models. Results of this study showed that the relationship between HWDI and BF% was linear, whereas other researchers have reported different forms in the relationship between BMI and BF%, such as a curvilinear one (77, 102). According to coefficient of determination (r^2) of each model, although r^2 of linear model was not different from non-linear model or other model (Appendix D-E), linear model is more simply to use and interpret (104, 105). Therefore, we purposed to use linear model to predict obesity in Thailand.

Even though including thickness and circumferential anthropometric measurement in the model might increase an accuracy to predict BF%, it might complicated to use because of difficulties or high cost of measurement. Therefore, to find the simple model, our study concerning BF% prediction models consisting of HWDI and age grouped by gender resulted in better SEE values than that of Matt et al. where BMI was used in the prediction of BF% in four different groups of population with Asian, Black, Puerto Rican, and White ethnicity. In addition, the standard error of estimate values derived from this study were similar to, yet higher than, those of some other studies (20, 77). This may be because the r value between HWDI and BF% in this research was lower in comparison to the others.

The prediction model derived from this study uses HWDI, which is more convenient and easier to use than BMI. This has resulted in an easier means to evaluate obesity, thus aiding the monitoring of high-risk groups in the population so as to avoid problems associated with it.

5.3 Recommendations

Previous studies (59, 60, 65) have shown that race and skin type were statistically significant in the relationship of BMI with BF%. Thus, a study on the influence of ethnic group in the relationship of HWDI with BF% may make cut-off for evaluating obesity by HWDI more conclusive.

Since at present, there are reports that obesity status is getting higher among the youth less than 18 years who tend to be overweight (88). Thus, if HWDI is developed it can be used for the age group less than 18 years and beneficial for practical applications since HWDI is a simple tool for evaluating obesity in its early status or useful in evaluating oneself to see the risk of obesity quickly.

5.4 Limitations

There were 4 main limitations in this study:

1. The data were inadequate on the group sample thin of the men from evaluation of BF%.

2. The most population live in northern of Thailand and thus may not be representative of the adult population living in Thailand.

3. This study emphasized on the adult group with good health conditions in Thailand only which cannot explain the differences of ethnic group within the group.

4. We were also unable to compare other assessment of obesity, such as waist-to-hip ratio with corresponding DXA measurements, due to lack of hip circumference data.