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DOSAGE OF THERAPEUTIC EXERCISE ACCORDING TOPATIENTS' RISK CHART DETERMINED BY BIOIMPEDANCE

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Abstract

Introduction. Recommendations regarding the correctness of the therapeutic exercisesmust take into account the patient's body composition, which can be evaluated by bioimpedance**.**

Material and method.21 outpatients were assessed using a single-frequency bioelectrical impedance analyzer (SF-BIA). Health outcomes such as fat mass (FM), fat-free mass imbalances (FFM), and skeletal muscle mass (SMM) were determined. SPSS software version 25 was used for statistical analysis.**Results and discussions.** Of the 21 subjects, there are 52.68% men, and 47.62% women.The mean age is 47.81 years ± 18.519 Std. Deviation, Body Mass Index (BMI) mean 26.38 ± 5.768, One-Sample T-Test Sig.<.001. Fat-free mass index (FFMI), fat mass index (FMI), and skeletal mass index (SMI) were computed by adjusting with height square. Measuring the variance by ANOVA with one independent variable - BMI and one response variable (FMI Types, FFMI Types), the results were statistically significant. For FMI TypesF(2,18)=9.255, Sig.<0.002, the measure of effect sizeEta Squaredη^2=50.7%, Cohen medium effect shows thatout of the total variation in BMI, the proportion that can be attributed to FMI Types is 50.7%. For FFMI Types F(2, 18)=10.943, Sig.<0.001, the measure of effect size Eta Squaredη^2=54.9%, Cohen medium effect shows that out of the total variation in BMI, the proportion that can be attributed to FFMI Types is 54.9%. FMI somatotype components results are 71.43% adipose cases, 19.05% intermediate, and 9.52% lean. One-Sample Chi-Square test applied to FMI

Types reveals the statistical significance of <.05(.001). FFMI somatotype components recorded 57.14% intermediate cases, 23.81% slender, and 19.05% solid. Regression equation of standard BMI and FMI with scatter plotstook into consideration the "chair stand test" for pre-sarcopenia with a result of84.5% No cases and 72.4% Yes cases. Nine patients exceeded 15 seconds at the chair stand test so probable sarcopenia was identified.Pearson correlation of BMI with FMI (r=.898), FFMI (r=.716) and SMI (r=.772), CI=99% Age (r=.518), CI=95% registered strong direct statistical significance. FMI also correlates with Age (r=.602), CI=95%, and FFMI with SMI (r=.984), CI=99%.

Conclusions. Dosage of the therapeutic exercises applied with cardiac parameters monitoring for FMI Adipose (n=15), FFMI Slender, and Intermediate (n=11) includesresistive, concentric exercises, low-medium intensityprogressive, pause integration for homeostasis balance,and a long period of rehabilitation for pre-sarcopenia (n=6). For FFMI Solid, eccentric exercise can be added, medium-high intensity, pause integration for homeostasis balance for a short period with cardiac reserve monitoring. The patient's risk chart regarding fat mass and skeletal muscle mass should be included in the rehabilitation process routine to avoid functional impairment and to improve global functionality.

Keywords: therapeutic exercises, body composition, rehabilitation, bioimpedance, fat-free mass index, fat mass index, skeletal muscle index

Introduction

Body composition evaluation based on bioimpedance assessment can provide a patient's risk chart that determines the correct dosage of the therapeutic exercise prescription.In this respect, this personal study is a framework that combines a non-invasive, low-cost, portable, and easy to apply method and the specific appropriate dosage for each patient. The specific dosage involves eight elements the type of contraction, intensity, speed, duration, frequency, sequence, environment, and feedback. (Suzuki T et al., 2017).

There are three models as table 1 shows comprising two up to four compartments out of which fat mass is a common one and fat-free body mass usually incorporates bone minerals, total body water, and visceral proteins.(Henche et al., 2005).

Table 1Body composition – compartment models*(Heymsfield et al., 1997; Wang et al., 1995)*

Models	Two-compartments Mollecular level	Three-compartments	Four-compartments
Body Weight (BW)	fat mass (FM)	fat (FM)	fat (FM)
		water (TBW- total body water)	water (TBW)
	fat-free body mass (FFM)	residual (glycogen+ minerals + protein)	minerals
			residual (glycogen + protein)

An upper body fat distribution is strongly linked with an abnormal metabolic profile, the most dramatic abnormality of metabolism is the failure to suppress the normal response to postprandial hyperinsulinemia. (Jensen et al., 2008). Predominantly upper body fat increases the risk for dyslipidemia(Kissebah et al., 1976), hypertension (Cassano et al.,1990, Seidell et al.,1991), type 2 diabetes (Carey et al., 1997, Chan et al.,1994), sleep apnea (Schafer et al.,2002).

Body fat increases led to obesity, high risks of developing cardiovascularand metabolic diseases, and degrades quality of life,ultimately increasing the risk of death. (Frank et al., 2019).

In healthy humans, body fat is a major determinant of the resting rate of muscle sympathetic nerve discharge. Overweight-associated sympathetic activation could represent one potential mechanism contributing to the increased incidence of cardiovascular complications in overweight subjects.(Scherrer et al., 1994).

Fat distribution phenotypes enhance that a lower amount of lower-body fat mass is equally important to a highamount of visceral fat mass as a determinant of cardiometabolic diseases. (Stefan, 2020).

Sarcopenia defined as age-related loss of skeletal muscle mass is a predictor of physical function integrity and consequently functional impairment, physical disability, gait speed, and mortality.(Heymsfield et al., 1997; Wang et al., 1995; Seene et al., 2012; Evans, 2010).

Material and method

21 outpatients were assessed using a single-frequency bioelectrical impedance analyzer (SF-BIA). Health outcomes such as fat mass (FM), fat-free mass imbalances (FFM), and skeletal muscle mass (SMM) were determined. SPSS software version 25 was used for statistical analysis.

The measurements of bioelectric impedance were obtained with Amazfit Smart Scale - Body Composition Analyzer (Declaration of Conformity with directives 2014/53/EU and 2014/65/EU) from the own endowment of the practice cabinet, using a single frequency of 50 kHz. For each subject major body compartments determined as a tissue system were determined. TBW, SMM, and FFM using bioimpedance were automatically estimated through linear empirical equations stored in the system memory together with personal physical data (age, weight, height).

Exclusion criteria: all situations of altered fluid balance (decompensated liver, kidney, heart disease), acute-contagious infections, subjects wearing a pacemaker,people with skin lesions, and pregnant women.

Inclusion criteria: no food, no drinking water for at least 4 h and no alcohol for at least 8 h before the test.

Procedure: subjects in the orthostatic posture with bare feetin contact with the conducting surface. (foot-foot touch).

Results interpretation Body Composition Zepp Analyser outputs were downloaded and statistical indices were calculated.Reference values used revised European consensus on the definition and diagnosis of sarcopenia (Cruz-Jentoft et al., 2019), fat-free mass index cut-off (FFMI =FFM/height^2), and fat mass index cutoffs (FMI = FM/height^2) (Hattori et al.1997),). Age groups were established based on the rate of muscle loss (Cruz-Jentoft et al., 2019, Seene et al., 2012).

Results and discussions

Results

Demographic variables

There are four age groups as follows: 23.81% for 18-39 years, 33.33% for 40-49 years, 23.81% for 50-69 years, and 19.05% for >70 years, based on the rate of muscle loss, because its integrity is essential for a rehabilitation program, according to Fig. 1 - Age Groups based on the rate of muscle loss. The reason for age group distribution was the variability of muscle mass with aging.

Variation of muscle mass and strength decreases with aging so up to 40 years are maximal levels and between 40 and 50 years and over, loss of leg muscle mass is 1–2% per year, and loss of strength levels 1.5–5% per year. As a result, 25 % of people under the age of 70 years and 40 % of those over the age of 80 years are sarcopenic. (Dodds et al., 2014; Keller at al.,2013; Hiona et al., 2008; Marzetti et al.,2006)

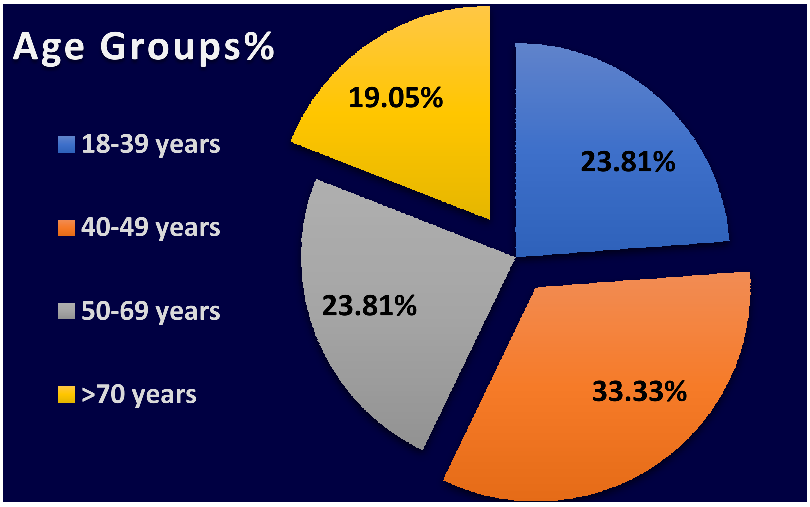


Fig.1 Age Groups based on the variation of muscle mass and strength

Of the 21 subjects, there are 52.68% men (M) and 47.62% women (W) as Tabel 2 and Fig 2 regarding Gender Distribution shows.

Tabel 2 Gender distribution

Age Groups	total	total	M	W	M	W
18-39	5	23.81%	3	2	14%	10%
40-49	7	33.33%	4	3	19%	14%
50-69	5	23.81%	2	3	10%	14%
>70	4	19.05%	2	2	10%	10%
total	21	100.00%	11	10	52.38%	47.62%

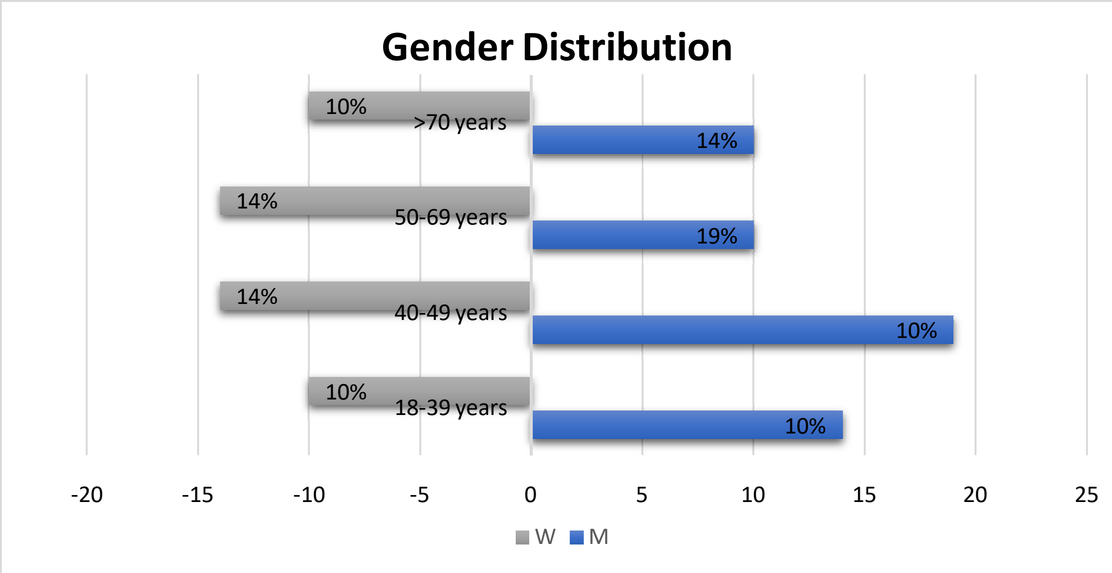


Fig. 2 Gender ditribution

BMI rezults denotes that 57.15% (12 cases) are obese&overweight: obesity 5 cases (23.81%, 2M, 3W), overweight 7 cases (33.33%, 5M, 2W).Normal weight was registered on 8 cases (38.10%, 4M, 4W) and underweight one case (4.76%,1W).

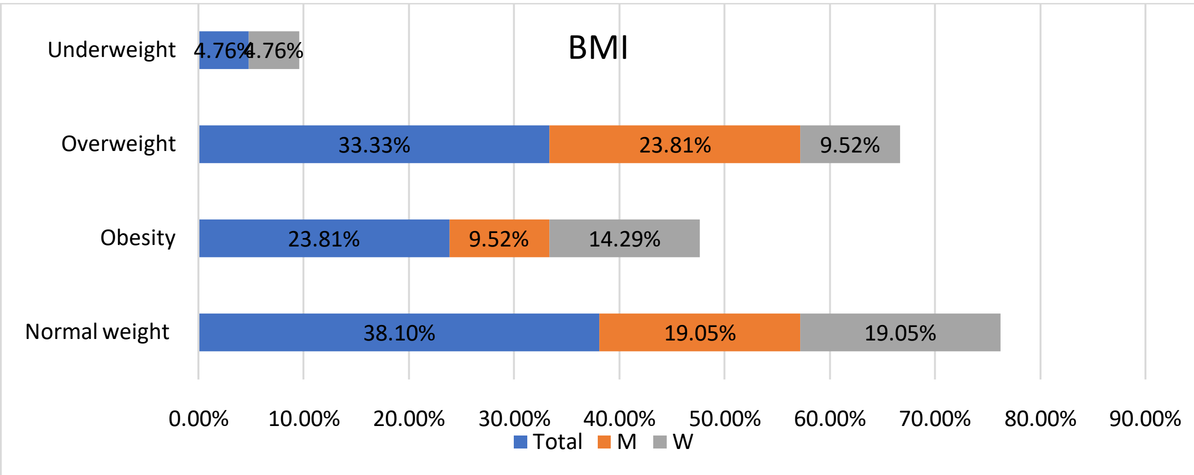


Fig. 3 BMI results

Outputs

The mean age is 47.81 years ± 18.519 Std. Deviation, Body Mass Index (BMI) mean 26.38 ± 5.768, One-Sample T-Test Sig.<.001, statistically relevant ($p<0.05$).

Tabel 3 One-Sample Statistics T-Test

One-Sample Statistics T-Test CI = 95%				
	N	Mean	Std. Deviation	Std. Error Mean
Age	21	47.81	18.519	4.041
BMI	21	26.38	5.76759	1.25859

Tabel 4 T-Test Significance

One-Sample Test						
	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Age	11.830	20	0.000	47.81	39.38	56.24
BMI	20.957	20	0.000	26.38	23.75	29.00

Fat-free mass index (FFMI), fat mass index (FMI), and skeletal mass index (SMI) were computed by adjusting with height square.

Fat mass (FM) was deducted from corporal fat percentage adjusted by weight. The results of body composition are based on the same principle as BMI calculation, towards the systematic normalization for a body height of FMI kg/height^2(m) = FM index. FMI types as lean, intermediate, and adipose wereused to evaluate general relationships between the body composition indices and somatotype components as Table 5 shows.

Table 5 FMI Types somatotype components

FMI Types (Hattori et al.1997)	Lean	Intermediate	Adipose
Males	<1.7	1.7–4.4	>4.4
Females	<3.4	3.4–6.4	>6.4

Measuring the variance by ANOVA with one independent variable - BMI and one response variable FMI Types, the results were statistically significant .002 ($p<.05$) Table 7

Tabel 6 ANOVA FMI Types

ANOVA FMI Types				
Report				
BMI				
FMI Types	N	Mean	Std. Deviation	%
Adipose	15	28.8028	4.75694	71.43%
Intermediate	4	21.8441	1.55501	19.05%
Lean	2	17.2436	1.98965	9.52%
Total	21	26.3764	5.76759	100.00%

Applying FMI Types somatotype components to the present sample results in 15(71.43%) adipose cases, 4 (19.05%) intermediate, and 2 (9.52%) lean as Table 6 shows.

For FMI Types $F(2,18)=9.255$, Sig.<.002, the measure of effect size Eta Squared$\eta^2$is 50.7%. Cohen's medium effect shows that out of the total variation in BMI, the proportion that can be attributed to FMI Types is 50.7%. (Table 7, Table 8).

Tabel 7 ANOVAwith one independent variable -BMI and one response variable - FMI Types

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
BMI * FMI Types	Between Groups	(Combined)	337.290	2	168.645	9.255	0.002
	Within Groups		328.011	18	18.223		
	Total		665.301	20			

Tabel 8 Eta Squared η^2 BMI/FMI Types

Measures of Association		
	Eta	Eta Squared η^2
BMI * FMI Types	0.712	0.507

Fat-free mass (FFM) was determined by summing the amounts adjusted by the weight of various components: bone mineral (%); the water seen as total body water (%) and visceral protein (%). A fat-free mass index (FFMI = FFM/ height^2) may also eliminate the influence of stature in comparing FFM by FFM index calculation as Table 9 shows.

Table 9 FFMI Types somatotype components

FFMI Types (Hattori et al.1997)	Slender	Intermediate	Solid
Males	<16.5	16.5–19.9	>19.9
Females	<14.4	14.4–17.1	>17.1

Measuring the variance by ANOVA with one independent variable - BMI and one response variable FFMI Types, the results were statistically significant .001 ($p<.05$) – Table 11.

Tabel 10ANOVA FFMI Types

ANOVA FFMI Types				
Report				
BMI				
FFMI Types	N	Mean	Std. Deviation	%
Intermediate	12	25.9096	3.82666	57.14%
Slender	5	21.3501	3.65587	23.81%
Solid	4	34.0597	5.34467	19.05%
Total	21	26.3764	5.76759	100.00%

Applying FFMI Types somatotype components to the present sample results in 12(57.14%) intermediate cases, 5 (23.81%) slender, and 4 (19.05%) solid as Table 10 shows.

For FFMI Types F(2, 18)=10.943, Sig.<.001, the measure of effect size Eta Squared$\eta^2$is 54.9%. Cohen's medium effect shows that out of the total variation in BMI, the proportion that can be attributed to FFMI Types is 54.9%. (Tabel 11, Tabel 12)

Tabel 11 ANOVAwith one independent variable -BMI and one response variable - FFMI Types

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
BMI * FMI Types	Between Groups	(Combined)	365.066	2	182.533	10.943	0.001
	Within Groups		300.235	18	16.680		
	Total		665.301	20			

Tabel 12 Eta Squared η^2 BMI/FFMI Types

Measures of Association		
	Eta	Eta Squared
BMI * FFMI Types	0.741	0.549

Descriptive statistics for FMI/FFMI and SMI denote a mean of FMI of 8.4746±4.34 std deviation - Adipose, mean of FFMI of 16.8768±2.58 std deviation - Intermediate, mean of SMI of 9.325±1.59 std deviation – Normal.(Table 13)

Tabel 13 Descriptive Statistics FMI/FFMI/SMI

Statistics				
		FMI	FFMI	SMI
N	Valid	21	21	21
	Missing	0	0	0
Mean		8.4746	16.8768	9.3925
Median		7.5563	16.7499	9.3359
Std. Deviation		4.34083	2.58289	1.59814
Minimum		0.93	12.93	6.99
Maximum		18.58	21.42	12.44
Percentiles	25	5.8673	14.4351	7.9305
	50	7.5563	16.7499	9.3359
	75	11.4419	18.6691	10.7126

Frequency percentiles for FMI, FFMI, and SMI are represented according to Fig. 4, Fig. 5, and Fig. 6.

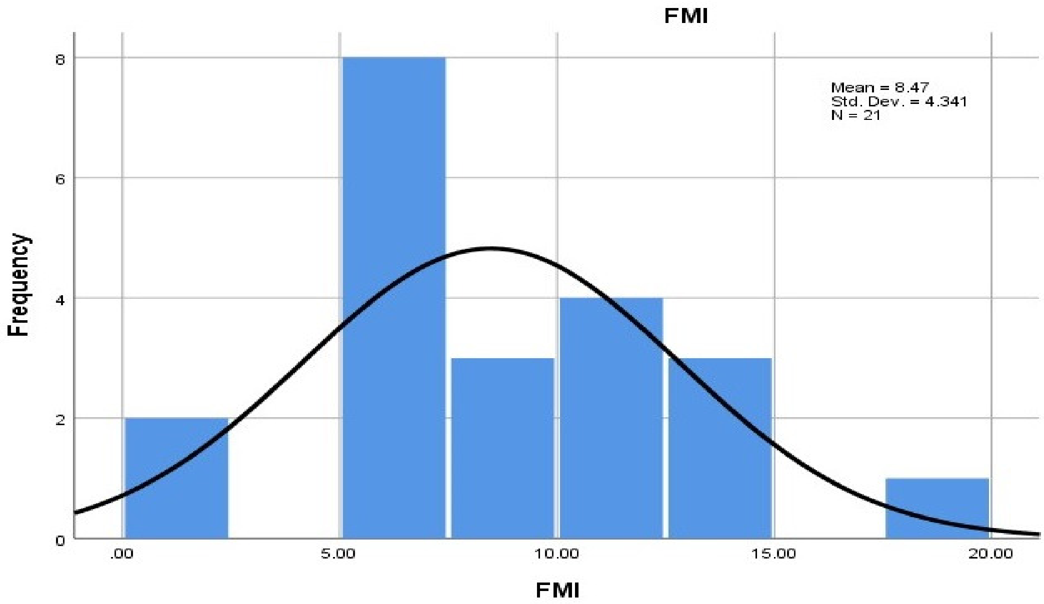


Fig. 4 FMI Frequency

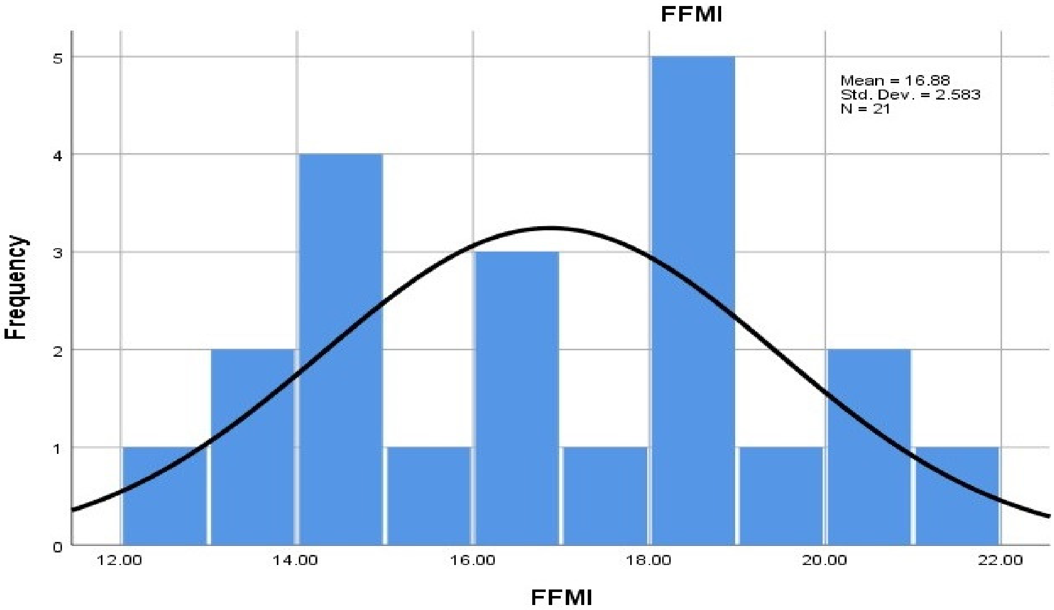


Fig. 5 FFMI Frequency

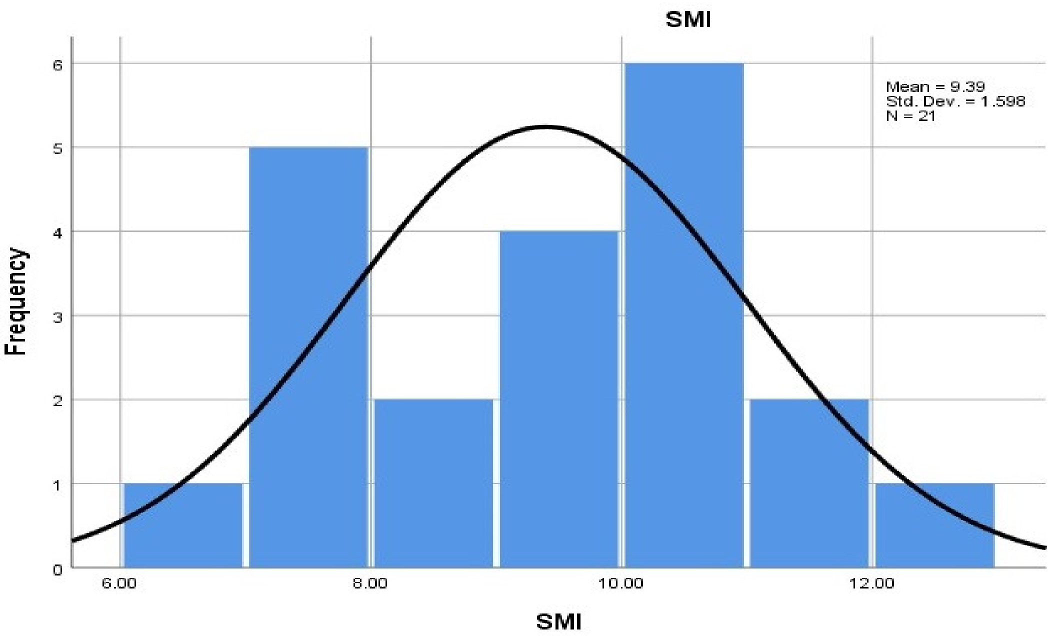


Fig. 6 SMI Frequency

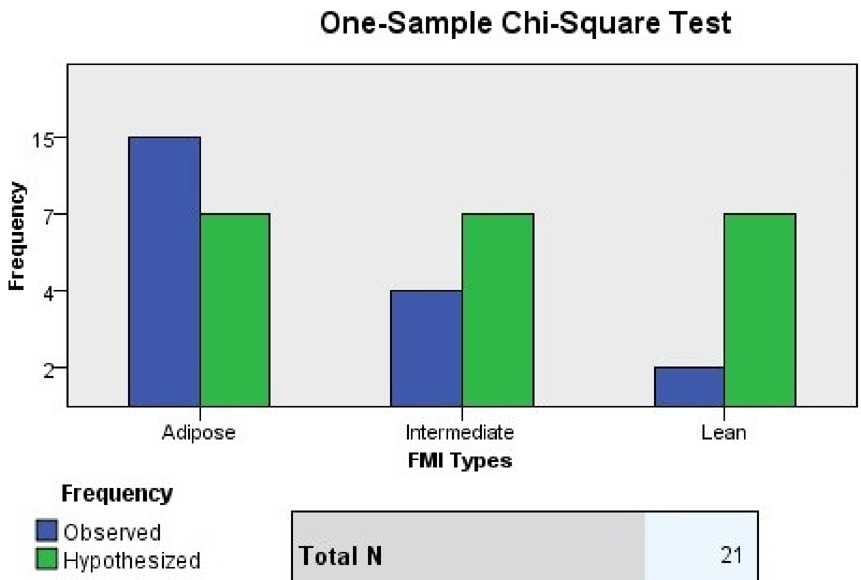
FMI somatotype components results are 71.43% adipose cases, 19.05% intermediate, and 9.52% lean. One-Sample Chi-Square test applied to FMI Types reveals the statistical significance<.05(.001) by rejecting the null hypothesis that the categories of FMI Types occur with equal probabilities. (Fig. 7 and Fig. 8)

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of FMI Types occur with equal probabilities.	One-Sample Chi-Square Test	.001	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Fig. 7 One-Sample Chi-Square test FMI Type significance



Total N	21
Test Statistic	14.000
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	.001

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 7.

Fig. 8 One-Sample Chi-Square test FMI Type Frequency

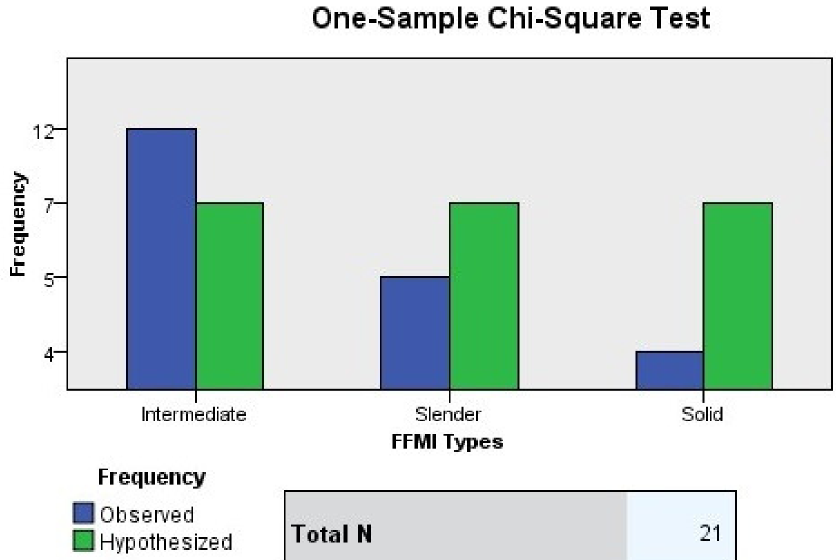
FFMI somatotype components recorded 57.14% intermediate cases, 23.81% slender, and 19.05% solid.One-Sample Chi-Square test applied to FFMI Types reveals nostatistical significance>.05(.066) by retaining the null hypothesis that the categories of FFMI Types occur with equal probabilities. (Fig. 9 and Fig. 10)

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of FFMI Types occur with equal probabilities.	One-Sample Chi-Square Test	.066	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Fig. 9 One-Sample Chi-Square test FFMI Type significance



Total N	21
Test Statistic	5.429
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	.066

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 7.

Fig. 10 One-Sample Chi-Square test FFMI Type Frequency

Regression equation of standard BMI and FMI with scatter plots took into consideration the "chair stand test" for pre-sarcopenia with a result of 84.5% No cases and 72.4% Yes cases.Nine patients exceeded 15 seconds at the chair stand test so probable sarcopenia was identified. (Fig.11- Scatter of FMI by BMI).

The factors that cause sarcopenia defined by the European consensus (EWGSOP2) usually interact and are categorized as primary age-associated muscle loss and secondary based on physical inactivity. Physical inactivity can be determined by sedentary behavior, under-nutrition or malabsorption, over-nutrition, obesity, inflammatory conditions, or debilitating diseases. (Cruz-Jentoft et al., 2019).

SMM and strength were evaluated according to the EWGSOP2 practical algorithm. The chair stand test (also called the chair rise test) was used for the strength of leg muscles. The chair stand test measures the time needed for a patient to rise five times from a seated position without using arms. Sincethe chair stand test requires both strength and endurance, this test is a qualified but convenient measure of strength. It is used to identify low muscle strength. If the time exceeds 15 seconds for five rises, the test is positive. Nine patients exceeded 15 seconds at the chair stand test so probable sarcopenia was identified: 3 women (FMI Types 2 adipose, one lean, FFMI Types 2 intermediate, one slender) and 6 men(FMI Types 5 adipose, one intermediate, FFMI Types 4 intermediate, one solid, one slender),From SF-BIA were extracted the value for the skeletal mass and SMI was calculated by height-adjusted: 18 (85.72%) cases have normal values and 2 (9.53%) case have an optimal value. EWGSOP2 sarcopenia cut-off points for low muscle quantity were used <7.0 kg/m2 - men and <5.5 kg/m2 - women. (Cruz-Jentoft et al., 2019; Gould et al., 2014)

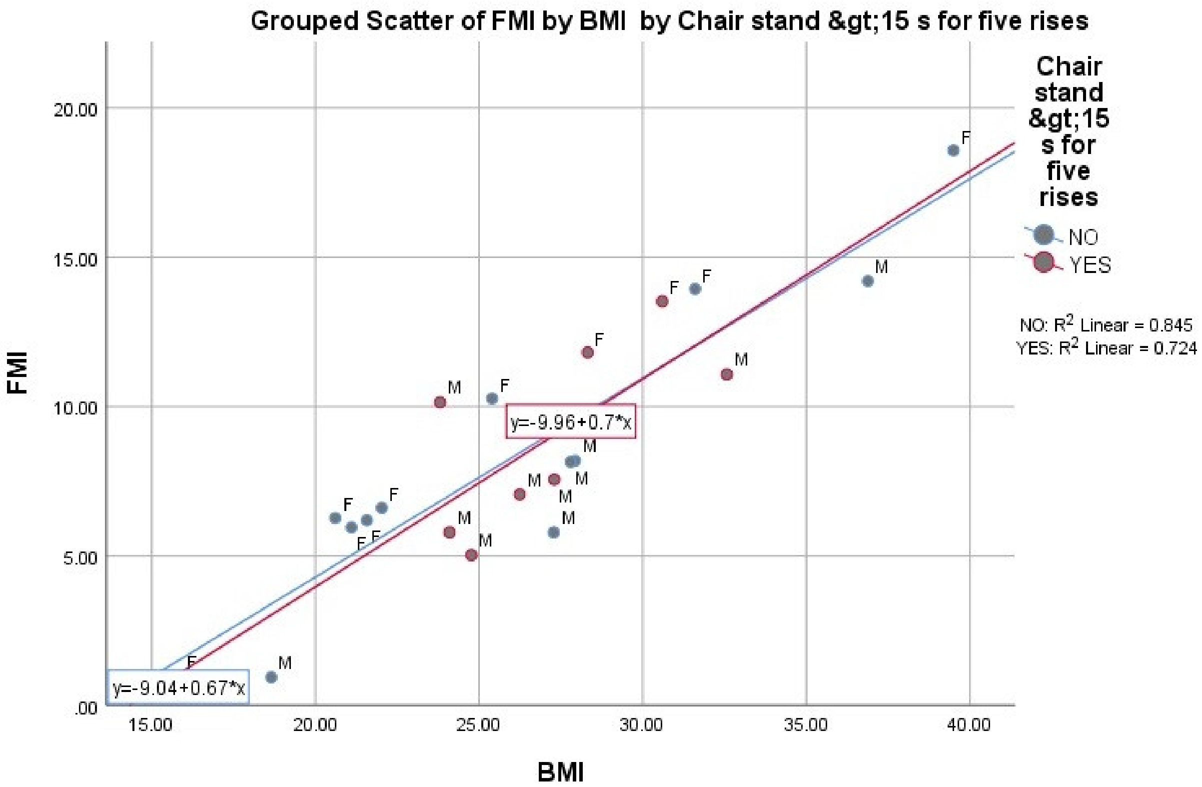


Fig. 11 Scatter of FMI by BMI

Regression equation of standard BMI and FMI with scatter plots positive at chair test for 72% of cases y(FMI) = -9.96+0.7X(BMI) – Fig 11.

Pearson correlation of BMI with FMI (r=.898), FFMI (r=.716) and SMI (r=.772), CI=99% Age (r=.518), CI=95% registered strong direct statistical significance. FMI also correllats with Age (r=.602), CI=95% and FFMI with SMI (r=.984), CI=99%. (Table 14)

Table 14 Pearson correlation

Correlations						
		BMI	FMI	FFMI	SMI	Age
BMI	Pearson Correlation	1	.898**	.716**	.772**	.518*
	Sig. (2-tailed)		0.000	0.000	0.000	0.016
	N	21	21	21	21	21
FMI	Pearson Correlation	.898**	1	0.337	0.421	.602**
	Sig. (2-tailed)	0.000		0.135	0.057	0.004
	N	21	21	21	21	21
FFMI	Pearson Correlation	.716**	0.337	1	.984**	0.167
	Sig. (2-tailed)	0.000	0.135		0.000	0.470
	N	21	21	21	21	21
SMI	Pearson Correlation	.772**	0.421	.984**	1	0.215
	Sig. (2-tailed)	0.000	0.057	0.000		0.349
	N	21	21	21	21	21
Age	Pearson Correlation	.518*	.602**	0.167	0.215	1
	Sig. (2-tailed)	0.016	0.004	0.470	0.349	
	N	21	21	21	21	21
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Discussions

Bioelectrical impedance analysis (BIA), used to estimate human body compositionis known as a low-cost technique, quick and non-invasive technique.

The human body can be divided into different compartments those changes are detected with the techniques of body composition evaluation.

The relation between FFM loss and mortality and the relation of phase angle with prognosis and disease severity reinforces the interest in using BIA for the clinical management of patients with chronic diseases at high risk of undernutrition and FFM loss. FFM loss or a low phase angle is related to mortality in patients with chronic diseases, cancer (including obesity cancer patients), and elderly patients in long-stay facilities. (Paiva et al., 2010; Shah et al., 2001).

The increased prevalence of obesity together with chronic illnesses associated with fat-free mass (FFM) loss leads to an increased prevalence of sarcopenic obesity. FFM loss is related to increased mortality, and impaired quality of life.The consensus paper on sarcopenia by EWGSOP2 focuses on low muscle strength, detection of low muscle quantity, and quality to confirm the sarcopenia diagnosis. A sarcopenia diagnosis isconfirmed by the presence of low muscle quantity or quality.(Cruz-Jentoft et al., 2019).

Sarcopenia increases the risk of falls and fractures, impairs the ability to perform activities of daily living, mobility disorders, and contributes to lowered quality of life.Sarcopenia is a progressive and generalized skeletal muscle disorder that is associated with increased adverse outcomes including fractures, falls, physical disability,and mortality. Sarcopenia is probable whenlow muscle strength is detected. (Shah et al., 2001; Bischoff-Ferrari et al., 2015;Schaap et al., 2018; Beaudart et al., 2017; Dos Santos et al., 2017;Steffl et al., 2017).

Bioelectrical impedance analysis (BIA) has beenexplored for the estimation of total or skeletal mass.

BIA equipmentdoes not measure muscle mass directly but instead derivesan estimate of muscle mass based on whole-body electricalconductivity. BIA equipment is affordable, widely available, and portable, especially single-frequency instruments (Rossi et al., 2014).

Bioelectrical impedance analysis – Fig. 12 shows the connexion between the high values of FM and obesity, diabetic patients, FFM loss or low phase angle, mortality rate related to chronic diseases, and low muscle quality related to mobility disorders and altered quality of life.

Body composition evaluation can be used for the assessment óf patients' chart risk and sequential follow-up during the rehabilitation phase,replacing the invasive laboratory analysis with a quick, noninvasive test that can be carried out in a medical office. (Murgoci, 2021).

This personal approach proposes an appropriate dosage of the therapeutic exercises taking into account the individual somatotype of each patient based on indices for FM, FFM, and SM determined by bioimpedance.

Patients'personal pathological historieslead to specific features of exercises - contraction, intensity, speed and duration, distribution in time-frequency and sequence, and external and intrinsic factors – environment and feedback.

In many cases, the patients have no case history but the bioimpedance can detect body composition imbalances so that the rehabilitation program is efficient.

A high value of fat mass requires dosing with caution implying aerobic effort (submaximal forces, resistive, concentric exercises, preceded by a warm-up and follows by stretching), cardiac reserve check, low intensity, progressive increasing of speed and frequency over a medium duration of time.

A low FFM and pre-sarcopenia were detected so changing the dosage parameters as intensity- medium to high, eccentric exercises can be added and a large duration of time for the rehabilitation process under the control of the cardiac reserve.

FFM loss
~ rate of mortality in nursing home residence, chronic heart failure, chronic obstructive pulmonary disease, dialysis, cancer, liver transplantation, amyotrophic lateral sclerosis,Alzheimer's disease
~ sarcopenic obesity
~ impaired quality of life.

FM high
~ progression of obesity
~ glucose homeostasis
~ management of the diabetic patient

Clinical management of patients with chronic diseases at high risk of undernutrition and FFM loss

Bioelectrical impedance analysis (BIA)

FFM loss or a low phase angle is related to mortality in patients with chronic diseases, cancer (including obesity cancer patients), and elderly patients in long-stay facilities

Measures the phase angle - low values related to survival in geriatrics, oncology, HIV, amyotrophic lateral sclerosis, peritoneal dialysis, cirrhosis

Low muscle quantity increases the risk of falls and fractures, impairs the ability to perform activities of daily living, mobility disorders, and contributes to lowered quality of life

New direction
Dosage of the therapeutic exercises

Fig. 12Bioelectrical impedance analysis (afterCruz-Jentoft et al.2019; Thibault et al.2012, Vestbo et al.2006; Fürstenberg et al.2011; Futter at al.2011; Martin et al.2011; Kimyagarov et al.2010; Buffa et al.2010; Avram et al.2010; Paiva et al.2010; Shah et al.2001; Bischoff-Ferrari et al. 2015;Schaap et al. 2018; Beaudart et al. 2017; Dos Santos et al. 2017;Steffl et al. 2017)

Conclusions

1.There are four age groups (n=21) as follows: 23.81% for 18-39 years, 33.33% for 40-49 years, 23.81% for 50-69 years and 19.05% for >70 years. Of the 21 subjects, there are 52.68% men (M) and 47.62% women (W). BMI results denotes that 57.15% (12 cases) are obese&overweight: obesity 5 cases (23.81%, 2M, 3W), overweight 7 cases (33.33%, 5M, 2W). Normal weight was registered in 8 cases (38.10%, 4M, 4W) and underweight in one case (4.76%,1W). The mean age is 47.81 years ± 18.519 Std. Deviation, Body Mass Index (BMI) mean 26.38 ± 5.768, One-Sample T-Test Sig.<.001, statistically relevant ($p<0.05$).

2.FMI somatotype components results are 71.43% (15) adipose cases, 19.05% (4) intermediate, and 9.52% (2) lean.One-Sample Chi-Square test applied to FMI Types reveals the statistical significance of <.05(.001).

3.FFMI somatotype components recorded 57.14% (12) intermediate cases, 23.81% (5) slender and 19.05% (4) solid cases.

4. Nine patients exceeded 15 seconds at the chair stand test so probable sarcopenia was identified according tothe EWGSOP2 practical algorithm.Regression equation of standard BMI and FMI with scatter plots took into consideration the "chair stand test" for pre-sarcopenia with a result of 84.5% No cases and 72.4% Yes cases.

5.Measuring the variance by ANOVA with one independent variable - BMI and one response variable (FMI Types, FFMI Types), the results were statistically significant.

5.1. For FMI Types $F(2,18)=9.255$, Sig.<0.002, the measure of effect size Eta Squaredη^2=50.7%, Cohen medium effect shows that out of the total variation in BMI, the proportion that can be attributed to FMI Types is 50.7%.

5.2. For FFMI Types $F(2, 18)=10.943$, Sig.<0.001, the measure of effect size Eta Squaredη^2=54.9%, Cohen medium effect shows that out of the total variation in BMI, the proportion that can be attributed to FFMI Types is 54.9%.

6.Pearson correlation of BMI with FMI (r=.898), FFMI (r=.716) and SMI (r=.772), CI=99% Age (r=.518), CI=95% registered strong direct statistical significance. FMI also correlates with Age (r=.602), CI=95%, and FFMI with SMI (r=.984), CI=99%. (Fig.13, Fig. 14, and Fig. 15).

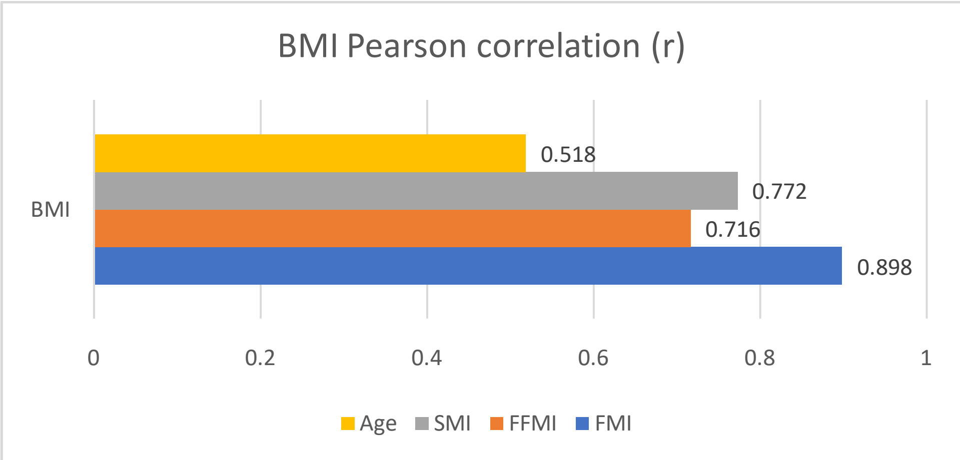


Fig. 13 BMI Pearson Correlation

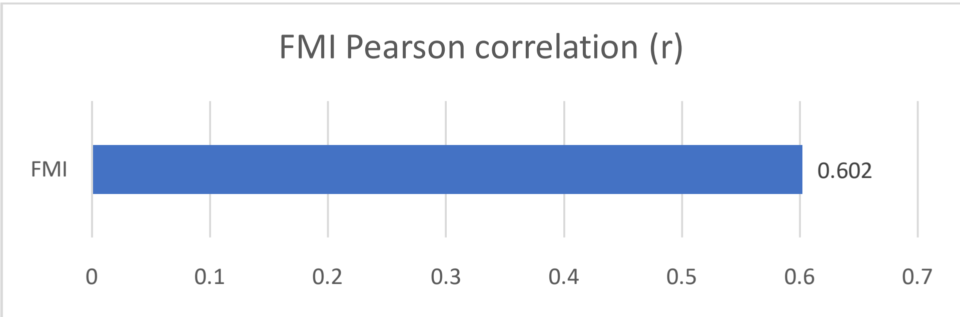


Fig. 14 FMI Pearson Correlation

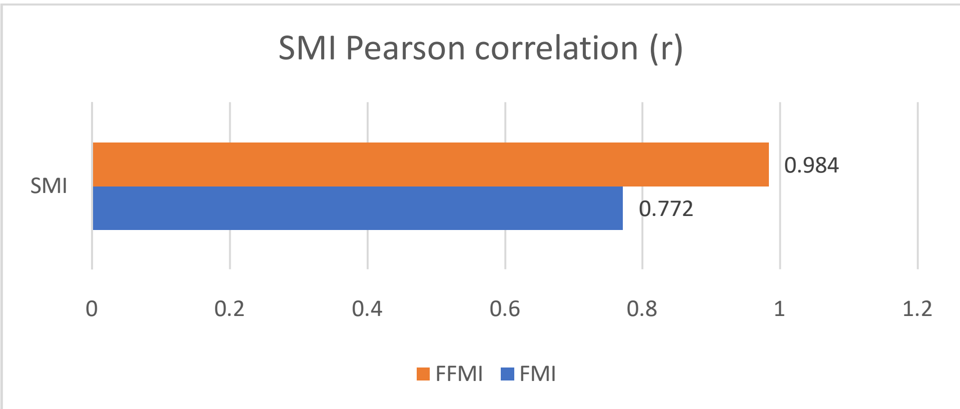


Fig. 15 SMI Pearson Correlation

7. Analysis between outputs reveals critical points (yellow) for adipose type (Table 15, Fig. 16)

Table 15 Analysis between outputs

FFMI (n= 21)	FMI Types (n= 21)			Pre-sarcopenia (n = 9)		
Types	Adipose	Intermediate	Lean	Adipose	Intermediate	Lean
Total	71.43%	19.05%	9.52%	33.33%	4.76%	4.76%
Slender	9.52%	9.52%	4.76%	4.76%	-	4.76%
Intermediate	42.86%	9.52%	4.76%	23.81%	4.76%	-
Solid	19.05%	-	-	4.76%	-	-

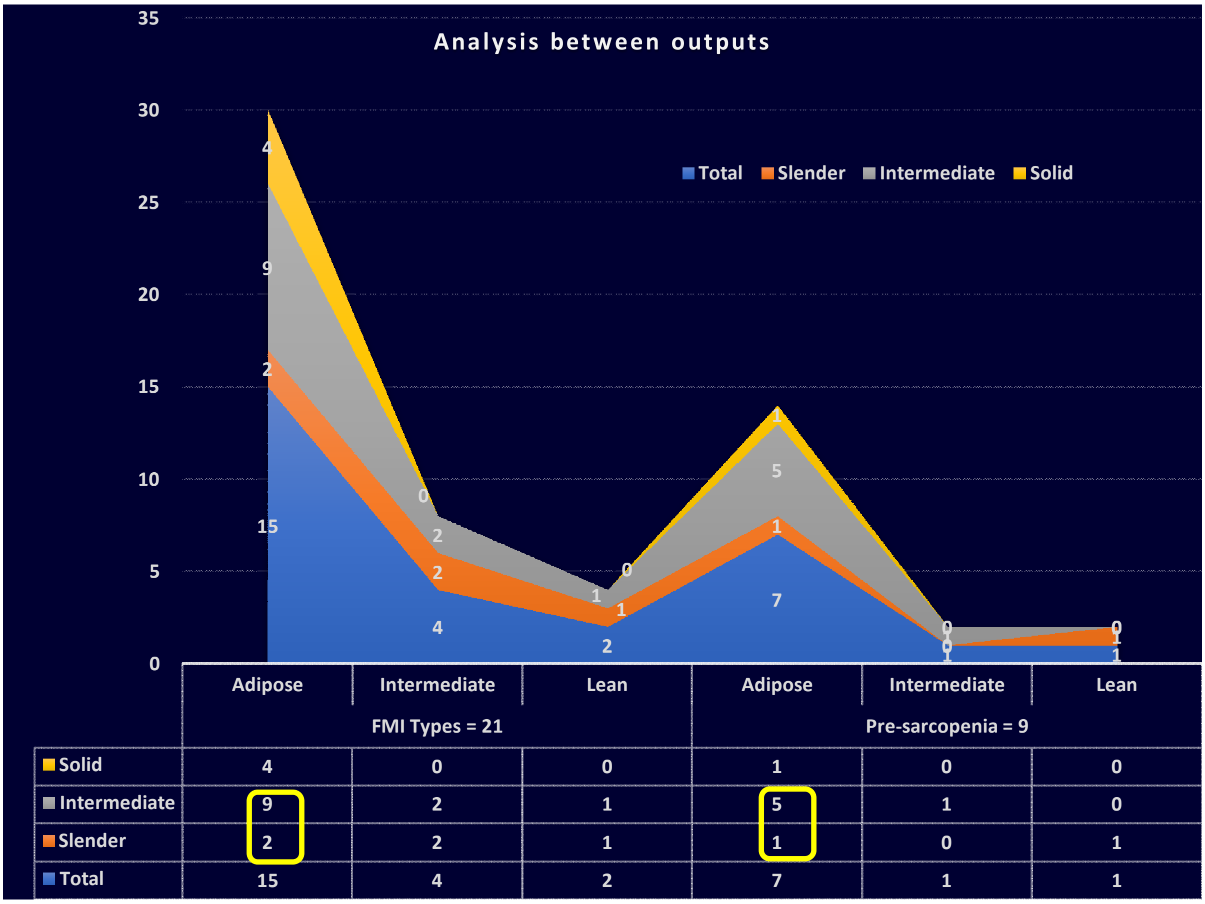
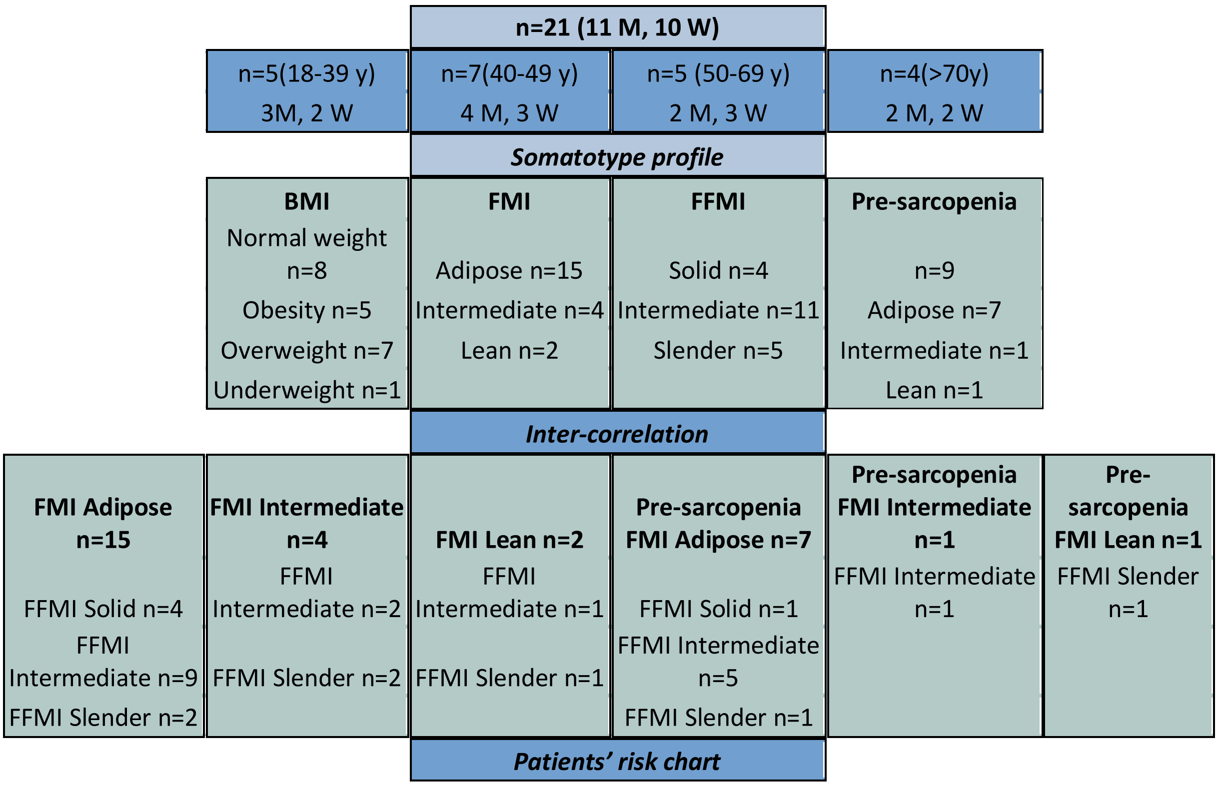


Fig. 16 Analysis between outputs (number of cases)

High FMI patients have the risk of metabolic syndrome, insulin resistance, comorbidities associated with obesity, impaired ability to perform activities of daily living,and association with cardiac and respiratory diseases.Low FFMI and SMI (pre-sarcopenia) patients have the risk of falls and fractures, which impairs the ability to perform activities of daily living mobility disorders, lowered quality of life, physical disability, and high mortality.

Dosage of the therapeutic exercises applied with cardiac parameters monitoring for FMI Adipose (n=15), FFMI Slender, and Intermediate (n=11) includes resistive, concentric exercises, low-medium intensityprogressive, pause integration for homeostasis balance,and a long period of rehabilitation for pre-sarcopenia (n=6).

For FFMI Solid, eccentric exercise can be added, medium-high intensity, pause integration for homeostasis balance for a short period with cardiac reserve monitoring. The patient's risk chart regarding fat mass and skeletal muscle mass should be included in the rehabilitation process routine to avoid functional impairment and to improve global functionality.The flow chart regarding the dosage of the therapeutic exercises based on patient risks determined by bioimpedance is summed up in Fig 17.



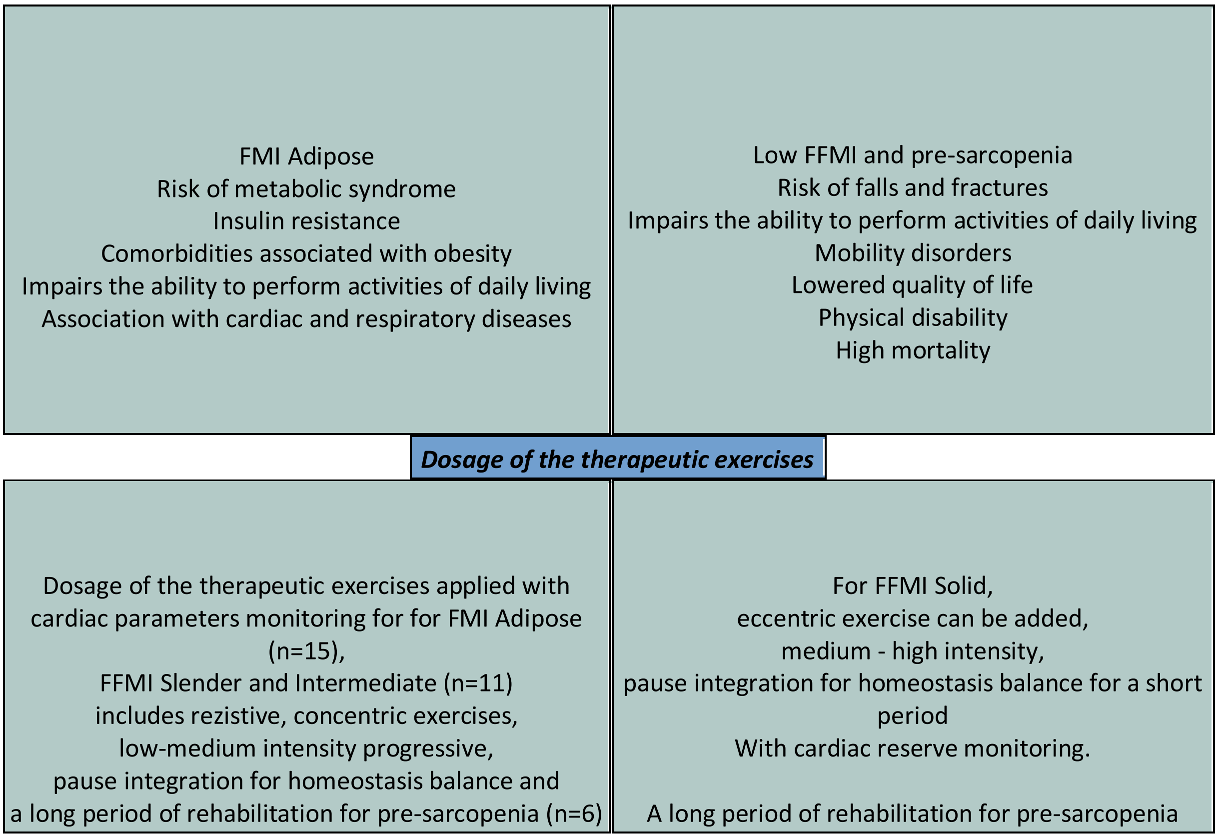


Fig. 17 Dosage of the therapeutic exercises – flow chart based on patient risks determined by bioimpedance

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