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*Building an evaluation model of physical health in women aged (35–50) years based on some anthropometric indicators*

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**ABSTRACT**

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**Keywords:**  
*evaluation model, physical health, women, anthropometric indicators*

Physical health is one of the main pillars of overall human health, especially in middle-aged women (35–50 years), due to physiological and hormonal changes that may affect physical fitness and health status. This research aims to build a physical health assessment model based on a set of anthropometric indicators including body mass index, waist ratios, thickness of skin folds, and periphery. The research used the descriptive correlational approach, and the data was collected from a sample of 80 women within fitness programs in Baghdad, with the application of standard measurement tools such as the Calibre skin fold measurement device and the measuring tape. The results of the analysis of the main components showed that four basic factors explain the overall variation in the data, where the factor of thickness of skin folds was the most influential by 35.888%, followed by the relative factor, body circumference and fat storage factor. These results confirm that anthropometric measurements provide accurate and objective indicators for assessing physical health in middle-aged women. The researcher concluded that the proposed evaluation model can be relied upon as a practical tool to accurately and reliably determine levels of physical health. It recommended the application of this model in preventive and evaluation programs to guide women towards healthy lifestyles and improve their quality of life and general health.

### 1-1 Introduction and importance of the research:

Physical health is one of the main pillars of general human health because of its active role in enhancing the efficiency of functional devices and the ability to perform the requirements of daily life efficiently and independently. The importance of paying attention to physical health increases in middle-aged women, especially in the age group (35–50) years, due to the physiological, hormonal and structural changes that may be directly or indirectly reflected in the level of physical fitness and the general health condition. This is a sensitive transitional phase in a woman's life, in which indicators of functional decline gradually begin to appear if they are not accompanied by healthy lifestyles and accurate assessments of physical condition. Anthropometric measurements are an important scientific means used to describe and build a clear picture of the human body structure because of its simplicity, accuracy and wide applicability. These measurements contribute to the early detection of changes that may occur in the body, such as an increase in the percentage of fat or a change in the distribution of muscle mass, factors that are closely related to physical health and the risk of chronic diseases. Anthropometric indicators are also an important tool in the health, sports and rehabilitation fields because they provide objective data on which to base assessments and follow-up. Despite the multiplicity of studies that dealt with physical health or body measurements separately, there is still a need to build an integrated scientific evaluation model based on a selection of anthropometric indicators to assess physical health in middle-aged women in a systematic and accurate manner. The existence of such a model contributes to diagnosing the health and physical reality of this age group and identifying the strengths and weaknesses in a quantifiable manner, which allows the development of preventive and intervention programs based on clear scientific foundations. Hence, the idea of this research stems from building an evaluation model of physical health in women aged (35–50) years based on some anthropometric indicators because of the importance of this trend in supporting efforts to promote women's health and reduce health problems associated with aging. This research also contributes to bridging a knowledge gap related to linking physical indicators to the level of physical health within a clear evaluation framework that can be used in the academic and applied fields. In that it contributes to providing a scientific evaluation model that can be relied upon to diagnose the level of physical health in middle-aged women based on accurate and objective anthropometric indicators. This model helps to provide a comprehensive picture of physical condition away from personal estimates or non-standard methods, which enhances the accuracy and reliability of the results. His contribution to supporting health and sports institutions with a clear scientific mechanism that can be used in the evaluation, follow-up and planning of health and physical programs for women aged (35–50) years. This is of great value in promoting the prevention of health

problems associated with overweight, physical inactivity and body composition disorders that may appear at this age. Moreover, this research is of practical importance, as its results can be used to guide women towards adopting healthy lifestyles based on scientific foundations by identifying their current physical level and working to improve it, which positively reflects on the quality of life and public health. Therefore, building a physical health evaluation model based on anthropometric indicators is an important step in advancing women's health in middle age and achieving sustainable health development.

### **1-2 Research Problem:**

Physical health is an essential aspect that is receiving increasing attention among women because of its direct impact on the quality of life and the ability to perform life and social roles efficiently. Recent years have witnessed a significant increase in the awareness of middle-aged women, especially the age group (35–50) years, of the importance of maintaining physical health and searching for scientific means to help evaluate and improve it. This is due to the physiological and structural changes that women are exposed to at this stage that may affect the structure of the body, the level of physical fitness and general health. Despite this growing interest in women's physical health, methods of evaluating physical health still often rely on general indicators or inaccurate estimates that lack objective scientific foundations. Hence, the problem of research emerged as the researcher noted a lack of evaluation models that rely on clear and specific anthropometric indicators through which the level of physical health can be accurately quantified. Determining the real reality of physical health among women aged (35–50) years and not making optimal use of the efforts made in the field of prevention and planning of health and physical programs. Hence, the problem of research is determined by the need to build a scientific evaluation model of physical health in women aged (35–50) years based on some anthropometric indicators, which contributes to providing an accurate and objective tool to assess the physical condition and diagnose it in a clear scientific way.

### **1-3 Research Objectives:**

- 1- Building an evaluation model of physical health in women (35–50) years old based on some anthropometric indicators
- 2- Identifying the level of some anthropometric indicators in women aged (35–50) years to determine the level of physical health in women aged (35–50) years
- 3- Extracting an evaluation equation or criterion that can be used to assess the physical health of women in this age group

### **1-4 Research Hypotheses:**

- 1- An evaluation model of physical health in women (35–50) years old can be built based on some anthropometric indicators
- 2- There is a statistically significant relationship between some anthropometric indicators and the level of physical health in women aged (35–50) years
- 3- Selected anthropometric indicators contribute to varying degrees in predicting the level of physical health in women (35–50) years old

### **2-1 Research Methodology:**

There are many approaches used in scientific research, as each study has a curriculum that suits the nature of its problem and its objectives and contributes to its systematic scientific treatment. The method means (following a set of logical and sequential steps in dealing with scientific problems, phenomena or issues with the aim of reaching accurate results and revealing the scientific truth. Accordingly, each research has its own approach to address its problem and achieve its objectives) (الكندري و عبد الدايم ، 1999 ، صفحة 107). Based on the nature of the research problem, the researcher adopted the descriptive approach in the method of interrelationships of a correlational nature because it is the most appropriate for the requirements of the study. (The descriptive analytical approach aims to characterize phenomena and analyze the conditions and relationships that contribute to their formation by collecting data from members of the studied community with the aim of determining the existing reality of a variable or a group of variables under study) (الهاشمي ، 1991 ، صفحة 139).

### **2-2 The research community and its sample:**

#### **2-2-1 Research Community:**

The research community was determined in a deliberate way, and they are among the participants in the fitness programs inside the fitness centers in Baghdad at the age of (35-50) years, as the research community takes the sample from it as it is "that part of the community that is selected according to scientific rules and principles so that it represents the community correctly." (السمك ، 1986 ، صفحة 64) The sample was chosen in a random way distributed over a sample of the exploratory experiment (4) women and a sample of (80) women who participated in the fitness and health programs to build an evaluation model for physical health

### **2-3 Means of collecting information used in the research:**

- Arab and foreign sources.
- Tests and Measurement
- Internet
- Expert interviews

#### **2-3-1 Appliances and tools used**

1. Medical scale to measure weight

1. Tape measure
2. Skinfold Caliper

## 2- 4 Steps to carry out the research :

### 2-4-1 Determining the anthropometric measurements of the research:

#### A. Relative Measurements of Body Composition:

1. Body Mass Index (BMI) is calculated from height and weight, and is a general indicator of weight status (thinness – normal – overweight – obesity).

$$(BMI) = \text{Weight (kg)} / \text{Length}^2 (\text{cm})^2$$

2. Waist to hip ratio (WHR): A strong indicator of fat distribution and chronic disease risk in middle-aged women measured by the following equation: (World Health Organization (WHO)., 2008, pp. 6-10)

$$\text{WHR} = \text{Waist circumference (cm)} / \text{Hip circumference (cm)}$$

3. WHtR : A relatively recent and accurate indicator of health risk associated with central obesity measured by the following equation: (Ashwell & Gibson, 2016, pp. 90-120)

$$\text{WHtR} = \text{Waist circumference (cm)} / \text{Length (cm)}$$

#### B- Measuring the thickness of subcutaneous fat layers

To take measurements and use the subcutaneous fat layer thickness meter, the following instructions are strictly followed:

1. Hold the appliance with the right hand from the designated place ( the handle ) and open it to the maximum extent possible (the maximum dimensions of both ends of the appliance).
2. Holding and lifting the skin fold to be measured with the thumb and index finger of the left hand from an area about 2 cm away from the place of measurement (to separate the skin fold from the muscles and prepare them for arrest by the ends of the device ), taking into account the direction of the skin fold ( head - oblique ) .
3. Place both ends of the device gently on both sides of the skin fold trapped by the thumb and index finger of the left hand and release the device to settle its ends holding the sides of the skin fold and then read the indicator directly .

After reading the indicator, the ends of the device are gently removed from the skin and pulled out slowly to avoid scratching the skin. The (حسانين , & ابو العلاء احمد ) 1997, pp. 333-335) measurement sites are special measurements of the area of fat compactness, including the area of:

- 1- Triceps
- 2- Measuring the thickness of the skin fold of the suprailiac muscle
- 3- Measuring the thickness of the skin fold of the thigh muscle (Thigh)

### **C- Measurement of ocean measurements (cm)**

Measurement method: Measured using a non-stretchy measuring tape. The examiner stands barefoot, in an upright position, the heels are close together, and the head is in a horizontal plane and the reading is recorded to the nearest (0.1) cm. These included: (شحاته و آخران، 1998، الصفحات 69-72)

- 1- Measuring the circumference of the humerus ,
- 2- Thigh circumference measurement
- 3- Leg circumference measurement

### **2-5 Reconnaissance experiment**

Due to the validity, reliability and objectivity of the anthropometric measurements related to the subject of the study, and their wide use has been proven in many scientific researches and studies, the researcher conducted a exploratory experiment on Wednesday, 4/2025, with the aim of achieving the organizational and administrative requirements for research procedures. This experiment was carried out on a sample of ten women aged between (35–50) years. The exploratory experiment aimed at organizing the progress of the anthropometric measurements process, ensuring the validity and efficiency of the devices and tools used, as well as providing the assistant team with experience and familiarity in implementing the measurements accurately, in addition to identifying the appropriate arrangement for conducting body measurements to ensure accurate and reliable results.

### **2.6 Key Experience.**

In order to implement the anthropometric measurements of the research, the researcher took a set of administrative and organizational measures necessary to ensure the proper functioning and accuracy of the results. Prior coordination was made with the departments of some fitness centers in the city of Baghdad for the purpose of obtaining official approvals and determining where to take measurements, as well as selecting the appropriate sample of women between the ages of (35–50) years. Coordination was also made with the trainers and administrators working in those centers to determine the appropriate dates for the implementation of the measurements, in line with the times of the presence of the target sample. The researcher began implementing anthropometric measurements from Sunday, //2025 to Wednesday, // 2025, taking into account the provision of appropriate conditions for accurate and regular

measurements. During the implementation, the researcher took into account the standardization of measurement procedures, the use of the same devices and tools for all members of the sample, in addition to explaining the measurement mechanism to the participants and providing them with the necessary privacy, in line with the nature of physical measurements. The measurements were conducted at close times to ensure the stability of the surrounding conditions, which contributed to obtaining accurate and reliable data that serve the objectives of the research.

## 2-7 Statistical means

The statistical data were processed using the SPSS statistical software

## 3-Presentation and discussion of the results

### 3-1 Presentation of the results of the specifications of anthropometric measurements for women aged (35-50) years

Table 1.

Shows the arithmetic mean and standard deviation of the specifications of anthropometric measurements for women aged (35-50) years

C	Search Variables	Arithmetic mean	Intermediary Name	Standard Deviation	Torsion coefficient	Lower value	Higher value
1	BMI	34	34	5	0.058	4.24	1
2	Waist to Hip Ratio	0.922	0.920	0.080	0.079	74%	1 10]
3	Waist-to-height ratio	575	575	0.070	0.047	42	72%
4	Thickness of skin fold of triceps muscle	40	38	12	0.241	18	65
5	Thickness of the skin fold of the suprailiac muscle	42	= 0.43	10	0.139	20	
6	Thickness of the skin fold of the quadriceps muscle	44	45	10	0.345	21	64
7	Measuring the circumference of the humerus	6	42	6	128[	31	58%

8	Thigh circumference measurement	6	5	9	221	45	86%
9	Leg circumference measurement	47.6	48	5	175	36	58%

### 3-2 Correlation Matrix:

The matrix helps you identify variables that are related to each other before performing factorization or advanced statistical analysis. They reveal possible dimensions or factors, so that very related variables can be grouped within the same factor. It also helps to uncover independent or unrelated variables that may play a different role in the research.

Table (2)

Shows correlation matrix

Agent	1	2	3	4	5	6	7	8	9
1	1	.531	.601	.352	.385	.392	.439	184	.266
2	.531	1	.496	.284	287-344	101-200	.366	[133]	.284
3	.601	.496	1	.396	.319	EN 341	.450	216	.415
4	.352	.284	.396	1	.800	.789	.248	203	.261
5	.385	287-344	.319	.800	1	.748	223	.147	.139
6	.392	101-200	EN 341	.789	.748	1	222	113	135
7	.439	.366	.450	.248	223	222	1	140	140
8	184	[133]	216	203	.147	113	140	1	.625
9	.266	.284	.415	.261	.139	135	140	.625	1

The matrix in Table (2) shows that the variables (4, 5, 6) (thickness of the skin fold of the triceps muscle, thickness of the skin fold of the suprailiac muscle, and thickness of the skin fold of the quadriceps muscle) are strongly related to each other (0.748 – 0.800), indicating that they may represent the same dimension or latent factor. Factors (8, 9) (thigh circumference measurement and leg circumference measurement) are moderately related (0.625), while (7) (humerus circumference measurement) shows a weak negative correlation with factors (8, 9), indicating a different direction or

independent dimension. The variables (1, 2, 3) (BMI, waist-to-hip ratio, waist-to-height ratio) show a moderate correlation to each other, but they are not very strong, which means they are partly related.

### 3-3 CMO and Partless Test:

The researcher used the Kamo and Bartles test and the result showed that (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) reached( 0.750) and a K2 score of (345.242) and the Bartles test reached (36) at a line level of (0.000)

### 3-4 Total Variance Explained

3

Shows the total explained variance

After rotation			Before rotating				Total intrinsic value of each component				
Cumulative Percentage	Contrast Ratio	Total	Cumulative Percentage	Cumulative Percentage	Contrast Ratio	Total	Cumulative Percentage	Cumulative Percentage	Contrast Ratio	Total	Agent
268.797	// 61	// 61	236.654	53	53	268.797	// 61	// 61	// 61	268.797	1
0.68	15	76	845	13	67	0.68	15	76	15	0.68	2
31	7	84.265	72%	16.	84.142	31	7	84.265	7	31	3
24	5	89	25	5	89	24	5	89	5	24	4
								94%	4	20	5
								98	3.	15	6
								99	1	8	7
								100		.003	8
								100	000		9
3.	35	35	2	27	27	3.	35	// 61	// 61	268.797	1
1	18	54	2	24	51	1	18	76	15	0.68	2
1	17	71%	1	19	71%	1	17	84.265	7	31	3
297.	3.	74%	.296	3.	74%	297.	3.	89	5	24	4
								94%	4	20	5
								98	3.	15	6
								99	1	8	7
								100		268.797	8
								100	000	0.68	9

Table (3) of the explained total variance shows the extent to which the extracted components are able to explain the variance in the data. The first components (1, 2) account for most of the variation, while the subsequent components contribute less. After rotation, the distribution of variance became clearer, making it easier to interpret each factor and relate it to variables.

### 3.5 Key Component Analysis (Factor Analysis)

Principal Component Analysis was performed to study the relationship between the variables in the research. Table (4) shows the extent to which the extracted components are able to interpret the variance for each variable

Demonstrates covariance

Agent	Original values of data before recycling		Standard Post-Rotation Values	
	Initial	Extraction	Initial	Extraction
1	20	11	1	// 59
2	0.004	0.001	1	SUGV 325
3	0.003	0.002	1	0.471
4	106	93%	1	885
5	104	101	1	0.976
6	41	89	1	0.958
7	31	28	1	0.921
8	51	14.	1	0.895

Table (4) shows that the majority of the variables are well explained by the extracted components, which supports the validity of the analysis and increases the reliability of the results. Variables with high values after covariance extraction are (5, 6), (0.976 and (0.958), indicating that the extracted components explain most of the variation in these variables, which means that they are strong and important elements in the structure of the factors. Variables with lower values after extraction, such as (2) (0.325), indicate that only a small fraction of the variance is explained by the components, and therefore may be less influential or need to be revised for measurement.

### 3-6 Component matrix after rotation (PAFA matrix):

Table (5) of the component matrix after rotation shows how the variables were distributed to the components after rotation. Each component represents a specific dimension, and variables with high values in the component itself contribute mainly to its interpretation. This makes it easier to interpret the factors and relate them to the variables in the research.

Ager	1	2	3	4	1	2	3	4
6	8	2	.233	3.	.897	230	.024	-.315
4	9	3.	1	128[	.878	300-400	0.152	.012
5	8	2	.334	3.	.866	.271	.033	.389
7	.053	5	1	219	.010	3	-.304	3
1	.917	3.	670	250	203	.723	.149	-.056
3	.012	.035	.013	.005**	202	.609	.227	-.084
2	.009	.033	.008	.010	145	.512	128[	161
8	.425	.890	6	.473	.059	.124	.933	.066
9	.564	.773	4	-.310	100	.138	.824.	-.055

The results showed that there are four basic factors for building an evaluation model of physical health in women aged (35–50) years, depending on some anthropometric indicators. The four factors were reached, namely:

- 1- The first factor is called the skin thickness factor and includes
  - Percentage thickness of the skin fold of the quadriceps muscle 35.888 %
  - Thickness of the skin fold of the triceps muscle
  - Thickness of the skin fold of the suprailiac muscle
- 2-The second factor is called the proportional factor and includes
  - BMI % 18.300%
  - Waist-to-height ratio
  - Waist to Hip Ratio
- 3-The third factor, called the ocean factor, includes:
  - Thigh circumference measurement in % 17.298%
  - Leg circumference measurement
  - Measuring the circumference of the humerus
- 4-The fourth factor is called the thickness factor
  - Percentage thickness of the skin fold of the suprailiac muscle 3.299%
  - Thickness of the skin fold of the quadriceps muscle
  - Measuring the circumference of the humerus

### 3-7 Conversion Matrix for Components

Table (6) of the transformation matrix of the components shows how to modify the extracted components to make each component more clearly interpreted. High values on the diagonal indicate that the new component resembles the original one, while small values indicate minor overlap with other components. This rotation makes factor analysis more straightforward and is useful in interpreting data and correlating variables with resulting factors.

Shows the transformation matrix of components

Agent	1	2	3	4
1	.928	.343	[136]	.042
2	[130]	-.044	.990	.031
3	-.342	.935	000	-.093
4	-.068	.075	-.037	.994

It shows how the components were rotated after extraction to make them clearer in interpreting the data. Each row represents the original component before rotation, and each column represents the new component after rotation. They represent the relationships or weights of the original components with the new components. It helps to explain the new factors clearly, that is, to know which variables contribute to each factor after rotation. It gives evidence of the success of recycling: each component after recycling represents a clear and relatively independent dimension from the other components

### 3-8 Discussion of the results:

The results of the data analysis in this study showed that the analysis of the main components was effective in determining the basic dimensions that explain the variation in anthropometric measurements related to physical health in women in the age group (35–50) years. These findings are in line with the scientific literature asserting that key component analysis is a statistical technique that can simplify a complex dataset and transform it into interpretable key components, holding as much original information as possible in the first dimensions. Anthropometric measurements are essential tools in the health and physical evaluation of humans, as the physical structure and body components represent strong elements that reveal health status and fitness-related changes across different stages of life. The results of this study showed that measurements that express the distribution of subcutaneous fat and body circumference and relative ratios such as body mass index and waist-to-hip ratio play an important role in explaining the variation in physical health in women in the age

group (35–50 years). In measuring the thickness of skin folds, it appeared as a key factor in the model, as the first component that explained the highest percentage of total variation in physical health data. This confirms that the thickness of the skin folds is an important indicator for measuring the distribution of subcutaneous fat, which is closely linked to health risks associated with excess fat or metabolic disorders. (González-Torres et al., 2023). (Measurements of the thickness of skin folds, such as suprailiac and bifurcate folds, are highly correlated with factors associated with the risk of metabolic syndromes and cardiovascular disease, even in individuals who are physically active or considered normal weights) )González ،López-Torres و ،Pérez-Lóp(1326 صفحة ،2023 ، and that the distribution of fat mass, and body measures such as waist circumference to height have had a significant impact in explaining the variation in different fitness states, and that reducing dimensions using the analysis of key components allows for the identification of variables that have the most impact on physical health and that measurements of skin fold thickness can be a better indicator for estimating body fat percentage compared to BMI alone, especially when studying the relationship between body composition and health functions. ( Sarría et al., 1998).that the sum of skin fold measurements (e.g. triple and quadruple fold) accounts for a higher portion of the variation in body density (Sarría, López, & Pérez, 1998, pp. 393–398) than just BMI), reinforcing the importance of using these values in health and research assessments In addition, that anthropometric body components, which include measurements of fold thickness, circumference, and proportions, are mainly used in assessing physical health and as indicators of fitness-related health, such as cardiorespiratory health and muscular endurance. Here he emphasizes (KamalDarwish et al.,1998) (The importance of physiological measurements is highlighted in that they enable the trainer to identify the physiological state of the individual depending on the results of these measurements, which are not an end in themselves, but are used as a means to evaluate the level of the individual and the training programs that he applies. These measurements contribute to revealing strengths and manifestations of development, both at the level of the individual himself or at the level of the training program prepared for him.) (درويش و وآخرون ، 1998 ، صفحة 81) They can be considered as primary diagnostic tools, easy to apply, and inexpensive compared to advanced laboratory methods, which makes them especially useful in this sense. The current results highlight the importance of the anthropometric measurement model as practical and reliable tools in evaluating women's physical health, especially in the studied age group. These measurements reveal the distribution of fat, body composition, and relative pattern of those indicators, which helps to understand more deeply the changing physical health factors with age and lifestyle.

## 4. Conclusions and recommendations:

### 4.1 Conclusions

- 1- Analysis of the main components showed that the first components (component 1 and component 2) (thickness of the skin fold of the thigh muscle and BMI) explain the bulk of the overall variance in the data
- 2- The results showed that the majority of the variables are well explained by the extracted components, which supports the validity of the analysis and increases the reliability of the results
- 3- The first component is a skin fold thickness factor represented by the skin fold thickness of the quadriceps muscle that accounts for about 35.888% of the variation after rotation.
- 4- The second component is the relative factor of BMI, waist-to-height ratio, and waist-to-hip ratio, and explains 18.300% of the variance
- 5- The third component is the ocean factor that measures the circumference of the thigh, and explains 17.298% of the variance
- 6- The fourth component, called the fat storage factor, measures the thickness of the skin fold of the suprailiac muscle, and explains 3.299% of the variation.
- 7- The researcher came up with the following model:  

$$\text{Model} = (\text{Thickness of the skin fold of the thigh muscle} \times 35.888 + (\text{BMI} \times 18.300) + (\text{Measurement of the circumference of the thigh} \times 17.298) + (\text{Thickness of the skin fold of the suprailiac muscle} \times 3.299)$$

### 4.2 Recommendations

- 1- Adopting the evaluation model for physical health, especially when designing prevention programs or improving physical fitness in women aged (35-50) years
- 2- Using the thickness of the skin fold as one of the basic indicators in the evaluation models of physical health, especially when designing prevention programs or improving physical fitness in women aged (35-50) years.
- 3- Relative indicators should be included when assessing the physical health of women (35-50 years), and used in future studies to determine the relationship between fat distribution and health risks
- 4- It is advisable to include ocean measurements in the evaluation models for women, at the age of (35-50) years, especially in studies aimed at determining the distribution of muscle and fat in the limbs
- 5- It is recommended to apply the evaluation model that combines the four components that explains most of the variation in the anthropometric

indicators for women (35–50 years), which proves the feasibility of using the analysis with the main components as a basis for building a reliable health model.

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