

[ORIGINAL ARTICAL]**Intra-rater and inter-rater reliability of bodyComposition analyzer in young adults aged 18-25 years**Mehta Arshi¹, Limbasiya Jalak², Pambhar Bansi³, Desai Henu⁴, Trapasiya Dipali⁵¹ Assistant Professor, ^{2,3,4,5} Clinical therapist, Shri Bharatimaiya college of Optometry and Physiotherapy, Surat.**ABSTRACT :**

Background: Bodecoder (model no.CHL-818E) is a body impedance analyzer for clinically assessing body composition, but psychometric properties of which has not been tested for clinical purpose. The study aims to determine intra-rater and inter-rater reliability of body composition components of equipment in healthy adult population.

Methodology: The examination of 125 healthy young adults (18-25 years) performed by trained raters using the bodecoder equipment. For intra-rater reliability, same rater performed the examination on three alternative days at the same time. For inter-rater reliability, 2 different raters performed examination on 2 different days at same time.

Result: ICC value for inter-rater and intra-rater was excellent for weight (0.986- 0.994), BMI (0.901-0.996), VFI (0.980-0.996), TBW% (0.974-0.988), BMC (0.967- 0.995) and BMR (0.970-0.987), whereas found good for SM% (0.864-0.856) and moderate for ULB (0.563-0.699). Here, TBF% (0.300-0.987) showed poor inter-rater reliability and excellent intra-rater reliability. Whereas, BB (0.465- 0.679) showed poor inter-rater reliability and moderate intra rater reliability. But, LLB showed both poor intra-rater and inter-rater reliability.

Conclusion: It is evident that Bodecoder equipment can be used for examining body composition components, but cannot be considered for examining total body fat percentage as well as balance components.

Keywords: Body-composition, BIA, reliability, adults, Bodecoder, Total-bodyfat.

Introduction:

Physical fitness can be referred in different terms such as it can be a set of attributes that people have or achieve that relates to the ability to perform physical activity, whereas in other terms it refers to any body movement produced by skeletal muscles that results in energy expenditure. It can be described in two components, i.e., health-related fitness components and skill related fitness components.^[1] Here, health related fitness includes five components: cardiovascular endurance, muscular strength, muscular endurance, flexibility and body composition.^[2]

Body composition refers to the relative amount of fat versus fat free body mass.^[2] A healthy body composition indicates that you may have less risk of developing obesity-related diseases, such as

diabetes, high blood pressure, and even some cancers.^[3] Assessment of body composition is crucial for the determination of nutritional status in both healthy individuals and patients. It is also necessary for the progress monitoring in weight loss, fitness assessment, rehabilitation programs and others.^[4] With the increasing prevalence of obesity, change in lifestyle, diseases, there is increased need for body composition methods with greater sensitivity and precision.^[5,6] Accurate measurement of muscle mass and strength is also important to identify individuals at risk and plan appropriate interventions. Different methods have been developed to determine the body composition with different physical principles, using different models and assumptions.^[7,8]

Field methods are most commonly used for assessing the body composition as users want simple,

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inexpensive, rapid, safe and accurate method, such as, Body Mass Index (BMI), Waist-hip ratio (WHR), Skinfold test and Body Impedance Analyzer (BIA).^[9-13] BIA is currently a widely used method for evaluating body composition in epidemiological studies conducted in the community.^[14] Bodecoder (model no.: CHL-818E) is one such equipment clinically available which has been designed to assess the body composition of 10-90 years old population. It is non-medical, non-invasive application.^[15]

Although the psychometric properties of the equipment had not been still examined. Moreover, The review study suggest that the changes are being observed in body composition with aging, particularly altered components such as fat mass distribution.^[16] Young adults are considered to be the phase where identifying the proper body composition can lead to proper management of the physical fitness with aging. So, the aim of this study is to determine the intra-rater and inter-rater reliability of body composition components of bodecoder equipment in healthy adult population aged 18 to 25 years.

Methodology:

A correlation study was carried out among purposively selected young adults aged 18 -25 years at Shri Bharatimaiya college of optometry and Physiotherapy. The participants were excluded if they were below 18 years of age and above 25 years of age, who has ongoing any kind of diet plans, carrying out any kind of fitness activity, any other systemic condition which affects the components of body composition or who refuse to participate.

Based on sample size calculation, where, $k=3$ and $CA0=0.50$, based on $\alpha < 0.05$ and power of 90.0%, a minimum of 123 is required to detect $CA1=0.70$, where k refers to the number of times analysis will be carried, $CA0$ refers to the Cronbach's alpha in null hypothesis and $CA1$ refers to the Cronbach's alpha in alternative hypothesis. Considering the dropout rate, which was assumed to be 5-10%, a questionnaire screening of total 140 subjects was carried out, out of which 137 subjects were included in the study, out of which 125 participants completed the study and other 12 participants dropped out from the study.^[17]

Procedure:

After explaining about the importance of research and the procedure for body composition analysis to

the participants, the written consent was taken for collecting the data. For inclusion in the study, they were screened using a self-administered questionnaire along with the demographic data such as name, age, gender, date of birth, height (using stadiometer) and health condition related questions.

For intra-rater reliability the analysis was performed by the same rater R1 who has been trained for using the bodecoder equipment on day one, day three and day five. The data were gathered at the same time on all the three days to avoid temporal variations.

For inter-rater reliability, the analysis was carried out by two raters, R1 and another co-researcher R2. Both the raters were trained for using the bodecoder equipment. Both the rater stored their data in different folders of the device; both raters were blinded to the score taken by each other.

Bodecoder equipment (fig-1):

It is non-medical, non-invasive application. It measures 5 segment (upper left and right limb, lower left and right limb and trunk) which is measure by 8-point tactile electrode in 10 seconds. It carries the frequency of 50KHZ and 0.5 mA current which measures accurate body composition. Its weight measurement capacity ranges from 2.5kg to 150 kg, height measurement capacity ranges from 100-210 cm and can be performed in male & female both.^[15] Following components are involved in bodecoder measurement system: Weight, BMI, Total Body fat percentage (TBF%), Total body water percentage (TBW%), Visceral Fat Index (VFI), Skeletal muscle percentage (SM%), Bone mineral capacity (BMC), Basal metabolic rate (BMR), Upper limb balance (ULB), Lower limb balance (LLB) and Body balance (BB).

The equipment provides the data using the application of bodecoder which can be installed in laptop, computer or smart phones. After installation, the registration of the user needs to be done which as shown in fig-2. After the registration of the subject, by entering the user Id and the password, window for the analysis will open (fig. 3).

After which the examination, according to the command being displayed on the window with the proceeding steps (fig. 4). Guidelines for procedure and safety precautions were explained to the subjects. The step wise examination was carried out as per the basic guide obtained with Bodecoder (model no.: CHL-818E).^[15]



Fig. 1 : Bodecoder equipment

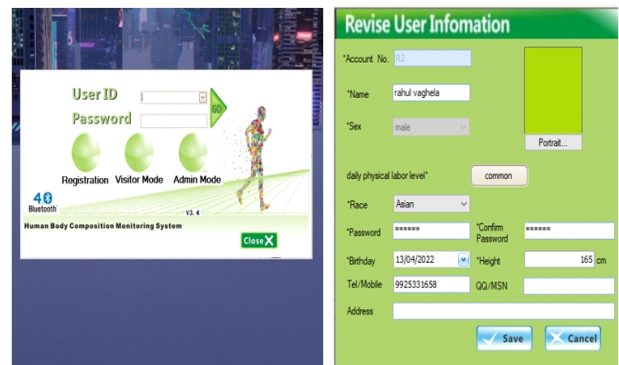


Fig. 2 : Registration process in Bodecoder equipment

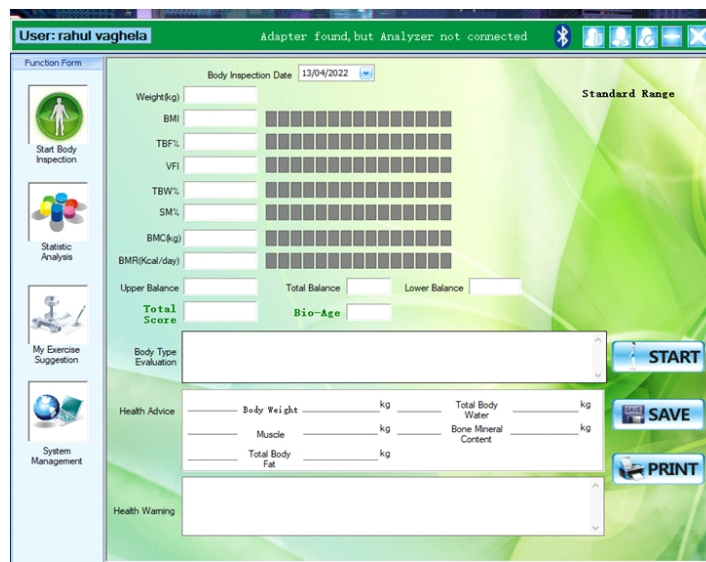


Fig. 3 : For starting body inspection

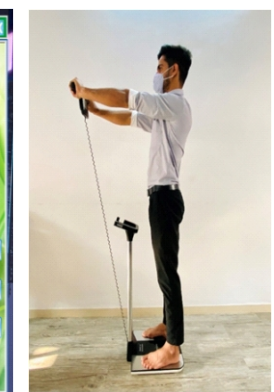
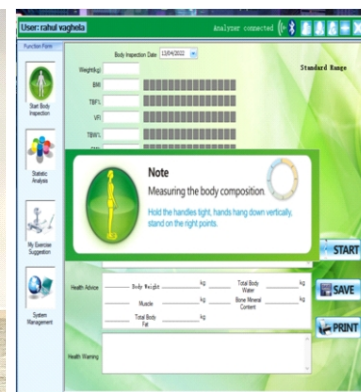
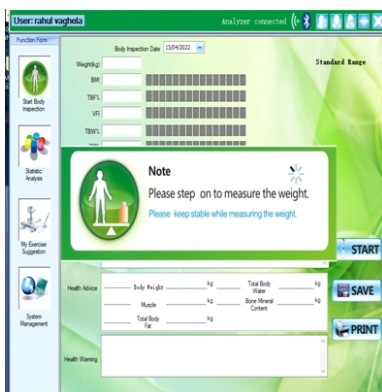


Fig. 4 : Analyzing body composition

Data analysis and result:

In this study, the analysis was carried out in SPSS version 21. The data of 125 participants out of 137 was analysed and dropouts were not included in the descriptive and correlation coefficient analysis. The analysis of demographic data was carried out using the descriptive statistics i.e., mean and standard deviation, is as shown in table-1. There were 18 male

participants and 107 female participants. The Cronbach's Alpha was used for carrying our inter-rater reliability and for intra-rater reliability, Intra-class correlation coefficient (ICC) was used for 11 components of body composition. The result which were obtained were considered significant if the value of <math><0.05</math> and the confidence interval of 95%.

	N	Minimum	Maximum	Mean	Std. Deviation
Participant's Age (years)	125	18	24	20.62	1.49
Participant's Height (cms)	125	136.00	179.00	158.06	7.82

Inter-rater reliability:

Hereby, table-2 shows the data of analysis for inter-rater reliability of the components. The ICC value for variables weight, BMI, VFI, TBW%, BMC AND BMR showed the excellent inter-rater reliability. The ICC value for variable SM% showed a good interrater reliability, whereas, ULB variable showed a moderate reliability. TBF% and BB variable showed a poor inter-rater reliability having ICC value <0.5. Here, LLB variable showed a negative ICC value stating a true low inter-rater reliability having ICC value -0.162.

Variable	Mean	Minimum	Maximum	Cronbach's Alpha (ICC)
Weight (years)	54.66	54.58	54.74	0.986
BMI (kg/m ²)	21.72	21.69	21.75	0.901
TBF%	29.62	28.84	30.04	0.300
VFI	3.56	3.52	3.06	0.980
TBW%	49.09	48.97	49.21	0.974
SM%	30.69	30.03	31.08	0.864
BMC (kg)	2.10	2.09	2.10	0.967
BMR (kcal/d)	1199.13	1195.92	1202.33	0.970
ULB	1.44	1.40	1.47	0.563
BB	1.09	1.05	1.13	0.465
LLB	1.28	1.23	1.32	-0.162

Intra-rater reliability:

Hereby, table-3 shows the data of analysis for intra-rater reliability of the components. The ICC value for variables weight, BMI, TBF%, VFI, TBW%, BMC and BMR showed an excellent intra-rater reliability. The ICC value for variable SM% showed a good intra-rater reliability. The ICC value for variable ULB and BB showed a moderate intra-rater reliability. Whereas the ICC value for variable LLB showed a poor reliability with value <0.5.

Variable	ICC	CI (Lower)	CI (Upper)
Weight (years)	0.994	0.991	0.995
BMI (kg/m ²)	0.996	0.995	0.997
TBF%	0.987	0.982	0.990
VFI	0.996	0.995	0.997
TBW%	0.988	0.983	0.991
SM%	0.856	0.808	0.896
BMC (kg)	0.995	0.993	0.996
BMR (kcal/d)	0.987	0.982	0.990
ULB	0.699	0.595	0.780
BB	0.697	0.591	0.778
LLB	0.456	0.267	0.603

Discussion:

The procedure used in this study was a correlation method in which the intra-rater and inter-rater reliability was identified for bodecoder equipment. For intra-rater reliability the data was collected on three alternate days keeping a longer time interval, as the body composition components were considered as having the stable characteristic, for that period of time, as even the subjects with any kind of diet or fitness program were excluded from the study.

The possibility of having more female subjects than male subjects, could not be possibly attributed to any specific reason but to the availability of the patients in random screening. Here, the components weight, BMI, VFI, TBW%, BMC and BMR showed an excellent intra-rater and inter-rater reliability suggesting that the clinical decision regarding the physical activities can be planned on basis of the examination carried out using the bodecoder equipment. The SM% also showed a good intra-rater and inter-rater reliability which leads to accurate and consistent calibration for clinical decision making.

But the component TBF% showed an excellent intra-rater reliability, but a poor inter-rater reliability suggesting that the consistency is good when examined with the same rater but not with different examiners. The possible reasons might be the calibration of the equipment not considering the training of the examiners, as the equipment works on the 8-point tactile sensor system.^[15] There are various other field methods proven to be standard and with high calibration for examining total body fat percentage which can be utilized for clinical practice.^[18]

On addition there were balance components are also being examined using the bodecoder equipment. The reliability result of ULB and BB component showed a moderate and poor reliability. Also, the LLB component showed poor intra-rater and inter-rater reliability. The possible reasons might be the posture of the individual while standing on the equipment or tilting while holding the handle vertically down or the pressure distribution over the sensor area while analysing process. This might affect the clinical decision making for good clinical practice. So, either the results must necessarily be correlated with the clinical methods of analysing results which have been proven to be the standard method for assessing the balance.^[19]

There was also binded with few of the

limitations such as psychometric properties like specificity and sensitivity were not included. As only healthy adults were taken in the study, the result might get affected by the population having systemic conditions. The age group selected was 18-25 years of healthy young adults, so this results cannot be applied to age below 18 years and above 25 years. Although the sample size was calculated with appropriate technique for the present study, but sample size might not be adequate for generalizability of the results as the sample selection for the present study was done within limited time constraints.

Further study is recommended for other different age group for generalizing the result, providing the use of equipment for all age group of population. Also, the physical activity can be planned using the body composition analysis report and the changes can be observed using the bodecoder equipment. The changes can be observed with the individuals having affected body composition.

Conclusion:

The results of this demonstrate that the bodecoder body impedance analyzer has an excellent intra-rater and inter-rater reliability for body composition components, i.e., weight, Body mass Index, Total Body Water percentage, Visceral Fat Index, Bone Mineral Capacity and Basal Metabolic Rate. But for total body fat percentage, it demonstrated an excellent intra-rater reliability but a poor inter-rater reliability. So, it can be taken into consideration if analysis is performed by the same rater or a different field method can be used to examine the total body fat percentage. For three added balance components in BIA bodecoder equipment, showed moderate to poor reliability, which is suggestive of using other standard procedure for analyzing upper limb, body and lower limb balance than this equipment. So, Bodecoder can be used separately for examining the body composition components excluding balance components.

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