# ANTHROPOMETRIC INDICES TO DEFINE OBESITY IN NON-DIALYSED CHRONIC KIDNEY DISEASE PATIENTS 

## Anjani Bakshi

Dr. Kalyani Singh

RD, Ph.D. Scholar, MSc., Food and Nutrition Department, Lady Irwin College, New Delhi, India - Corresponding author

(ABSTRACT) Obesity not only increases the risk of kidney disease but also increases disease progression. To measure obesity in chronic kidney disease patients, anthropometry emerged to be the most easy, practical, and inexpensive method. Present study was undertaken with the aim of assessing obesity in 120 chronic kidney disease patients. Measures such as height, weight, waist circumference and hip circumference were taken. Waist hip ratio and waist height ratio were computed. Independent $t$ test was used as statistical test to find difference in between stages. Mean body mass index of the patients was $26.83 \pm 5.35 \mathrm{~kg} / \mathrm{m} 2$. Out of 120 CKD patients, $62 \%$ were pre-obese and obese. As compared with the reference values form literature, non-dialysed patients of the present study, appeared to be obese. Strategies, thus need to be identified to prevent patients from obesity associated complications and from progression to end stage renal disease.

KEYWORDS : Obesity, chronic kidney disease, anthropometry

## INTRODUCTION

Obesity is considered to be the most preventable risk factor for chronic kidney disease (CKD) due to its strong link with diabetes and hypertension, the two primary causes of CKD. ${ }^{1}$ This is supported by various other studies, suggesting obesity not only increases the risk of kidney disease but also increases progression of the disease. ${ }^{1,2}$ Possible mechanism could be increased intra-capillary perfusion pressure that leads to glomerulosclerosis and loss of GFR over time, or an increase in the activity of rennin-angiotensin system (RAS). ${ }^{3}$ Measures such as body weight, body mass index (BMI), waist circumference, waist-hip ratio and waist-height ratio can be used to define obesity in nondialysed chronic kidney disease patients. These are anthropometric indices with many advantages in patient population. They are easily available, practical, inexpensive and apt to describe body size and identify level of fatness and leanness in adults with CKD. ${ }^{4}$

Body weight is an important measure of anthropometry because it is simple and accessible. Any change in weight status over time, clearly defines nutritional status of patient population. Its estimation in CKD patients helps in determining protein and energy needs. BMI is a proxy index of thinness or fatness ${ }^{5,6}$ and hence related with the health risk and death rates in patient population. ${ }^{7}$ It is calculated by two simplest measures i.e. height and weight. BMI is calculated as body weight in kilograms divided by squared height in meters $\left(\mathrm{kg} / \mathrm{m}^{2}\right)$ and compared with the standard cut off points given by WHO, which categorizes patients as underweight, normal, pre-obese and obese. These BMI cut off points are used clinically to determine individuals at high risk and absolute risk of being under nourished or over nourished. ${ }^{7}$ Waist circumference is more useful, simple and inexpensive method to assess intra-abdominal fat. ${ }^{8}$ It measures central adiposity which has been shown to correlate significantly with higher mortality, ${ }^{9,10}$ hypertension, dyslipidaemia and metabolic syndrome. ${ }^{11}$ Waist-to-hip ratio (WHR) is calculated taking ratio of two measurements, waist circumference and hip circumference. It measures both, central obesity as well as visceral fat. ${ }^{11,12}$ In a community-based US population study, WHR was associated with not only the development of kidney disease but also was associated with poor outcome of decreased kidney function. ${ }^{10}$ WHR is indirectly linked with hyperglycaemia, hyperte nsion, hypercholesterolemia, atherosclerosis which may lead to the development of kidney disease. More recently, the ratio between waist and height (WheiR) is considered to be a better index associated with CKD than WC, WHR. ${ }^{13}$ WheiR measure abdominal adiposity and was highly correlated with dual-energy x-ray absorptiometry (DEXA).

## MATERIALSAND METHODS

The present study was a cross sectional study. It was conducted at a private hospital with sample size 120 . CKD patients at stage $2,3 \mathrm{a}, 3 \mathrm{~b}$ and 4 were included in the study whereas dialysis and transplant patients were excluded. Ethical approval was taken prior from the institute and informed consent was signed by each patient before participation. All measures were done by standardised equipment's. Weight was taken by digital balance. Patients were asked to stand on
balance without footwear and socks, weight was recorded in kilogram Height of the patients was taken by microtoise. Patients were asked to stand erect just below the point of attachment of microtoise, nearest 0.5 cm was recorded. Once weight and height was measured, BMI was calculated as weight in kg divided by height in meter square. Waist circumference and hip circumference was measured by nonstretchable tape. WHR was calculated by dividing waist with hip circumference $[$ i.e. $\mathrm{WHR}=\mathrm{WC}(\mathrm{cm}) / \mathrm{HC}(\mathrm{cm})]$. Lately, ratio of waist and height have proved to be a better index associated with CKD. It is an effective and definite anthropometric index to measure abdominal adiposity. It was calculated as $[\mathrm{WheiR}=\mathrm{WC}(\mathrm{cm}) / \operatorname{Height}(\mathrm{cm})] .{ }^{13}$

## RESULTS

Mean height of the Chronic Kidney Disease (CKD) patients was $164.48 \pm 7.65 \mathrm{~cm}$, with significant difference ( $p<0.001$ ) between both genders; males ( $167.95 \pm 6.46 \mathrm{~cm}$ ), females $(157.53 \pm 4.44 \mathrm{~cm})$. At stage $3 \mathrm{a}, 3 \mathrm{~b}$ and 4 , significant difference in height was observed among males and females as given in table 1.

Table1: Mean height of patients at different stages

|  | Stage |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 2 |  | 3a |  | 3b |  | 4 |  |
|  | $\begin{array}{\|c\|} \hline \text { Male } \\ (\mathrm{n}=15) \\ \hline \end{array}$ | $\begin{array}{\|c\|} \hline \text { Female } \\ (\mathrm{n}=6) \end{array}$ | $\begin{array}{\|c\|} \hline \text { Male } \\ (\mathrm{n}=20) \\ \hline \end{array}$ | $\begin{array}{\|c\|} \hline \text { Female } \\ (\mathrm{n}=6) \end{array}$ | $\begin{gathered} \text { Male } \\ (\mathrm{n}=24) \\ \hline \end{gathered}$ | $\begin{array}{\|l\|} \hline \text { Female } \\ (\mathrm{n}=11) \end{array}$ | $\begin{gathered} \text { Male } \\ (\mathrm{n}=21) \end{gathered}$ | $\begin{array}{\|l\|} \hline F e m a l e \\ (n=17) \end{array}$ |
|  | $\begin{array}{\|c\|} \hline \text { Mean } \pm \\ \text { SD } \end{array}$ | $\begin{gathered} \text { Mean } \pm \\ \mathrm{SD} \end{gathered}$ | $\begin{gathered} \text { Mean } \pm \\ \text { SD } \end{gathered}$ | $\begin{gathered} \text { Mean } \pm \\ \mathrm{SD} \end{gathered}$ | $\begin{gathered} \text { Mean } \pm \\ \mathrm{SD} \end{gathered}$ | $\begin{gathered} \text { Mean } \pm \\ \text { SD } \end{gathered}$ | $\begin{gathered} \text { Mean } \pm \\ \text { SD } \end{gathered}$ | $\begin{gathered} \mathrm{Mean} \pm \\ \mathrm{SD} \end{gathered}$ |
| Height | $\begin{array}{\|c\|} \hline 166.38 \\ \pm \\ 7.75 \end{array}$ | $\begin{gathered} 159.6 \pm \\ 6.25 \end{gathered}$ | $\begin{gathered} 166.9 \pm \\ 6.08 \end{gathered}$ | $\begin{array}{c\|} \hline 156.6 \pm \\ 3.36 \end{array}$ | $\begin{array}{\|c\|} \hline 171.81 \\ \pm \\ 5.85 \\ \hline \end{array}$ | $\begin{array}{\|c} \hline 157.74 \\ \pm \\ 4.41 \end{array}$ | $\begin{gathered} 165.67 \\ \pm \\ 4.65 \end{gathered}$ | $\begin{array}{\|c\|} \hline 156.99 \\ \pm \\ 4.22 \end{array}$ |
|  | 0.073 |  | <0.001* |  | <0.001* |  | <0.001* |  |
| *p value significant |  |  |  |  |  |  |  |  |

In the present study, mean present weight of the CKD patients in the study was $72.62 \pm 15.20 \mathrm{~kg}$. There was a significant difference ( $\mathrm{p}=$ 0.002 ) in weight of females $(66.66 \pm 14.44 \mathrm{~kg})$ as compared to males $(75.61 \pm 14.76 \mathrm{~kg})$. Significant difference $(\mathrm{p}=0.028)$ in weights was also observed between patients of stage $2(80.48 \pm 16.48 \mathrm{~kg})$ and stage 4 $(69.94 \pm 16.72 \mathrm{~kg})$. At all stages, weight of males was higher than females. BMI, was used as a proxy index of thinness and fatness of CKD patients. Mean BMI of the patients with present weight and height was $26.83 \pm 5.35 \mathrm{~kg} / \mathrm{m} 2$. Out of 120 CKD patients, $36 \%$ were in normal category, whereas $62 \%$ were pre-obese and obese. Independent t test was used to observe differences in BMI as per stages of the disease (table 2). Significant difference ( $p=0.029$ ) was noted between stages for BMI, where at stage 4, BMI was $26.70 \pm 6.0 \mathrm{~kg} / \mathrm{m} 2$ whereas at stage 2, it was $29.80 \pm 6.05 \mathrm{~kg} / \mathrm{m} 2$. At later stage of disease, BMI of CKD patients was lower. BMI, hence may help in assessing effect of disease progression on nutritional status of CKD patients.

Table 2: Stage wise comparison of height, weight and BMI of CKD patients

|  | Stages of Disease |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Stage 2 $(\mathrm{n}=21)$ | Stage 3a $(\mathrm{n}=26)$ | $\begin{gathered} \text { Stage 3b } \\ (\mathrm{n}=35) \end{gathered}$ | Stage 4 $(\mathrm{n}=38)$ | $\underset{\text { value }}{\mathbf{p}}$ |
|  | Mean $\pm$ SD | Mean $\pm$ SD | Mean $\pm$ SD | Mean $\pm$ SD |  |
| $\begin{gathered} \text { Height (in } \\ \mathrm{cm}) \end{gathered}$ | $\begin{gathered} 164.44 \pm 7 \\ 85 \end{gathered}$ | $\begin{gathered} 164.52 \pm 7 . \\ 07 \end{gathered}$ | $\begin{array}{\|c} 167.39 \pm 8 \\ 53 \end{array}$ | $\begin{gathered} 161.79 \pm 6 . \\ 20 \end{gathered}$ | 0.019 |
| $\begin{gathered} \text { Weight (in } \\ \mathrm{kg}) \end{gathered}$ | $\begin{gathered} 80.48 \pm 16 . \\ 48 \end{gathered}$ | $\begin{gathered} 68.52 \pm 10 . \\ 05 \end{gathered}$ | $\begin{gathered} 73.88 \pm 14 . \\ 48 \end{gathered}$ | $\begin{gathered} 69.94 \pm 16 . \\ 72 \end{gathered}$ | 0.028* |
| $\begin{gathered} \hline \text { Present } \\ \text { BMI }(\mathrm{kg} / \\ \left.\mathrm{m}^{2}\right) \end{gathered}$ | $\begin{array}{\|c} 29.80 \pm 6.0 \\ 5 \end{array}$ | $25.31 \pm 3.5$ 2 | $\begin{gathered} 26.33 \pm 4.7 \\ 9 \end{gathered}$ | $26.70 \pm 6.0$ | 0.029* |
| $\begin{gathered} \mathrm{SD}=\text { Standard deviation } \\ \text { *p value significant at }<0.05 \end{gathered}$ |  |  |  |  |  |

Mean waist circumference (WC) of the CKD patients in the present study was $100.91 \pm 14.55 \mathrm{~cm}$. Comparing two genders, females in the present study group had WC, $98.59 \pm 14.19 \mathrm{~cm}$, whereas males had $102 \pm 14.67 \mathrm{~cm}$, however there was no significant difference between both the genders. For both males and females of present study, values were on the higher side. In addition, males had higher WC than females. This shows that patients of the present study had higher WC than patients of other studies and higher than the recommendation by Mishra et al., 2009 and International Diabetes Federation Criteria for ethnic or country specific values for waist circumference, where men should have WC 90 cm and women should have 80 cm .14 Mean Hip circumference $(\mathrm{HC})$ of the patients was $101.75 \pm 12.11 \mathrm{~cm}$. Females in the present study had higher $\mathrm{HC}(104.44 \pm 12.38 \mathrm{~cm})$ as compared to males ( $100.47 \pm 11.855 \mathrm{~cm}$ ) with no significant difference. On computing waist and hip ratio, mean WHR for CKD patients was $0.99 \pm 0.09 \mathrm{~cm}$. In the present study, highest WHR was noted in stage 2 patients and in patients with age more than 65 years. It has been observed that WHR values at stage 4 was lower than earlier stages, however, difference was not significant. The only significant difference ( $\mathrm{p}<0.001$ ) was obtained between males (WHR= $1.02 \pm 0.09$ cm ) and females ( $\mathrm{WHR}=0.94 \pm 0.07 \mathrm{~cm}$ ).

Mean WheiR of the CKD patients was $0.633 \pm 0.01 \mathrm{~cm}$. Females had higher WheiR $(0.626 \pm 0.15)$ as compared to males $(0.61 \pm 0.01)$ with no significant difference.

## DISCUSSION

In the present study, anthropometry represents body size as well as gross body composition of patients with CKD. In CKD, inflammatory markers are not stable, which could affect visceral proteins (biochemistry). ${ }^{15}$ Therefore, somatic protein status needed to be assessed. Anthropometry hence became an important, valid and clinically useful measure for determining nutritional status of CKD patients. In other studies, mean weight at stage 2 was $66.5 \pm 13.4 \mathrm{~kg}$, whereas patients at stage 4 had $58.7 \pm 9.9 \mathrm{~kg}$, however the difference was not significant. ${ }^{16}$ The results were similar to the present study. With severity of illness, possibly there could be weight reduction due to anorexia, poor food intake, and loss of muscle mass. According to WHO, 2004, BMI is a very well accepted measure of obesity.' In the present study, BMI emerged to be a very useful measure in predicting obesity related higher risk of kidney disease. Waist circumference (WC) is an index of upper body adiposity and is more sensitive, ${ }^{17}$ simple, better predictor of visceral fat and is related with less measurement errors as compared to waist hip ratio. ${ }^{18}$ Other studies report mean WC among non-dialysed patients as $84.6 \pm 10.7 \mathrm{~cm}$, ${ }^{19}$ $87.4 \pm 9.9 \mathrm{~cm} 20$ and $94.2 \pm 12.2 \mathrm{~cm},{ }^{14}$ i.e. lower than the value obtained in the present study. Asian Indians have higher upper body adiposity and higher visceral fat, and this could be the reason of higher waist circumference. Other studies report lower values of WC for both male and female non-dialysis patients, i.e. males: $92.5 \pm 10.9 \mathrm{~cm}$ and females: $87.3 \pm 11.7 \mathrm{~cm}$, statistically significant with $\mathrm{P}<0.001 .^{13} \mathrm{~A}$ study by Sanches et al., 2008, reported WC of non-dialysed patients as for males: $94.5 \pm 10.3$ and females: $93.8 \pm 14.9$ with no significant difference. ${ }^{21}$

WHR in other studies was reported as $0.88 \pm 0.07 \mathrm{~cm}^{19}$ and $0.9 \pm 0.07 \mathrm{~cm} .{ }^{20}$ A study reported WHR of non-dialysed males as $0.97 \pm 0.07$ and females as $0.91 \pm 0.09$, statistically significant at $\mathrm{p}<0.0001 .{ }^{13}$ WHR of patients in the present study was higher than the previous finding, as well as higher than the recommendation by Snehlatha for healthy Asians (males: 0.89 and 0.81 for women). ${ }^{17}$ In a study the best WheiR cut off point for the outcome of high Homeostatic Model Assessment- Insulin Resistance (HOMA-IR) value was 0.55 for
non-dialysed patients. ${ }^{13}$ Compared to this, the value of WheiR in the present study was higher for abdominal obesity putting patients in high risk for coronary diseases. Another study reported similar findings with WheiR in men: $0.56 \pm 0.07$ and females: $0.57 \pm 0.08 .{ }^{13}$ As compared with the reference values for non-dialysed patients (males: 0.52 and females: 0.53 ), 13 present study patients appeared to be obese.

## CONFLICT OF INTEREST: None

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