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ASSOCIATION BETWEEN ANTHROPOMETRIC INDICATORS OF NUTRITIONAL STATUS AND
LENGTH OF STAY IN HOSPITALIZED PATIENTS

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Association Between Anthropometric Indicators of Nutritional Status and Length of Hospital Stay in Hospitalized Patients

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List of abbreviations and acronyms

AMA - Mid-upper arm muscle area

AMC - Mid-upper arm muscle circumference

APMT - Adductor pollicis muscle thickness

BMI - Body mass index

CI - Confidence intervals

HR - Hazard ratio

IQR - Interquartile range

LOS - Length of stay

MUAC - Mid-upper arm circumference

PG-SGA - Patient-Generated Subjective Global Assessment

TST - Triceps skinfold thickness

Abstract

Background: Undernutrition is highly prevalent in hospitalized patients worldwide and this condition has been associated with increased hospital length of stay (LOS). The diagnosis of undernutrition includes anthropometric measurements. The aim of this study was to measure the independent association of the anthropometric and derived indicators triceps skinfold thickness (TST), mid-upper arm circumference (MUAC), adductor pollicis muscle thickness (APMT), mid-upper arm muscle area (AMA) and mid-upper arm muscle circumference (AMC) with LOS, within a varied group of hospitalized patients.

Methods: A total of 695 patients were enrolled in a prospective observational study, conducted in a Portuguese university hospital. Participants were dichotomized for the anthropometric and derived indicators TST, MUAC, APMT, AMA and AMC according to the percentiles 5th and 25th described in the literature, except for APMT, for which only the 5th percentile was used. Cox regression analysis was used to estimate adjusted hazard ratios (HR) and corresponding 95% confidence intervals (95% CI).

Results: Patients that presented values lower than the 5th percentile for TST (HR=0.759, 95% CI=0.579;0.995), MUAC (HR=0.822, 95% CI=0.687;0.983), APMT (HR=0.791, 95% CI=0.671;0.933), AMA (HR=0.797, 95% CI=0.660;0.962) and AMC (HR=0.746, 95% CI=0.611;0.911), showed a lower probability of being discharged from the hospital to usual residence over time. For TST (HR 0.798, 95% CI=0.673;0.946), patients whose values were below the 25th percentile also presented a lower probability of being discharged from the hospital to usual residence over time.

Conclusion: For all the anthropometric and derived indicators studied, patients that presented values lower than the 5th percentile had a lower probability of being discharged from the hospital to usual residence. For TST, values below the 25th percentile were also associated with lower probability of discharge. Thus, TST was found to be the best anthropometric indicator to predict LOS. This anthropometric indicator can present advantages for the diagnosis of undernutrition since it may allow an earlier detection of a poor nutritional status.

Key-words: Triceps skinfold thickness, Mid-upper arm circumference, Adductor pollicis muscle thickness, Mid-upper arm muscle area, Mid-upper arm muscle circumference, Hospital length of stay, Undernutrition, Survival analysis.

Resumo

Introdução: A desnutrição apresenta elevada prevalência em doentes hospitalizados e esta condição tem vindo a ser associada com maior tempo de internamento (TI). O diagnóstico da desnutrição inclui indicadores antropométricos. O objetivo deste trabalho foi estudar a associação independente entre os indicadores antropométricos prega cutânea tricipital (PCT), perímetro do meio braço (PB), espessura do músculo adutor do polegar (AP), área muscular do braço (AMB) e perímetro muscular do braço (PMB) e o TI em doentes hospitalizados.

Métodos: 695 indivíduos participaram num estudo observacional realizado num hospital universitário Português. Os participantes foram dicotomizados para cada indicador antropométrico PCT, PB, AP, AMB e PMB de acordo com os percentis 5 e 25 descritos na literatura, exceto para o AP, para o qual apenas o percentil 5 foi utilizado. Utilizaram--se modelos de regressão de Cox para calcular os *hazard ratios* (HR) e os intervalos de confiança a 95% (IC 95%) correspondentes.

Resultados: Os participantes que apresentaram valores abaixo do percentil 5 para PCT (HR=0,759; IC 95%=0,579;0,995), PB (HR=0,822; IC 95%=0,687;0,983), AP (HR=0,791; IC 95%=0,671;0,933), AMB (HR=0,797; IC 95%=0,660;0,962) e PMB (HR=0,746; IC 95%=0,611;0,911), revelaram uma menor probabilidade de alta para o domicílio. Para a PCT (HR=0,798; IC 95%=0,673;0,946), apresentar valores abaixo do percentil 25 também se associou a uma menor probabilidade de alta para o domicílio.

Conclusão: Os participantes que apresentaram valores abaixo do percentil 5 para todos os indicadores antropométricos mostraram uma menor probabilidade de alta domiciliar. Para a PCT, o percentil 25 também foi associado com uma menor probabilidade de alta para o domicílio. A PCT foi então o melhor indicador antropométrico capaz de prever o TI hospitalar. Incluir este indicador antropométrico nos métodos de diagnóstico de desnutrição pode ser uma mais valia por poder detetar mais precocemente um pior estado nutricional.

Palavras-chave: Prega cutânea tricipital, Perímetro do meio braço, Espessura do músculo adutor do polegar, Área muscular do braço, Perímetro muscular do braço, Tempo de internamento hospitalar, Desnutrição, Análise de Sobrevivência.

Introduction

Undernutrition is highly prevalent in hospitalized patients worldwide. In developed countries this condition is estimated to range from 28% to 50%, depending on the methods used for its identification or the characteristics of the evaluated population (1). It is also alarming the association of undernutrition with negative outcomes, such as higher rates of complications, higher mortality rates, higher hospital costs and increased hospital length of stay (LOS) (2–4). Moreover, patients' nutritional status tends to worsen during hospitalization (5). Thus, nutrition assessment is important in order to prevent deterioration of nutritional status and possibly to shorten LOS in the hospital setting. The diagnosis of undernutrition includes anthropometric measurements, that are different in what concerns the equipment needed, the time taken to be executed and the expertise level required to the health practitioner. So, in order to improve undernutrition diagnostic methods and to spread its implementation, it is important to increase knowledge towards anthropometry capacity in diagnosing undernutrition.

There is an sustained evidence that anthropometric and derived indicators are related to undernutrition and nutrition risk (6–9). However, previous evidence on the association of anthropometric and derived indicators with LOS is contradictory. Whereas in some studies an association between triceps skinfold thickness (TST), mid-upper arm circumference (MUAC), adductor pollicis muscle thickness (APMT), mid-upper arm muscle area (AMA) and mid-upper arm muscle circumference (AMC) with longer LOS has been shown (1,7,10–15), in others this association was not found (1,7,12,16–23). However, it is important to highlight that LOS may be influenced by many factors other than nutritional status and in some of the mentioned studies, the association between anthropometric and derived indicators with LOS was not adjusted for possible confounding variables (7,12,18,20,22). Furthermore, in only one study discharge destination was taken into account and it was shown that MUAC had the greatest influence on LOS. However, this study sample was confined to patients with neoplasms (1). Survival analysis has the advantage of allowing to define the main outcome variable, such as discharge to usual residence, and to treat LOS as a continuous variable.

The main objective of this study was to measure the independent association of the anthropometric and derived indicators TST, MUAC, APMT, AMA and AMC with LOS, within a varied group of hospitalized patients. It is also aimed to investigate if these

anthropometric and derived indicators have a similar validity in predicting LOS, after adjusting for possible confounding variables.

Methods

Study Population and Design

A prospective observational study was conducted between July 2011 and December 2014 in a Portuguese university hospital. Eligibility criteria to participate in this study were being 18 years old or more, caucasian, conscious, cooperative, able to provide written informed consent and to have been given an expected LOS superior to 24 hours. Patients with a critical illness, pregnant women, those with hemodynamic instability at the time of evaluation, individuals in isolation and that were admitted for procedures that implied bed rest were excluded from the study. Therefore, patients from angiology and vascular surgery; cardiology; digestive, nondigestive and hepatobiliary surgeries; endocrinology; gastroenterology; internal medicine; nephrology; orthopaedics; otolaryngology and urology wards were recruited for this study.

From 1053 subjects invited to participate in this study, a total of 825 (78.3%) patients accepted to participate; 205 (19.5%) refused to participate, 13 (1.2%) were excluded because they were positively screened for cognitive impairment and 10 (1.0%) were excluded because they did not complete the study. Moreover, 8 had missing data for TST (1.0%), 8 for MUAC (1.0%), 20 for APMT (2.4%) and 120 for Patient-Generated Subjective Global Assessment (PG-SGA) (14.6%), therefore they were excluded from present data analysis. The final study sample was composed by 695 participants. The follow-up interval for LOS was defined as 30 days.

Ethical disclosure

The presented research was conducted according to the guidelines established by the Declaration of Helsinki and approved by the Institutional Review Board and the Ethics Committee of *Centro Hospitalar do Porto* (Appendix I). Written informed consent was obtained from the all study participants.

Data Collection

Data on sex, date of birth, hospital ward, clinical history, medical diagnosis, date of hospital admission, date of hospital discharge and discharge destination were obtained by consulting hospital and medical records. All other data was collected by two nutritionists, using a structured questionnaire.

Potential participants were screened for cognitive impairment using the Abbreviated Mental Test (24). Educational level was determined by the number of years of school attended. Marital status was categorised as single, married or in common-law marriage, divorced and widowed. Katz index was used to evaluate the independence in daily activities (25). Disease severity was evaluated by the Charlson disease severity index. This index takes into account the number and the seriousness of comorbid diseases, each scored from 0 to 6 (26). Nutritional status was assessed by PG-SGA and accordingly patients were classified as being not undernourished, as exhibiting moderate or suspected undernutrition or as exhibiting severe undernutrition (27).

Standing height (cm) was measured with a metal tape with 0.1 cm resolution and, for those who could not be measured, height was estimated by hand length (n=342, 49.2%) or by half-span (n=2, 0.3%) (28,29). Body weight (kg) was obtained with a calibrated beam scale with a 0.5 kg resolution. If body weight could not be measured, it was estimated using MUAC and height (n=165, 23.7%) (14). For patients on dialytic treatments, body weight was reported by the patient (n=22, 3.2%). The MUAC was measured with a metal tape measure with 0.1 cm resolution (29). The TST and the APMT from non-dominant hand were obtained with a Harpenden calliper with a 0.2 mm resolution (29,30). For patients whose non-dominant APMT was impossible to measure, the dominant APMT was used (n=38, 5.5%). The AMA was calculated using the formula [MUAC (cm) $- \pi*TST^2$ (cm)/ 4π] (31) and the AMC was calculated using the formula [MUAC (cm) $- \pi*TST$ (cm)] (32). Body mass index (BMI) was calculated using the formula [weight (kg)/height^2 (m)].

Statistical Analysis

The Kolmogorov-Smirnov test was used to assess whether the variables were normally distributed. Continuous variables are reported as median and interquartile range (IQR) and categorical variables are reported as frequencies.

The following education categories were created: 0 to 4, 5 to 12 and more than 12 school years. Concerning the Katz index, participants were classified as presenting severe dependence if the score obtained ranged from 0 to 2 points, as presenting moderate dependence if the score ranged from 3 to 4 points and as presenting independence if the punctuation was 5 to 6 points. Participants were categorized into four classes according to their BMI: underweight (<18.5 kg/m^2), normal weight (from 18.5 to 24.9 kg/m^2), overweight (from 25.0 to 29.9 kg/m^2) and obesity (≥ 30.0 kg/m^2).

Moreover, participants were dichotomized for the anthropometric and derived indicators TST, MUAC, AMA and AMC according to the percentiles 5th and 25th described in the literature (32–35). For the APMT only the 5th percentile was used since the 25th percentile was not found described in the literature (36).

The length of hospital stay was dichotomized at 7 days, based on the median LOS of the entire sample. To evaluate the association between LOS and demographic, functional, clinical and nutritional characteristics, patients with and without a long LOS (<7 versus ≥ 7 days) were compared using the Pearson chi-squared test for categorical variables and the Mann Whitney test for continuous variables.

LOS was determined as the number of days from the date of hospital admission to date of discharge to usual residence (the main outcome variable). Patients who were not discharged to usual residence within the study period were censored at the time of the occurrence of other events, namely death, transfer (to another hospital ward, to another hospital or to continuing care units) and discharge against medical advice (n=84). Since the follow-up interval for LOS was defined as 30 days, patients who remained hospitalized more than 30 days after hospital admission were also censored (n=20).

The Kaplan-Meier method was used to estimate the cumulative probability of discharge-free over time, according to the five anthropometric and derived indicators.

Cox regression analysis was used to estimate unadjusted and adjusted hazard ratios (HR) and corresponding 95% confidence intervals (95% CI). Different models were conducted for each anthropometric and derived indicator. For TST, MUAC, AMA and AMC, participants were dichotomized according to the 5th and to the 25th percentiles, whereas for APMT only the 5th percentile was used. The adjusted model included the following characteristics: age (dichotomous), marital status (dichotomous), education (categorical), Katz index (categorical) and Charlson index (continuous).

P value was considered statistically significant when lower than 0.05. Statistical analysis was conducted using the Software Package for Social Sciences, version 25, from IBM, 2017.

Results

This study included 695 patients, 320 women (46.0%) and 375 men (54.0%), aged between 18 and 91 years, with a median age (and IQR) of 57 (22) years. According to PG-SGA, 362 patients (52.1%) were not undernourished, 170 patients (24.5%) presented moderate or suspected undernutrition and 163 patients (23.5%) were severely undernourished.

The characteristics of the study participants' according to LOS, short LOS (<7 days) versus long LOS (≥7 days), are presented in Table 1. Patients in the long LOS group were older (*P*<0.001) and presented lower median values for TST (*P*=0.043) and for APMT (*P*=0.029). Higher proportions of participants aged 65 years and older (*P*=0.001), presenting 0 to 4 and 5 to 12 years of school attended (*P*=0.025), being widowed and divorced (*P*=0.004), presenting moderate and severe dependence (*P*=0.001), that were discharged against medical advice, transferred or deceased (*P*<0.001) and presenting moderate and severe undernutrition (*P*<0.001) were found in the long LOS group. Moreover, within this group, higher proportions of participants were found to be below the 25th percentile for TST (*P*=0.006) and below the 5th percentile for MUAC (*P*=0.004), APMT (*P*=0.005) and AMC (*P*=0.029).

Figure 1 shows the probability of being discharge-free over time according to the five anthropometric and derived indicators used. Patients that presented values lower than the 5th percentile for all the indicators studied showed a lower probability of being discharged from the hospital to usual residence, since higher proportions of patients remained hospitalized over time. For TST, patients who were below the 25th percentile also presented a lower probability of being discharged from the hospital to usual residence.

Using unadjusted Cox proportional hazard models, for MUAC, APMT, AMA and AMC, patients who were below the 5th percentile, presented lower HR for occurrence of the event (discharge to usual residence) over time. For TST, values below the 5th and the

25th percentiles were associated with lower HR for occurrence of the event over time (Table 2, Model 1). After adjusting for age, marital status, education, Katz and Charlson indexes, the results remained similar (Table 2, Model 2), meaning that for all the anthropometric and derived indicators studied, values lower than the 5th percentile were independently associated with longer LOS and for TST, presenting values lower than the 25th, was also independently associated with longer LOS.

Discussion

According to the results of the present study, depletion of TST, MUAC, APMT, AMA and AMC, was each independently associated with longer LOS in a large sample of hospitalized patients from different medical and surgical wards. In fact, for all the anthropometric and derived indicators studied, patients that presented values lower than the 5th percentile had a lower probability of being discharged from the hospital to usual residence. Moreover, the association between undernutrition indicators and LOS was not weakened by adjusting for age, educational level, marital status, Katz index and Charlson index since the HR and corresponding 95% CI were similar between the crude and the adjusted Cox proportional hazard models.

Other relevant finding is that patients that presented TST values below the 25th percentile had a lower independent probability of being discharged from the hospital to usual residence, which highlights that for this anthropometric indicator, a less marked depletion may allow an earlier detection of undernutrition.

Comparing all the anthropometric and derived indicators studied, the present study highlights that those that involve calculations, AMA and AMC, that are not as quick and easy to use, do not present any advantage since the HR and 95% CI obtained were similar to those obtained from the direct measurements, TST, MUAC and APMT.

Disease related undernutrition is commonly associated with an inflammatory component. Acute disease related undernutrition is characterized by a severe inflammation response, along with catabolism and muscle mass loss. In chronic disease related undernutrition, the most frequent type of disease-related undernutrition, the degree of inflammation is mild to moderate and muscle mass loss may occur gradually during a period of time that can last from months to years (37). Furthermore, when at rest, common

situation among hospitalized patients, muscles prefer to use fat for fuel (38). Analysing the HR obtained for TST, considering the dichotomization on the 25th percentile, a low HR suggests a higher association with longer LOS and thus it is possible to state that, in this study sample, fat mass depletion allowed an earlier detection of undernutrition.

The association between the anthropometric and derived indicators studied with LOS has been previously investigated but results from precedent studies were contradictory. Whereas some authors found an association between the indicators and LOS (1,7,10–15), others did not find this association (1,7,12,16–23).

These contradictory results can be due to several causes. In some studies, the statistical analysis conducted were limited to bivariate analysis (7,12,18,20,22), whereas in other studies multivariable analysis were done (1,10,11,13–17,19,21). Differences in the studied population can also, at least in part, explain the different findings, namely restricting the sample to a specific age group (23) or to surgical, to oncologic or to Intensive Care Unit patients (1,7,13,15,17,18,21). Sample size is another aspect to take into account, since in previous studies it ranged from 82 (18) to 3087 participants (22).

The definition of depletion concerning anthropometric variables also varied between studies. The anthropometric and derived indicators depletion was defined as a percentage from 60 to 80% of the 50th percentile (10,16), or as values below the 5th percentile (13) and below the 10th percentile (17). Moreover, some authors used a specific value to define normality and depletion (10,11,14,15). The dichotomization of LOS is another aspect to consider, since some authors used LOS dichotomized at 3 days (13), at 7 days (11,19), at 10 days (15,16) or at 12 days (10). In other studies LOS was analysed as a continuous variable (1,14,17,21).

In a study conducted with 278 hospitalized patients and by multivariable logistic analysis adjusted for sex, TST was shown to be the best predictor for longer LOS (10). Previous studies on the association between APMT and LOS did not provide definitive findings. Two of them found an association (13,15) and other two did not (17,21). Regarding AMA and AMC, a previous study found an association between these two derived indicators with LOS (15). Concerning MUAC, only two studies did not corroborate the association between this anthropometric indicator and LOS (16,19). However, most of the previous studies found an association between MUAC and LOS (1,10,11,14,15). It is also important to highlight that by using a Cox's regression model,

in a study among patients with neoplasms, MUAC was independently associated with LOS and as MUAC increased, LOS decreased (1).

Although the association between anthropometry and LOS has been extensible studied, to our knowledge, only this previous study used survival analysis but the study sample was restricted to oncologic patients (1). Survival analysis is the most appropriate analysis to study this association because it treats LOS as a continuous outcome and allows to define the event of interest as being discharge to usual residence. Moreover, this analysis accounts for censored data. In fact, patients that experienced discharge against medical advice, were transferred, deceased and had LOS superior to 30 days were censored. By censoring, it is possible to include cases that could not be included with other statistical approaches, such as logistic regression, and thus, survival analysis reflects the hospital reality more accurately.

The statistical methodology used was a study strength, as well as the use of several anthropometric and derived indicators. The characteristics of the present study sample can also be regarded as a study strength, since a large number of patients with different types of diagnosis and pathologies and with a large age range, from 18 to 91 years, were included.

Nutritional and medical procedures were not recorded, so HR were not adjusted for these potential confounding variables. Although LOS was arbitrarily censored at 30 days, only 20 participants (2.9%) remained hospitalized longer than 30 days, so this probably did not affect present study findings.

To sum up, the association of several anthropometric and derived indicators with LOS was compared and it was shown for the first time, using survival analysis among a sample presenting a broad age range and various diagnosis and pathologies, that TST, MUAC, APMT, AMA and AMC values below the 5th percentile and that TST values below the 25th percentile were independently associated with LOS. Results from the present study suggest that TST is a more relevant indicator for the diagnosis of undernutrition given its stronger association with LOS and it may allow an earlier detection of undernutrition. Also, TST can be used to predict LOS in clinical practice, which is relevant, since it is quick and easy to measure, non-invasive and the equipment is inexpensive and portable. Thus, the present study findings allow to improve undernutrition diagnostic tools.

Conclusion

When analysing the findings of the present study, it is possible to conclude that depletion of TST, MUAC, APMT, AMA and AMC was independently associated with LOS in hospitalized patients. Furthermore, TST was found to be the best anthropometric indicator to predict LOS. Using this anthropometric indicator can present advantages for the diagnosis of undernutrition since it may allow an earlier detection of a poor nutritional status.

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Table 1. Baseline demographic, clinical, nutritional status and anthropometric characteristics of 695 Portuguese inpatients participating in a prospective observational study according to short and long LOS.

Characteristic	Short LOS (<7 d) (n=326)	Long LOS (≥7 d) (n=369)	*P* value
Age (y), median (IQR)	54 (24)	61 (20)	<0.001[b]
Age (y), n (%)			
<65	240 (73.6)	229 (62.1)	0.001[a]
≥65	86 (26.4)	140 (37.9)	
Sex, n (%)			
Female	155 (47.5)	165 (44.7)	0.455[a]
Male	171 (52.5)	204 (55.3)	
Education (y)[c], n (%)			
0-4	134 (41.2)	165 (44.7)	0.025[a]
5-12	154 (47.4)	183 (49.6)	
>12	37 (11.4)	21 (5.7)	
Marital status, n (%)			
Married or in common-law marriage	218 (66.9)	239 (64.8)	
Single	63 (19.3)	47 (12.7)	0.004[a]
Widowed	21 (6.4)	48 (13.0)	
Divorced	24 (7.4)	35 (9.5)	
Hospital ward, n (%)			
Medical	135 (41.4)	177 (48.0)	0.083[a]
Surgical	191 (58.6)	192 (52.0)	
Katz index, n (%)			
Independence	313 (96.0)	325 (88.1)	
Moderate dependence	4 (1.2)	11 (3.0)	0.001[a]
Severe dependence	9 (2.8)	33 (8.9)	
Discharge destination, n (%)			
Home	306 (93.9)	305 (82.7)	
Transfer or discharge against medical advice or death	20 (6.1)	64 (17.3)	<0.001[a]
Body mass index (kg/m^2), median (IQR)	25.7 (6.4)	25.5 (7.1)	0.526[b]
Body mass index class, n (%)			
Underweight	12 (3.7)	24 (6.5)	0.237[a]
Normal weight	122 (37.4)	144 (39.0)	
Overweight	122 (37.4)	118 (32.0)	
Obese	70 (21.5)	83 (22.5)	
PG-SGA, n (%)			
Not undernourished	218 (66.9)	144 (39.0)	
Moderate or suspected undernutrition	56 (17.2)	114 (30.9)	<0.001[a]
Severe undernutrition	52 (16.0)	111 (30.1)	
Charlson index score, median (IQR)	2 (2)	2 (3)	0.002[b]
Triceps skinfold thickness (mm)			
Median (IQR)	15.5 (10.9)	13.5 (11.8)	0.043[b]
Percentiles, n (%)			

25th			
Above	231 (70.9)	225 (61.0)	0.006 [a]
Below	95 (29.1)	144 (39.0)	
5th			
Above	295 (90.5)	323 (87.5)	0. 215[a]
Below	31 (9.5)	46 (12.5)	
Mid-upper arm circumference (cm)			
Median (IQR)	29.0 (5.0)	28.5 (5.2)	0.065[b]
Percentiles, n (%)			
25th			
Above	134 (41.1)	132 (35.8)	0.149[a]
Below	192 (58.9)	237 (64.2)	
5th			
Above	251 (77.0)	248 (67.2)	0.004[a]
Below	75 (23.0)	121 (32.8)	
Adductor pollicis muscle thickness (mm)			
Median (IQR)	21.4 (6.0)	20.5 (5.8)	0.029[b]
Percentile, n (%)			
5th			
Above	211 (64.7)	200 (54.2)	0.005[a]
Below	115 (35.3)	169 (45.8)	
Mid-upper arm muscle area (cm²)			
Median (IQR)	36.9 (16.7)	35.6 (15.8)	0.242[b]
Percentiles, n (%)			
25th			
Above	149 (45.7)	149 (40.4)	0.157[a]
Below	177 (54.3)	220 (59.6)	
5th			
Above	225 (78.2)	268 (72.6)	0.088[a]
Below	71 (21.8)	101 (27.4)	
Mid-upper arm muscle circumference (cm)			
Median (IQR)	23.9 (4.6)	23.7 (4.5)	0.339[b]
Percentiles, n (%)			
25th			
Above	180 (55.2)	186 (50.4)	0.205[a]
Below	146 (44.8)	183 (49.6)	
5th			
Above	267 (81.9)	277 (75.1)	0.029[a]
Below	59 (18.1)	92 (24.9)	

IQR: interquartile range; LOS: length of stay; PG-SGA: Patient-Generated Subjective Global Assessment.

[a]Pearson chi-squares test.

[b]Mann Whitney test.

[c]One missing value for education status in short LOS.

Table 2. Hazard ratios of occurrence of the event (discharge to usual residence) over time associated with anthropometric or derived indicators for 695 Portuguese inpatients participating in a prospective observational study[a].

Measure	Model 1 Crude HR (IC 95%)	Model 2 Adjusted HR[b] (IC 95%)
Triceps skinfold thickness Percentiles 25th		
Above	1	1
Below	0.797 (0.674; 0.942)	0.798 (0.673; 0.946)
5th		
Above	1	1
Below	0.707 (0.542; 0.924)	0.759 (0.579; 0.995)
Mid-upper arm circumference Percentiles 25th		
Above	1	1
Below	0.898 (0.762; 1.058)	0.879 (0.745; 1.038)
5th		
Above	1	1
Below	0.810 (0.678; 0.967)	0.822 (0.687; 0.983)
Adductor pollicis muscle thickness Percentiles 5th		
Above	1	1
Below	0.795 (0.676; 0.935)	0.791 (0.671; 0.933)
Mid-upper arm muscle area Percentiles 25th		
Above	1	1
Below	0.881 (0.750; 1.034)	0.876 (0.744; 1.031)
5th		
Above	1	1
Below	0.828 (0.687; 0.997)	0.797 (0.660; 0.962)
Mid-upper arm muscle circumference Percentiles 25th		
Above	1	1
Below	0.872 (0.743; 1.022)	0.855 (0.727; 1.006)
5th		
Above	1	1
Below	0.745 (0.612; 0.907)	0.746 (0.611; 0.911)

[a]Lower HR values represent a lower probability of hospital discharge; in-hospital deaths, transfers and discharge against medical advice were censored at time of those events; length of hospital stay was censored at 30 days.

23

[b]Adjusted for age [<65 (reference) and ≥65 years], education [0 to 4, 5 to 12 and >12 (reference) years], marital status [married or in common-law marriage (reference) and single, widowed or divorced], Katz index [severe dependence, moderate dependence and independence (reference)] and Charlson index (continuous).

Figure 1. Kaplan-Meier curves for being discharge-free over time[a] for 695 Portuguese inpatients participating in a prospective observational study, according to (A) 5th and 25th triceps skinfold thickness percentiles, (B) 5th and 25th mid-upper arm circumference percentiles, (C) 5th adductor pollicis muscle thickness percentile, (D) 5th and 25th mid-upper arm muscle area percentiles and (E) 5th and 25th mid-upper arm muscle circumference percentiles. [a]Higher values of being discharge-free over time represent a lower probability of hospital discharge; in-hospital deaths, transfers and discharge against medical advice were censored at time of those events; length of hospital stay was censored at 30 days.

A
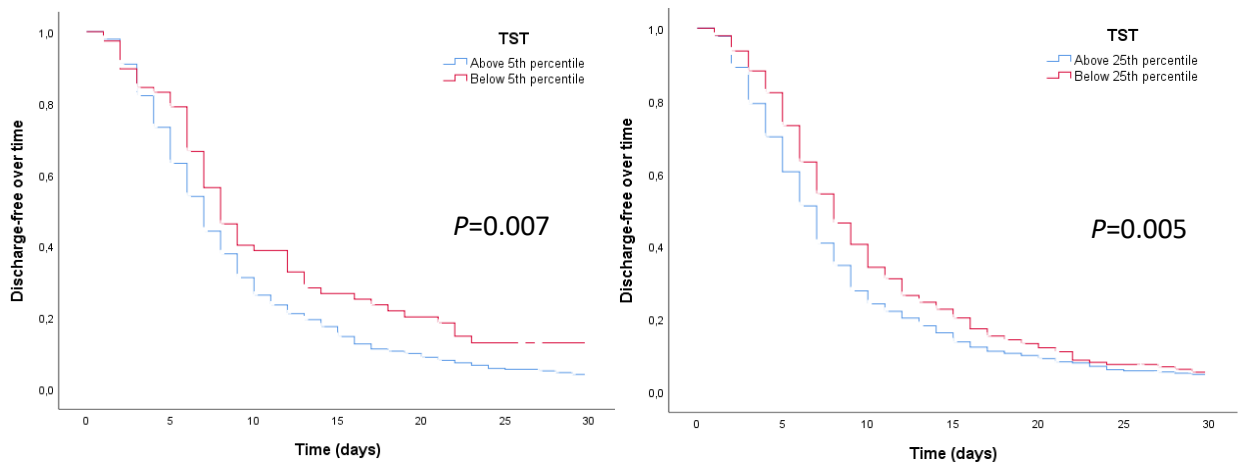
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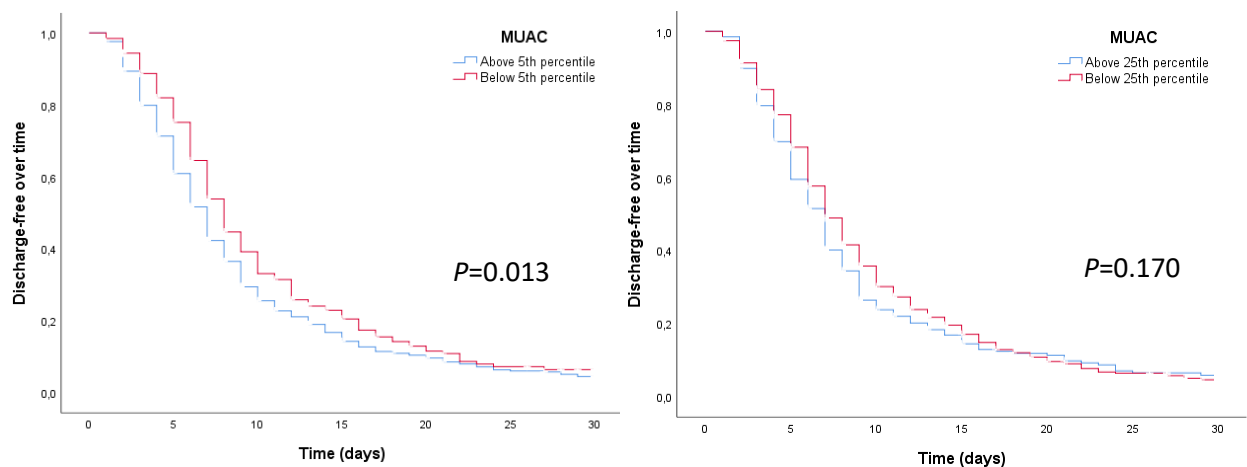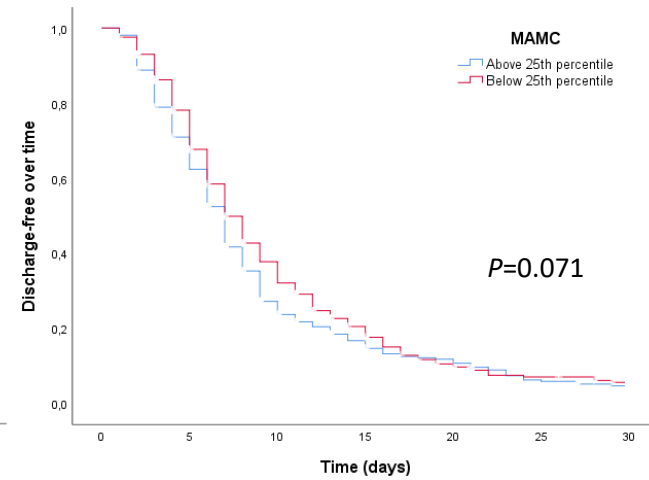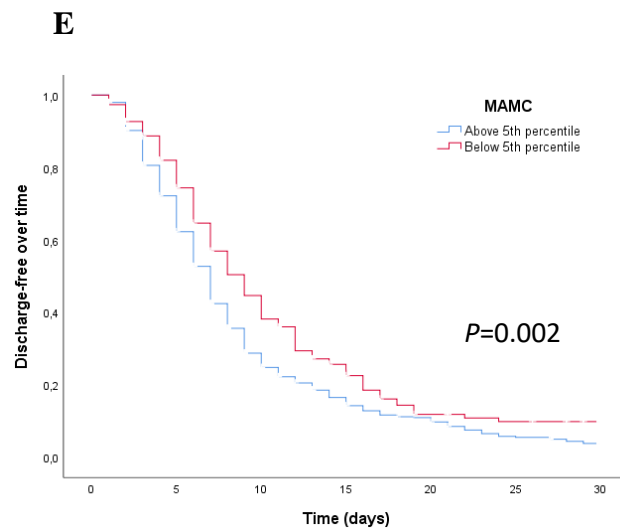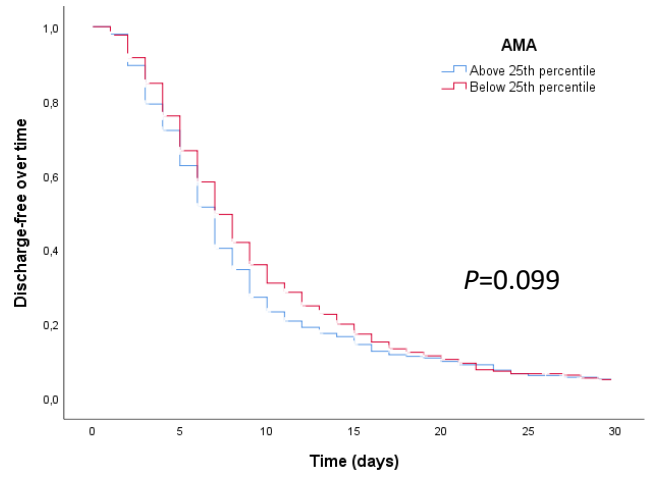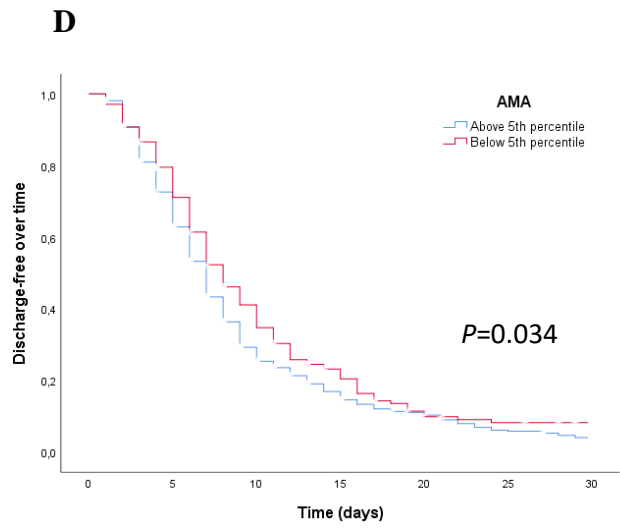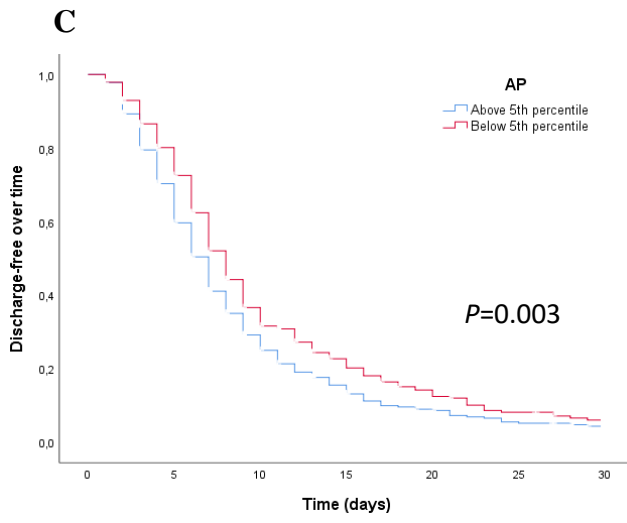
Appendix I

centro hospitalar
do **Porto**

Para:	DR.ª RITA ALEXANDRA C S GUERRA	De:	PEDRO ESTEVES
	~ MEC – Polo FCUP		PRESIDENTE DO CONSELHO DE
	Dr Robe. Frni s/n		. MINIST.
	4200-465 PORTO		

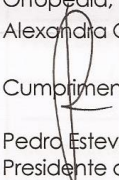|			
Fax:		Data:	7 DE JUNHO DE 2011
Tel.:		Págs.:	
Ref.:	**N/ REF.ª 093/11(057-DEFI/089-CES)**	CC:	

x Urgente   ☐ Apreciar p.f.   ☐ Comentar p.f   ☐ Responder p.f.   ☐ Fazer circular p.f.

ASSUNTO: Trabalho Académico no âmbito de Doutoramento - **"Força muscular da mão e ângulo de fase no rastreio da desnutrição"**

Em resposta ao solicitado, em 12 de Abril de 2011, informo que, após apreciação por parte do Gabinete Coordenador de Investigação/DEFI e da CES, foi emitido **parecer favorável** sobre o assunto em epígrafe pelo que nada há a opor à realização do mesmo nesta Instituição, nos Serviços de Angiologia e Cirurgia Vascular, Cardiologia, Cirurgia Geral, Endocrinologia, Gastro, Medicinas, Nefrologia, Ortopedia, ORL, Cirurgias e Urologia, sendo Investigadora Principal a Dr.ª Rita Alexandra Couto Soares Guerra.

Cumprimentos,

Pedro Esteves
Presidente do Conselho de Administração

* Em todas as eventuais comunicações posteriores sobre este estudo é indispensável indicar a nossa ref.ª.

FORMULÁRIO de registo institucional
Estudos de Investigação

N.º Interno: 093/11(057-DEFI/089-CES)

Título: "Força muscular da mão e ângulo de fase no rastreio da desnutrição"

SECRETARIADO PARA ESTUDOS DE INVESTIGAÇÃO (SEI)

☐ Recepção no SEI
27 / 04 / 2011   Ass. _____

☐ Enviado ao DEFI p/ parecer
2 9 /ABR. /2011   Ass. _____

☐ Recebido parecer do DEFI
06 / 05 / 2011   Ass. _____

☐ Enviado à CES p/ parecer
16 / 05 / 2011   Ass. _____

☐ Recebido parecer da CES
01 / 06 / 2011   Ass. _____

☐ Enviado à Direcção Clínica p/ parecer
03 / 06 / 2011   Ass. _____

☐ Recebido parecer da Direcção Clínica
0 6 / JUN. 2011   Ass. _____

☐ Enviado ao GIAD p/ gestão financeira
___ / ___ / ___   Ass. _____

☐ Recebido no GIAD
___ / ___ / ___   Ass. _____

☐ Enviado ao CA p/ autorização
08 / 06 / 2011   Ass. _____

☐ Recebida autorização do CA
07 / 06 / 2011   Ass. _____

☐ Devolvido ao proponente s/ critérios de aceitação
___ / ___ / ___   Ass. _____

☐ Informado proponente da decisão
09 / 06 / 2011   Ass. _____

COMISSÃO DE ÉTICA PARA A SAÚDE (CES)

☐ Recepção na CES
16 / 05 / 2011   Ass. _____

Enviado à CEIC, p/ parecer (se aplicável)
___ / ___ / ___   Ass. _____

☐ Recebido parecer da CEIC
___ / ___ / ___   Ass. _____

☐ Enviado a CFT, p/ parecer (se aplicável)
___ / ___ / ___   Ass. _____

☐ Recebido parecer da CFT
___ / ___ / ___   Ass. _____

Parecer da CES ☑ Favorável ☐ Sob condição ☐ Desfavorável
01 / 06 / 2011   Ass. _____

☐ Reenviado ao SEI, p/ proceder
02 / 06 / 2011   Ass. _____

Observações
ultimas autorizações recepcionadas em 03.06.2011

COMISSÃO DE FARMÁCIA E TERAPÊUTICA (CFT)

☐ Recepção na CFT
___ / ___ / ___   Ass. _____

☐ Reenviado à CES
___ / ___ / ___   Ass. _____

Parecer da CFT ☐ Favorável ☐ Sob condição ☐ Desfavorável
___ / ___ / ___   Ass. _____

Observações

CONSELHO DE ADMINISTRAÇÃO (CA)

☐ Recepção no CA
08 / 06 / 2011

☐ Reenviado ao SEI, p/ proceder
09 / 06 / 2011   Ass. _____

Parecer do CA   ☑ Autorizado ☐ Não autorizado

Observações

DEFI – Folha de rosto para Estudo de Investigação – Edição 1 / Versão 1 – Aprovado em CA em 09-05-2007   Página 1 de 2

DEPARTAMENTO ENSINO, FORMAÇÃO E INVESTIGAÇÃO (DEFI)

□ Recebido no Secretariado do GCI

2 9 ABR. 2011   Ass.

□ Reenviado ao SEI

16 /05 /2010   Ass.

GABINETE COORDENADOR DA INVESTIGAÇÃO (GCI)

Apreciação do GCI ☒ Favorável □ Sob condição □ Desfavorável

6-5-2011

A proposta de investigação foi analisada pelo GCI/DEFI não havendo questões a colocar aos investigadores

Parecer Favorável

DEFI
Gabinete Coordenador de Investigação
(Análise de Estudos de Investigação)

Assinatura _____ Nº Mec. 6266 6 15 2011

Assinatura _____ Nº Mec.

COMISSÃO DE ÉTICA PARA A SAÚDE

APRECIAÇÃO E VOTAÇÃO DO PARECER

Deliberação	Data: 1 6 2011	Órgão: Reunião Plenária
Título: "Força muscular da mão e ângulo de fase no rastreio da desnutrição"		Ref.ª: 093/11(057-DEFI/089-CES)
Protocolo/Versão:		Investigador: Rita Alexandra Couto S Guerra TSS FMUP

A Comissão de Ética para a Saúde – CES do CHP, ao abrigo do disposto no Decreto-Lei n.º 97/95, de 10 de Maio, em reunião realizada nesta data, apreciou a fundamentação do relator sobre o pedido de parecer para a realização de **Trabalho Académico - Doutoramento** acima referenciado:

Ouvido o Relator, o processo foi votado pelos Membros da CES presentes:

Presidente: Dr.ª Luisa Bernardo
Vice-Presidente: Dr. Paulo Maia

Dr.ª Paulina Aguiar, Enf.ª Paula Duarte, Dr.ª Fernanda Manuela, Prof.ª Doutora Maria Manuel Araújo Jorge

Resultado da votação:

PARECER FAVORÁVEL à realizaçã nos serviços cujo director autorizou.

A deliberação foi aprovada por unanimidade.

Pelo que se submete à consideração superior.

AUTORIZO
CONFORME PARECER
DE CES.

Data 1 6 2011

A Presidente da CES

6/6/011

Dr.ª Luisa Bernardo

DR. SEVERO TORRES
Adjunto do Director Clínico

Modelos: PEDIDO DE AUTORIZAÇÃO INSTITUCIONAL

Utilize os modelos que forem aplicáveis ao Estudo de Investigação em causa, acrescentando a informação que considerar pertinente.

Trabalho académico de investigação (título)

FORÇA MUSCULAR DA MÃO E ÂNGULO DE FASE NO RASTREIO DA DESNUTRIÇÃO

Presidente do Conselho de Administração do CHP

Exmo. Senhor Presidente do Conselho de Administração do CHP

Teresa Maria de Serpa Pinto Freitas do Amaral, na qualidade de Investigador Principal [x] Investigador Responsável ☐ Aluno, vem por este meio, solicitar a Vossa Exa. autorização para realizar no Centro Hospitalar do Porto o Estudo de Investigação acima mencionado, de acordo com o programa de trabalhos e os meios apresentados.

Data   Assinatura

12/04/2011   *Teresa Maria de Serpa Pinto Freitas do Amaral*

Presidente da Comissão de Ética para a Saúde do CHP

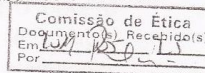Exma. Senhora Presidente da Comissão de Ética para a Saúde do CHP

Teresa Maria de Serpa Pinto Freitas do Amaral, na qualidade de Investigador Principal [x] Investigador Responsável ☐ Aluno, vem por este meio, solicitar a Vossa Exa. autorização para realizar no Centro Hospitalar do Porto o Estudo de Investigação acima mencionado, de acordo com o programa de trabalhos e os meios apresentados.

Comissão de Ética
Documento(s) Recebido(s)
Em _____
Por _____

Data   Assinatura

12/04/2011   *Teresa Maria de Serpa Pinto Freitas do Amaral*

Directora do Departamento de Ensino, Formação e Investigação do CHP

Exma. Senhora Directora do Departamento de Ensino, Formação e Investigação do CHP

Teresa Maria de Serpa Pinto Freitas do Amaral, na qualidade de Investigador Principal [x] Investigador Responsável ☐ Aluno, vem por este meio, solicitar a Vossa Exa. autorização para realizar no Centro Hospitalar do Porto o Estudo de Investigação acima mencionado, de acordo com o programa de trabalhos e os meios apresentados.

Data   Assinatura

12/04/2011   *Teresa Maria de Serpa Pinto Freitas do Amaral*

CENTRO HOSPITALAR DO PORTO
SECRETARIADO
ESTUDOS INVESTIGAÇÃO

27/04/2011