The Accuracy of the Ishii Score Chart in Predicting Sarcopenia in the Elderly Community in Chengdu

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Research article

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Abstract

Background: Sarcopenia is an age-related disorder that results in loss of skeletal muscle mass, loss of muscle strength, and/or reduced physical performance . It leads to a high incidence of falls, fractures, hospitalizations, a loss of mobility, and subsequently reduced quality of life.Therefore, it is crucial to find effective screening tools for early screening in the elderly community. Many studies had shown the Ishii score chart predicts sarcopenia with high sensitivity and specificity. But, the Ishii score chart is mainly based on the European Working Group on Sarcopenia in Older People (EWGSOP) consensus. Now, the Asian Working Group for Sarcopenia (AWGS)2019 consensus has changed its previous diagnostic criteria, so whether the Ishii score chart is suitable for China needs to be verified. This study, intends to verify the accuracy of the Ishii score chart within the Chinese elderly community in an effort to find a suitable model of screening for sarcopenia.

Methods: Using the AWGS2019 sarcopenia diagnostic criteria as a reference, the accuracy of the Ishii score chart among the elderly community was evaluated using indicators such as sensitivity, specificity, the ROC curve (receiver operating characteristic curve), and the area under the curve (AUC) .

Results: 1.The prevalence rate of sarcopenia in the Chengdu elderly community was 18.38%, of which 19.87% were males and 16.91% were females. 2. The Ishii score chart predicted sarcopenia when the AUC was 0.84 with 95% confidence interval (CI) of 0.80-0.89 for females and 0.81 with 95% CI of 0.75-0.86 for males. According to original cut-off, which was set at 120 points for females, the corresponding sensitivity was 45.7% and the specificity was 93.2%. The 105 cut-off points set for males revealed a corresponding sensitivity of 53.3% and the specificity of 88.9%. 3. After adjusting the cut-off and maximizing the sum of sensitivity and specificity, sensitivity, specificity, and positive and negative predictive values for sarcopenia were 75.3%, 80.2%, 43%, and 94% for females, and 70.7%, 81.6%, 49%, and 92% for males respectively. 4.The Ishii score chart predicted severe sarcopenia when the AUC was 0.96 with 95% CI of 0.94-0.98 for females and 0.93 with 95% CI of 0.89-0.98 for males. When the sum of sensitivity and specificity was maximized, sensitivity, specificity, and positive and negative predictive values for severe sarcopenia were 100%, 88.6%, 33%, and 99% for females, and 91.7%, 87.0%, 21%, and 97% for males respectively.

Conclusion: After adjusting the cut-off values, the Ishii score chart had high predictive value for both sarcopenia and severe sarcopenia among the elderly Chengdu community.

Background

Sarcopenia is an age-related disorder that results in loss of skeletal muscle mass, loss of muscle strength, and/or reduced physical performance [1]. It leads to a high incidence of falls, fractures, hospitalizations, a loss of mobility, and subsequently reduced quality of life [2]. Sarcopenia is usually asymptomatic in its early stages, but becomes more pronounced after a serious event (such as a fall or disability) [3]. Therefore, it is crucial to find effective screening tools for early screening in the elderly

community. Currently, commonly used screening tools for sarcopenia include: SARC-F((Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls))scale [4], calf circumference (CC) [5], Ishii score chart [6], and more. An ideal screening model should define a reasonable cut-off point, be effective, reliable, convenient, economical, and have reasonable accuracy, sensitivity, and specificity [7]. SARC-F is currently widely used in various countries, and most studies have shown it has screening value for sarcopenia. SARC-F has four subjective questions on the screening questionnaire, the results of which may be affected by the life attitude and psychology of the elderly [8], therefore, the specificity is high and the sensitivity is low [9–10].In 2019, AWGS recommended calf circumference as a screening tool for sarcopenia [1]. This was based on a Japanese study by Kawakami R et al. where calf circumference measurement was compared with dual x-ray absorptiometry (DXA) to predict the onset of sarcopenia as being 34 cm and below in males (sensitivity 88%, specificity 91%) and 33 cm and below in females (sensitivity 76%, specificity 73%)[11]. Yves Rolland et al. retrospectively analyzed 1458 French females over the age of 70 with no history of hip fracture and found that calf circumference was associated with skeletal muscle mass, but not with sarcopenia (defined by DXA) [12]. In this study, the researchers found calf circumference measurement was compared with bioelectrical impedance analysis (BIA) to predict the onset of sarcopenia as being 34 cm and below in males (sensitivity 80.5%, specificity 55.4%) and 33 cm and below in females (sensitivity 70.9%, specificity 77.8%).The significance of calf circumference in the screening of sarcopenia has always been quite controversial. For the Ishii score chart, the screening model was constructed with age, grip strength, and calf circumference as objective indicators that were used in a mathematical formula to deduce the occurrence of sarcopenia. Male score = 0.62 ×(age-64) -3.09 ×(grip strength − 50) -4.64 ×(CC-42). Female score = 0.8 ×(age-64)- 5.09 ×(grip strength − 34)- 3.28 ×(CC-42). The results revealed that the higher the score, the higher the incidence of sarcopenia. It is recommended that ≥ 105 points in males and ≥ 120 points in females be used as the diagnostic cut-off points for sarcopenia [6]. When Chinese scholar Li Min [13] et al. took the AWGS2014 consensus as the diagnostic standard, geriatric inpatients were included. They found that the sensitivity and specificity of males were 90.9% and 70.4% respectively. The sensitivity and specificity of females were 82.4% and 70.0% respectively. Therefore, the Ishii score chart predicts sarcopenia with high sensitivity and specificity.

But, the Ishii score chart is mainly based on the European Working Group on Sarcopenia in Older People (EWGSOP) [14] consensus. Now, the AWGS2019 consensus has changed its previous diagnostic criteria, so whether the Ishii score chart is suitable for China needs to be verified. This study, therefore, intends to verify the accuracy of the Ishii score chart within the Chinese elderly community in an effort to find a suitable model of screening for sarcopenia.

Method

Participants

A total of 941 patients over 60 years of age who lived in the Yulin community, Jumper Tower community, and Grout Street community of Chengdu, Sichuan province for more than 12 months were included in the

study. Prior to study participation, subjects or their legal guardians voluntarily signed an informed consent approved by an independent Ethics committee/Institutional Review Committee (IEC/IRB). We excluded elderly with severe disease or advanced cancer, with physical disability, with hand/wrist or leg/foot within 3 months injury of surgery, with orthopedic metal implants, with electronic devices, and those using diuretics, except for the ones who use diuretics during antihypertensive therapy and the dose has been stable for more than 3 weeks. Any other condition or disease that the investigator considered inappropriate for the participation in the study was also excluded.

Muscle mass measurement

Muscle mass was measured by BIA using an Inbody720 (Inbody720, Biospace China Inc.). Appendicular skeletal muscle mass (ASM) was defined as the skeletal muscle present in the arms and legs.ASM was then normalized by height in meters squared to yield skeletal muscle mass index (SMI) (kg/m2)[1].

Muscle strength measurement

Muscle strength was assessed by handgrip strength, which was measured using a digital grip strength dynamometer (CAMRY EH 101). We performed measurements on each hand (n = 3) and only the highest values were recorded.

Physical performance measurement

Physical performance was assessed by the usual 6 m gait speed, accurate to 0.01 second. Participants were allowed to warm up for ~ 5 min and performed the 6 m walk twice. We took the average speed.

Other measurements

The height was measured in cm, accurate to 0.1 cm. The weight was measured in kg, accurate to 0.01 kg. The calf circumference was measured to 0.1 cm. The above indices were measured twice and the average value was taken.

Sarcopenia classification and measurement of each component of sarcopenia

We followed the recommendation of the AWGS2019[1].The proposed diagnostic criteria required the presence of low muscle mass plus the presence of either low muscle strength or low physical performance. If low muscle mass is accompanied by the presence of either low muscle strength or low physical performance, it would be considered severe sarcopenia. A low muscle mass was defined as the ASM index < 7.0 kg/m2 for males and < 5.7 kg/m2 for females. A grip strength of < 28 kg and < 18 kg was recorded for males and females. Low levels of physical performance were defined as gait speeds of < 1.0 m/s.

Statistical analysis

All analyses were stratified by sex. All analyses were carried out using IBM SPSS 21.0 (IBM, Armonk, NY, USA). Two-sided $P < 0.05$ was considered statistically significant. For quantitative data, if the data obeyed

normal distribution or unimodal symmetric distribution, the centralized discrete trend was selected for description; if the data had skewed distribution, M ± Q was selected to describe the centralized discrete trend. For classified data, absolute and relative numbers (composition ratio and ratio) were selected for statistical description. The predictive ability of the model is evaluated by the ROC curve (receiver operating characteristic curve), area under the curve (AUC), and the prediction result classification table corresponding to the probability boundary value obtained according to the ROC curve.

Results

1. In 2014, a total of 941 elderly people were included in the community, with the minimum age of 60 and the maximum age of 92, with an average age of 68.79±6.53 years old. The prevalence rate of sarcopenia was 18.38%, 19.91% for males and 16.91% for females, the various characteristics of sarcopenia patients by gender are shown in Table 1 .

2. The results revealed that when the Ishii score chart predicted sarcopenia, the AUC was 0.84 with 95% confidence interval (CI) ranging 0.80-0.89 for females and 0.81 with 95% CI ranging 0.75-0.86 for males, as shown in Figure 1. The cut-off point was 120 for females, the corresponding sensitivity was 45.7% and the specificity was 93.2%. The positive predictive value was 58%, the negative predictive value was 90%, the positive likelihood ratio was 6.92, and the negative likelihood ratio was 0.57, as shown in Table 2. The cut-off point was 105 for males, the corresponding sensitivity, specificity, positive and negative predictive value, positive and negative likelihood ratio were 53.3% , 88.9%, 47%, 92%, 4.46, and 0.41 respectively, as shown in Table3.

3. The AUC of the Ishii score chart that determines sarcopenia in both males and females is > 0.8. Considering the higher predictive value, this model is suitable. However, the original cut-off value is less sensitive when applied to the population and need to be adjusted. In females, the sensitivity and specificity of predictability were 75.3% and 80.2% respectively. When the Yoden index reached the highest level with a score of 102, the positive and negative predictive values were 43% and 94% respectively, the positive and negative ratio were 3.75 and 0.31 respectively (Table 4). Severe sarcopenia was suspected when the AUC was 0.96 with 95% CI ranging 0.94-0.98. When the cut-off value point for severe sarcopenia in females was set to 117, the sum of the sensitivity and specificity was maximized. The sensitivity, specificity, positive and negative predictive, positive and negative likelihood ratio values were 100%, 88.4%, 33%, 99%, 5.86, and 0.07 respectively (Figure 2). The sensitivity and specificity of predicting sarcopenia were 70.7% and 81.6% when the males Yoden index reached the highest level with a score of 95, the positive and negative predictive, positive and negative likelihood ratio were 49%, 92%, 4.05 , and 0.30 respectively (Table 5). Predicting severe sarcopenia, the AUC was 0.93 with 95% CI ranging 0.89-0.98, P<0.01, as shown Figure 2 .When the cut-off value point for severe sarcopenia was set to 108 in males, the sum of sensitivity and specificity was maximized, the sensitivity, specificity, positive and negative predictive values were 91.7%, 87%, 21%, and 97% respectively. The positive and negative likelihood ratios were 2.55 and 0.31 respectively.

Discussion

The Ishii score chart includes three sarcopenia indicators (age, grip strength, and calf circumference) which can easily be obtained within the elderly community. It is based on the consensus of EWGSOP which included 1971 community elders aged 65 and above. The AUC was 0.939 with 95% CI ranging 0.918–0.958 for males and 0.909 with 95% CI ranging 0.887–0.931 for females. When the sum of sensitivity and specificity was maximized, sensitivity, specificity, positive and negative predictive values for sarcopenia were 84.9%, 88.2%, 54.4%, and 97.5% for males, and 75.5%, 92.0%, 72.8%, and 93% for females respectively. At the same time, Li Min [13] et al. also verified the accuracy of the Ishii score chart based on the AWGS2014 consensus study. The study concluded that the AUC of male Ishii score was 0.94 with 95% CI ranging 0.88-1.00, the highest corresponding sensitivity and specificity of the Yoden index were 90.9% and 70.4% respectively. For females, however, the AUC was 0.79 with 95% CI ranging 0.65–0.92, the highest corresponding sensitivity and specificity of the Jorden index were 82.4% and 70.0% respectively. It is generally considered that $0.5 < AUC \leq 0.7$ means low predictive value, $0.7 < AUC \leq 0.8$ means certain predictive value, $0.8 < AUC \leq 0.9$ indicates the high predictive value, and $AUC > 0.9$ indicates very high predictive value. So, we consider that the Ishii score chart has high predictive value for predicting sarcopenia. Considering the operability, objectivity, and simplicity of the Ishii score chart, we chose it for verification. The Ishii score chart was verified among 941 people, and the results revealed that sarcopenia can be suspected when the AUC of both males and females were > 0.8.

Generally speaking, the "rule-out" screening test should have high sensitivity and high negative predictive value (NPV), while the "rule-in" screening test should have high specificity and high positive predictive value PPV [15]. Current screening methods are mostly "rule out" tests to identify people in the community who are not at risk of sarcopenia. We found that in the Ishii score chart for predicting sarcopenia, the negative predictive values of both males and females were 92% and 90% respectively. Therefore, it has a high negative predictive value. But the sensitivity corresponding to the original truncation value is low. Sensitivity, also known as true positive rate, refers to the ability of a diagnostic or screening tool to correctly identify actual sick people as patients or the percentage of sick people who are judged to be positive. Sensitivity is only related to the case group; the higher the sensitivity the higher the ability to correctly identify high-risk patients. The value of sensitivity is therefore dependent on the cut-off point, meaning the value would change with a change to the cut-off point. So, we adjusted the cut-off value to improve sensitivity. After adjusting the cut-off value, the sensitivity of the Ishii score chart in predicting sarcopenia for females improved from 45.7–75.3% and the sensitivity of males increased from 53.3–70.7%.

The Ishii score chart showed high sensitivity and specificity in predicting severe sarcopenia, indicating that the model is suitable for screening elderly people with severe sarcopenia. In our study, the Ishii score chart had higher accuracy in screening for severe sarcopenia as compared to sarcopenia. But, the sample size needs to be increased for better prediction in the future.

The study had some limitations. Firstly, we verified the Ishii score chart using select communities in Chengdu, the verification of populations in other regions was not performed. Therefore, it is not certain whether the results can be extended to populations in other regions and/or countries. Secondly, this study had a small number of sample cases. Moreover, all of the study participants were healthy volunteers, therefore introducing a deviation in the included population. For this reason, further studies are warranted using a large sample population.

Conclusion

After adjusting the cut-off, the Ishii score chart had high predictive value for predicting sarcopenia and severe sarcopenia in the elderly Chengdu community. We recommend male > 95 points and female > 102 points to be the diagnostic cut-off values for sarcopenia, and male > 108 points and female > 117 points to be the diagnostic cut-off values for severe sarcopenia.

Abbreviations

AWGS Asian Working Group for Sarcopenia

ROC receiver operating characteristic

AUC the area under the curve

CI confidence interval

SARC-F Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls scale

CC calf circumference

DXA dual x-ray absorptiometry

BIA bioelectrical impedance analysis

EWGSOP European Working Group on Sarcopenia in Older People

ASM Appendicular skeletal muscle mass

SMI skeletal muscle mass index

NPV negative predictive value

PPV positive predictive value

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of West China Hospital, Sichuan University. Participants were recruited by convenience and asked verbally by the researchers about their willingness to take part in the study. Before investigation, informed consent was signed and obtained by each participant.

Consent to publish

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available due to this is a database which has a lot of important information and we are applying some important projects based on this. But this dataset will be available 2 years later and is also available now from the corresponding author on a reasonable request.

Competing Interests

The authors declare no competing interests.

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Authors' contributions

XC designed the study and wrote the paper. LH, YZ SL take part in the interpretation of data. BD reviewed and edited the manuscript. All authors have read and approved the manuscript.

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References

1. Chen LK, Woo J, Assantachai P, et al. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment[J]. Journal of the American Medical Directors Association, 2020.,21(3):300–307.DOI:10.1016/j.jamda. 2019.12.012.
2. Cruz-Jentoft AJ, Sayer AA. Sarcopenia[J] Lancet. 2019;393(10191):2636–46.
3. Visvanathan R, Chapman I. Preventing sarcopaenia in older people[J]. Maturitas. 2010;66(4):383–8.

4. Malmstrom TK, Morley JE. SARC-F: A Simple Questionnaire to Rapidly Diagnose Sarcopenia[J]. J Am Med Dir Assoc. 2013;14(8):531–2.
5. Barbosa-Silva TG, Menezes AMB, Bielemann RM, et al. Enhancing SARC-F: Improving Sarcopenia Screening in the Clinical Practice[J]. Journal of the American Medical Directors Association, 2016:1136.
6. Ishii S, Tanaka T, Shibasaki K, et al. Development of a simple screening test for sarcopenia in older adults[J]. Geriatrics & Gerontology International, 2014, 14 Suppl 1:93–101.
7. Grimes DA, Schulz KF. Uses and abuses of screening tests.[J]. Lancet. 2002;359(9309):881–4.
8. Cao L, Chen S, Zou C, et al. A pilot study of the SARC-F scale on screening sarcopenia and physical disability in the Chinese older people[J]. Journal of Nutrition Health Aging. 2014;18(3):277–83.
9. Woo J, Leung J, Morley John E. Validating the SARC-F: a suitable community screening tool for sarcopenia?[J]. J Am Med Dir Assoc. 2014;15(9):630–4.
10. Miller J. Wells, et al. Validated screening tools for the assessment of cachexia, sarcopenia, and malnutrition: a systematic review[J]. Am J Clin Nutr. 2018;108(6):1196–208.
11. Ryoko K. Haruka, et al. Calf circumference as a surrogate marker of muscle mass for diagnosing sarcopenia in Japanese men and women[J]. Geriatrics Gerontology International. 2015;15(8):969–76.
12. Rolland Y,Valérie Lauwers-Cances,Maxime Cournot, et al.Sarcopenia, calf circumference, and physical function of elderly women: a cross-sectional study[J]..Journal of the American Geriatrics Society, 2003. 51(8): p. 1120–1124.
13. Li Min S, Jiqi R, Haiyan, et al. The application of Ishii's scores in The screening for sarcopenia in community elderly[J]. China Nursing Management. 2018;018(008):1034–8.
14. Cruz-Jentoft Alfonso J,Baeyens Jean Pierre,Bauer Jürgen M, et al.Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People[J].Age Ageing 2010; 39: 412–423.
15. Florkowski CM, Sensitivity. Specificity, Receiver-Operating Characteristic (ROC) Curves and Likelihood Ratios: Communicating the Performance of Diagnostic Tests[J]. Clinical Biochemist Reviews. 2008;29(Suppl 1(Suppl 1):83-7.

Tables

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Figures

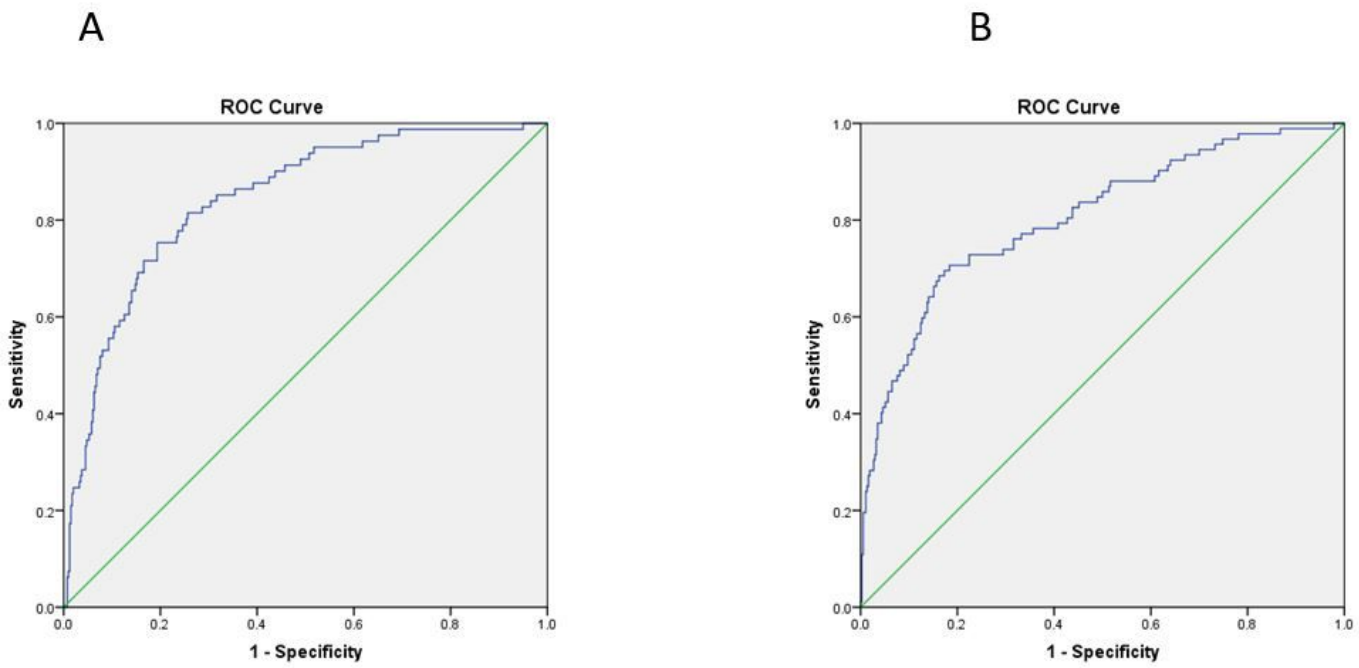

Figure 1

The Ishii score chart predicting sarcopenia in the elderly community in females (a) and in males (b).

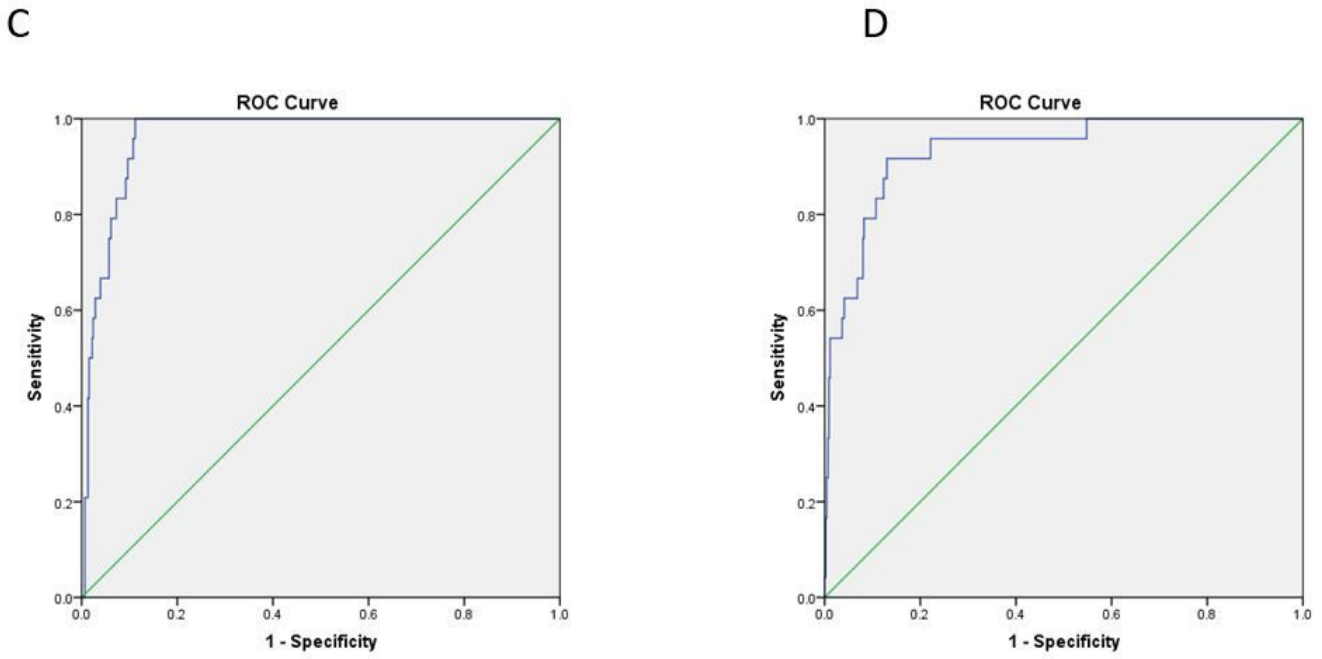

Figure 2

The Ishii score chart predicting severe sarcopenia in the elderly community in females (c) and in males (d).