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Anthropometric parameters as alternatives to identify visceral fat and cardiovascular risk in hepatitis C patients

Parâmetros antropométricos como alternativas para identificar gordura visceral e risco cardiovascular em pacientes com hepatite C

Parámetros antropométricos como alternativas para identificar grasa visceral y riesgo cardiovascular en pacientes con hepatitis C

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Abstract
Objective: To analyze the anthropometric parameters used as alternatives to identify visceral fat and cardiovascular risk in patients with hepatitis C. Methodology: Study carried out between June to November of 2017, with hepatitis C patients. Social data, lifestyle and biochemical parameters were collected. Anthropometric assessment was carried out, being measured height, weight, waist circumference and hip circumference were measured. Then, body mass index, waist and height ratio, waist-to-hip ratio, visceral adiposity index and Framinghan risk score were calculated. For statistical analysis, chi-square test was applied, and simple and multiple logistic regressions have been performed to explore the correlation between anthropometric parameters and Framingham risk score, adopting a 5% significance level. Statistical Package for Social Science software was used. Results: 55 patients evaluated. It was observed that 56.36% presented cardiovascular risk according to waist circumference and waist-to-hip ratio, 78.18% according to the waist and height ratio, and 74.55% according to the visceral adiposity index. In the relation between Framingham risk score and anthropometric parameters it was observed that waist-to-hip ratio was considered a significant independent predictor (OR=14.7000; CI95% = 3.5360 – 61.1180). Conclusion*:* For the identification of visceral fat, it

is suggested to use the waist-to-hip ratio because it indicated a probability for the development of cardiovascular events in individuals with hepatitis C.
Keywords: Cardiovascular diseases; Hepatitis C; Anthropometry; Nutrition assessment.

Resumo

Objetivo: Analisar os parâmetros antropométricos utilizados como alternativas para identificar gordura visceral e risco cardiovascular em pacientes com hepatite C. Metodologia*:* Estudo realizado em junho a novembro de 2017, com pacientes com hepatite C. Foram coletados dados sociais, estilo de vida e parâmetros bioquímicos. Foi realizada avaliação antropométrica, sendo mensurados altura, peso, circunferência da cintura e circunferência do quadril. Posteriormente, foram calculados o índice de massa corporal, relação cintura e estatura, relação cintura-quadril, índice de adiposidade visceral e Escore de risco de *Framingham*. Para a análise estatística, foram utilizados os testes qui-quadrado, e testes de regressão logística simples e múltiplas para explorar a correlação entre os parâmetros antropométricos e o escore de risco de *Framingham*, adotando-se o nível de significância de 5%. Foi utilizado o programa *Statistical Package for Social Science*. Resultados: 55 pacientes avaliados. Observou-se que 56,36% apresentaram risco cardiovascular de acordo com a circunferência da cintura e relação cintura-quadril, 78,18% de acordo com a relação cintura e estatura e 74,55% segundo o índice de adiposidade visceral. Na relação entre o Escore de risco de *Framingham* e parâmetros antropométricos, observou-se que a relação cintura-quadril foi considerada um previsor significativo independente (OR=14,7000; IC95% = 3,5360 – 61,1180). Conclusão: Para a identificação da gordura visceral, sugere-se que a relação cintura-quadril pode indicar probabilidade para o desenvolvimento de eventos cardiovasculares em indivíduos com hepatite C.
Palavras-chave: Doenças cardiovasculares; Hepatite C; Antropometria; Avaliação nutricional.

Resumen

Objetivo: Analizar los parámetros antropométricos utilizados como alternativas para identificar grasa visceral y riesgo cardiovascular en pacientes con hepatitis C. Metodología: Estudio realizado de junio a noviembre de 2017, con pacientes con hepatitis C. Se recogieron parámetros sociales, de estilo de vida y bioquímicos. Se realizó valoración antropométrica, midiendo talla, peso, perímetro de cintura y perímetro de cadera. Posteriormente se calculó el índice de masa corporal, índice cintura-estatura, índice cintura-cadera, índice de adiposidad visceral y puntaje de riesgo de Framingham. Para el análisis estadístico, se utilizaron pruebas de chi-cuadrado y pruebas de regresión logística simple y múltiple para explorar la correlación entre los parámetros antropométricos y el puntaje de riesgo de Framingham, adoptando un nivel de significación del 5%. Se utilizó el programa *Statistical Package for Social Science*. Resultados: 55 pacientes evaluados. Se observó que el 56,36% tenía riesgo cardiovascular según perímetro de cintura y relación cintura-cadera, el 78,18% según relación cintura-talla y el 74,55% según índice de adiposidad visceral. En la relación entre el Framingham Risk Score y los parámetros antropométricos, se observó que el índice cintura-cadera fue considerado un predictor independiente significativo (OR=14,7000; IC95% = 3,5360 – 61,1180). Conclusión: Para la identificación de la grasa visceral, se sugiere que la relación cintura-cadera puede indicar la probabilidad de desarrollo de eventos cardiovasculares en individuos con hepatitis C.
Palabras clave: Enfermedades cardiovasculares; Hepatitis C; Antropometría; Evaluación nutricional.

1. Introduction

The hepatitis C virus (HCV) infection allows metabolic alterations that may contribute to the development of metabolic syndrome, and consequently, insulin resistance (IR), type 2 diabetes mellitus (T2DM) and cardiovascular diseases (CVD) (Negro 2014). Besides, it is believed that the infection may allow chronic inflammation and can be responsible for possible modifications of the vascular endothelium (Badawi et al., 2018). In a study was evidenced that HCV infected patients presented from 2.5% to 3.5% higher chances of developing a cardiovascular problem in 10 years than the ones not infected (Badawi et al., 2018).

It is suggest that HCV can promote atherogenesis and its complications through different biological mechanisms, from which involve the virus' colonization and replication inside the arterial walls, hepatic steatosis and fibrosis, inflammatory cytokines' increased and unbalanced secretions, oxidative stress, cellular and humoral disorders, hyperhomocysteinemia, IR and T2DM (Domont & Cacoub, 2016). According to Petta (2017) a pro-inflammatory and pro-fibrogenic environment increases even more the development of cardiovascular lesions.

Thus, due to metabolic alterations and extrahepatic manifestations observed in patients, it is common to observe overweight in these individuals (Menta et al., 2015). Alves, Schmidt and Benet (2018) evidence that the high percentage of

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body fat observed in chronic hepatitis C patients is considered as an important risk factor to the appearance of CVD and other associated complications.

According to Gadekar et al. (2020) there is a massive necessity of simple methods, as of easy application, low cost and practices to be used as substitutes to body fat measuring. Therefore, it has been created parameters based in anthropometric data capable of estimating body fat and, consequently, identifying the cardiovascular risk, being able to be considered as good alternatives (Carvalho et al., 2015). Among these, it is highlighted the body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), waist and height ratio (WHtR) and visceral adiposity index (VAI) (Carvalho et al., 2015; Czeczelewski et al., 2020; Amato et al., 2010).

However, until this moment the researches that use such parameters in patients diagnosed with hepatitis C are scarce. Therefore, the present study has as objective analyzing the anthropometric parameters used as alternatives to identify visceral fat and cardiovascular risk in patients with hepatitis C.

2. Methodology

2.1 Study protocol and patients

Cross-sectional, descriptive and analytical study, because according to Zangirolami-Raimundo et al. (2018), cross-sectional studies allow the researcher to observe the variables at a single moment, being the collection of information carried out in a short space of time, without the follow-up of the individuals. As for descriptive studies, the main objective is to describe in a detailed and organized way one or more phenomena, and analytical studies, establish relationships and/or associations between two or more variables (Zangirolami-Raimundo et al., 2018)

Data collection was carried out between June and November in 2017. The sample was selected by convenience sampling with non-probabilistic methods. Participated patients from 32 to 74 years old, from both genders, diagnosed with hepatitis C, treated at a Brazilian Eastern Amazon reference center.

The exclusion criteria adopted were: liver disease by other viral agents which are not virus C carriers, pregnant and nursing mothers, edematous patients, ascites presence, clinical intercurrence that made impossible the research formulary and nutritional evaluation application.

2.2 Biochemical evaluation, life style, anthropometric assessment and Framingham risk score

It was applied a particular formulary developed by the research team, containing items related to social data (age and gender), biochemical evaluation, clinical characterization, and lifestyle. Data has been collected from the patients' medical record and/or during the interview.

Regarding the biochemical exams, values were collected from the patient's medical records. Were evaluated considering the reference values established by the Brazilian Society of Cardiology (2019): total cholesterol (TC) (<190 mg/dL), high-density lipoprotein cholesterol (HDL-c) (>40 mg/dL), low-density lipoprotein cholesterol (LDL-c) (<100 mg/dL) and triglycerides (TG) (<150 mg/dL).

For clinical characterization, information about the presence or absence of T2DM and systemic blood pressure values (mm/Hg), were collected from the patient's medical record.

Life style evaluation was carried out through investigation of the practice of physical activity, according to World Health Organization [WHO] (2004), existence of alcoholic consumption, considering the reference by the National Institute on Alcohol Abuse and Alcoholism [NIAAA] (2005) and smoking habits, as suggested by the WHO (2003).

Weight and height were measured in anthropometric evaluation, in a platform type weighing scale from Welmy® (Brazil) brand with a 180 kg capacity and 100g precision, with attached stadiometer, according to Lohman protocol (1988). In addition, for the BMI calculus the formula used was: weight (kg) / height squared (m^2). Parameters from the WHO (2000) and from Lipschitz (1994) were used for classification to adults and elderly, respectively.

WC measurement (cm) was performed using an inelastic measuring tape, at the midpoint between the iliac crest and the last rib, as suggested by the WHO (2000). For the cardiovascular risk evaluation, the parameters from WHO (2000) were considered.

Hip circumference (cm) was measured by going around the height of the largest gluteus circumference, with the aid of an inelastic measuring tape and making adjustments to avoid looseness (Rossi et al., 2017).

Then, WHtR was obtained by the formula: WHtR = WC (cm) / height (cm), and the patients were classified according to Ashwell and Hsieh (2005). WHR was obtained by the formula: WHR = WC (cm) / HC (cm), and the results was classified by Heyward and Stolarczyk (2000).

What regards VAI the formula suggested by Amato et al. (2010). For the male gender, VAI is calculated using the formula: VAI= (WC / 39.68 + (1.88 x BMI)) x (TG / 1.03) x (1.31 / HDL-c), and for the female gender: VAI= (WC / 36.58 + (1.89 x BMI)) x (TG / 0.81) x (1.52 / HDL-c). They were classified according to the presence of visceral adipose dysfunction associated with cardiovascular risk, as stated by Amato et al. (2011).

The Framingham risk score (D'Agostino et al., 2008) was calculated considering the variables: age, LDL-c, HDL-c, systemic blood pressure (mm/Hg), T2DM and smoking, for males and females. The results were classified as: low risk (risk less than 10%), moderate risk (values between 10% to 20%) or high risk (risk above 20%).

2.3 Statistical analysis and ethical aspects

The data were analyzed by Statistical Package for Social Science software. For analytical analysis, chi-square test was applied, and to explore the association between anthropometric parameters and Framingham risk score, simple and multiple logistic regressions have been performed. Were used adopting the alpha significance level of 5%. The Framingham risk score "moderate risk" and "high risk" categories were grouped into only one category for regression analyses. The Framingham risk score was considered as the dependent variable, and the anthropometric variables (BMI, WC, WRtH, WRH, VAI) were considered as independent.

Regarding ethical aspects, the present study is inserted in the research project "Clinical and nutritional evaluation of subjects diagnosed with viral hepatitis treated at a reference center in the Amazon" approved by the Research Ethics Committee of the reference hospital (number 2.084.522), complying with the legal requirements of Resolution n. 466/12 from the National Health Counsel (Brasil, 2012) according to the Helsinki Declaration. All participants signed an informed consent form.

3. Results

55 patients were evaluated with 56.85 (±12.67 years) average of age, from which 52.73% (n=29) was of female gender, as observed in the table 1. Regarding life style, 70.91% (n=39) of patients reported not practicing physical activities; 45.45% (n=25) did not consumed alcoholic beverage and 58.18% (n=32) did not present smoking habits. When the biochemical parameters were evaluated, it was observed that the majority of patients have presented adequate results of total cholesterol (76.36%; n=42; $p<0.001$) and triglycerides (83.64%; n=46; $p<0.001$). Regarding the Framingham risk score, it was observed that most participants were classified as low risk (56.37%; n=31) (Table 1).

Table 1 – Characterization of patients diagnosed with hepatitis C treated at a Brazilian Eastern Amazon reference center.

	Avarage ± SD / n	**Interval / %**
Age (years)	56.85 ±12.67	32 - 74
Gender		
Female	29	52.73
Male	26	47.27
Physical activity		
Practitioner	16	29.09
Non-practitioner	39	70.91
Alcoholic beverage		
Yes	10	18.18
No	25	45.45
Former drinker	20	36.36
Tobacco		
Yes	3	5.45
No	32	58.18
Former smoker	20	36.36
Total Cholesterol[a]		
Adequate	42	76.36
Inadequate	13	23.64
HDL-c		
Adequate	34	61.82
Inadequate	21	38.18
LDL-c		
Adequate	25	45.45
Inadequate	30	54.55
Triglycerides[a]		
Adequate	46	83.64
Inadequate	9	16.36
Framinghan risk score		
Low risk	31	56.37
Moderate risk	20	36.36
High risk	4	7.27

[a]Statistically significant (chi-square test); SD, standard deviation; HDL-c, high- density lipoprotein cholesterol; LDL-c, low- density lipoprotein cholesterol. Source: Authors

Regarding the anthropometric parameters, weight average observed was of 68.36 (±13.31) kg. It can be observed in Table 2 that 48.00% (n=12) of adults were classified with overweight and 46.67% (n=14) of elderly were eutrophic and overweight, according to BMI. Regarding the CVD's risk, it is observed that 56.36% (n=31) presented cardiovascular risk when the WC was evaluated, 78.18% (n=43) according to WHtR, 56.36% (n=31) according to WHR, and the 74.55% (n=41) when the VAI was evaluated (Table 2).

Table 2 – Anthropometric parameters of patients diagnosed with hepatitis C treated at a Brazilian Eastern Amazon reference center.

Parameters	n	%
Adult BMI (n= 25)		
Eutrophy	7	28.00
Overweight	12	48.00
Obesity	6	24.00
Elderly BMI (n= 30)		
Low weight	2	6.66
Eutrophy	14	46.67
Overweight	14	46.67
WC		
Risk for CVD	31	56.36
No risk for CVD	24	43.64
WHtR		
Risk for CVD	43	78.18
No risk for CVD	12	21.82
WHR		
Risk for CVD	31	56.36
No risk for CVD	24	43.64
VAI		
Risk for CVD	41	74.55
No risk for CVD	14	25.45

BMI, body mass index; CVD, cardiovascular diseases; VAI, visceral adiposity index; WC, waist circumference; WHR, waist-to-hip ratio; WHtR, waist and height ratio. Source: Authors.

When evaluated the relation between Framingham risk score and BMI, WC, WHtR, WHR and VAI it is observed in Table 3 that there had been significance between the VAI and WHtR and WHR. However, when multivariate analysis was performed, only the WHR remained significant [$X^2(1) = 18.282$; $p<0.0001$, $R^2_{\text{Negelkerke}} = 0.379$]. Therefore, only the WHR was considered an independent significant predictor (OR=14.7000; IC95% = 3.5360 – 61.1180).

Table 3 – Unadjusted and adjusted OR for of association between Framinghan risk score and antropometric parameters.

Variables	Coefficient	Standard Error	Wald	p-value*	Unadjusted OR [CI 95%]	Adjusted OR [CI 95%]
BMI	-0.2920	0.5510	0.2820	0.5957	0.7464 [0.2530 – 2.1990]	0.2153 [0.0322 – 1.4379]
WC	0.7580	0.5630	1.8140	0.1781	2.1330 [0.7080 – 6.4280]	1.3643 [0.2142 – 8.6918]
WHtR	1.6560	0.8330	3.9570	0.0467	5.238 [1.025 – 26.780]	3.4150 [0.2440 – 47.7790]
WHR	2.6680	0.7270	13.6680	0.0000	14.7000 [3.5360 – 61.1180]	13.917 [2.3515 – 82.3674]
VAI	0.4412	0.6397	0.4757	0.4904	1.5550 [0.4440 – 5.4460]	0.4317 [0.0692 – 2.6905]

*Logistic regressions; BMI, body mass index; CI, confidence interval; CVD, cardiovascular diseases; OR, odds ratio; VAI, visceral adiposity index; WC, waist circumference; WHR, waist-to-hip ratio; WHtR, waist and height ratio; Source: Authors.

4. Discussion

In this present study was possible analyzed the anthropometric parameters of risk identification to cardiovascular diseases in patients diagnosed with hepatitis C. The majority of patients were female, similarly as observed by Menta et al.

(2015) in which 54.0% of hepatitis C patients were female. Regarding the lifestyle evaluation, this present research evidenced a high rate of physical inactivity. Hudson et al. (2015) reported that the practice of physical activity with restrictions is well tolerated in chronic hepatitis C patients, including cirrhotic patients, and the authors also present association with the reduction of the circulating liver enzymes, body fat and insulin resistance. Nonetheless, if the treatment load (intensity, volume, frequency and density) is not adequate to the subject it can show negative effects.

Regarding the alcoholism, results of this present study was differently from observed in the Cortes et al. (2017) study, in which all individuals presented alcohol consumption history, 38.9% of them being classified as alcohol abusers and 56.7% as dependents. It is important to mention that according to the authors alcohol consumption is one of the factors that contribute to the infection progression.

As of smoking, the result was similar to the Beltrão et al. (2015) study in which the authors had as objective to associate the nutritional state with the gravity stage of the chronic hepatic disease, and observed that the majority of the evaluated patients was classified as non-smoker. The authors reported that the stage and the disease's clinical conditions induce the patients to stop such habit, once that nicotine can contribute to fibrogenesis.

In the biochemical parameters it was observed that most patients had adequate levels of TC and TG. Pesset et al. (2016) found high levels of TC and TG only in 14.0% of patients with hepatitis C and hepatic steatosis, and 9.9% in individuals without steatosis. In the Muñoz-Cabrejas et al. (2020) study, the authors mention that patients with chronic HCV infection present a lipid-lowering pattern, with a decrease in TC levels, due to the fact that lipoproteins presented a fundamental role in the virus life cycle. So the virus promotes lipogenesis, reducing the oxidation of fatty acids and decreasing the export of lipids. As for triglycerides, Miyajima et al. (2013) also found that chronic HCV infection promotes significantly lower levels of TG, compared to the group of inactive infection and uninfected patients. Nevertheless, Munoz-Cabrejas et al. (2020) mention that although an adequate lipid pattern is observed, there is an increase in cardiovascular events associated with HCV infection, due to other pathophysiological mechanisms.

On evaluating the anthropometric parameters, the majority of adult patients was diagnosed with overweight. In the Santis and Silva et al. (2015) study, the majority of hepatitis C patients presented obesity (34%) or overweight (20%) according to BMI. However, Czeczelewski et al. (2020) report that despite being largely used, BMI is not a precise indicator of CV risk identification, once it does not evaluate body fat distribution.

In the Hu et al. (2004) study it has been verified that the HCV infection was the main cause of alterations in the BMI and lipid levels, and was positively associated to T2DM, cardiovascular events and kidney diseases. Besides, according to Badawi (2018), overweight can contribute to the LDL-C levels increase, corroborating with the observed this present study.

Regarding the anthropometric parameters commonly used to estimate the body composition and CV risk, the majority of patients from this present research was diagnosed with CV risk in all employed methods. Furthermore, it is important to highlight that there was not found studies in which such anthropometric indexes were evaluated in hepatitis C patients.

Regarding the WC, according to Czeczelewski et al. (2020) it is the basic clinic indicator employed to evaluate visceral fat and presents as advantage the measurement simplicity, besides not needing an additional calculus in order to obtain results. In the Zhao et al. (2017) study the authors observed that the SAH risk increased significantly with the WC elevation in both genders' subjects in a Chinese population.

As for the WHR, once it is turned towards the visceral adiposity, it is routinely employed in the CV risk prediction, and present a good level of reliability and low cost (Carvalho et al., 2015). In the Medina et al. (2017) study the authors observed that the WHR is associated with a higher risk of cardiovascular events among women, but not in men presenting coronary artery disease. As well as Streng et al. (2018) observed that increased WHR was associated to a higher mortality in women with cardiac insufficiency, but not in men. The authors suggest that the difference found between genders can be due to the body fat distribution, once men accumulate more visceral fat and women store subcutaneous fat in the gluteal-femoral region (Streng et al., 2018).

Regarding the WHtR, it is considered a method which presents advantage over the isolated employment of WC to verify the risk of CVD, that is, it is significantly associated to all risk factors for obesity and metabolic syndrome, presenting better index of dyslipidemia prognosis, SAH and risk of CVD, in both genders, according to Ashwell and Hsieh (2005). Hsieh and Muto (2005) compared in non-obese Japanese the effects of age, BMI, WC and WHtR with coronary risk factors and the sensibilities and specificities of proposed anthropometric indexes, and observed that the WHtR identified more subjects in CV risk and presented more sensibility in identification when compared to the other parameters, in both genders.

On evaluating VAI, Jablonowsk-Lietz et al. (2017) carried out a study in the National Food and Nutrition Institute in Warsaw, and suggested that VAI is a method that can be considered useful in daily clinic practice and in populational studies, and to the evaluation of cardiometabolic risk associated with visceral adiposity, being a substitute marker for the dyslipidemia dysfunction and insulin resistance. According to Czeczelewski et al. (2020) VAI can be considered a useful indicator to trace dyslipidemia, hyperuricemia, hyperglycemia, SAH and CV risk factors associated.

In the Kouli et al. (2017) study, authors had as objective evaluating associations between VAI and the incidence of cardiovascular disease in 10 years, and observed that VAI is independently associated to a elevated risk for CVD, suggesting to be an additional indicator that can be employed to identify CV risk in a long term in Caucasian/Mediterranean men without previous CVD. Bagyura et al. (2020) evaluated the association between VAI and the coronary artery calcium score in asymptomatic Caucasian population, and observed that the method can be a clinical marker of cardiometabolic risk and central obesity mainly in men, it can though present ethnical difference. It highlights the necessity of more studies which evaluate the association of VAI with the risk of CVD development in Brazilian population.

From logistical regression between Framingham risk score with the anthropometric variables to identify the CVD, it was observed that WHR was considered an independent significant predictor. There has not been found studies in hepatitis C patients, but Aparicio et al. (2019) assessed the risk of ischemic stroke associated with BMI, WC, and WHR in a community sample, and observed that higher WHR predicted 10-year risk of ischemic stroke. Therefore, the authors suggest that the WHR is a simple measure of abdominal obesity that should be used in future studies investigating weight loss interventions for stroke prevention.

Medina-Inojosa et al. (2018) evaluated whether patients with established coronary artery disease and central obesity, defined as an elevated WHR, have an increased risk of adverse cardiovascular events when compared to patients without central obesity, and observed that WHR is associated with a higher risk of adverse cardiovascular events among women. Streng et al. (2018) evaluated the association between abdominal fat (as measured by WHR), BMI, and all-cause mortality in patients with heart failure, and found that increased WHR values were associated with a higher risk of death in female patients with heart failure.

Gadekar et al. (2020) study the authors had as objective to evaluate the correlation between visceral fat area and WHR, WC and BMI in healthy young adults, and observed a strong correlation between visceral fat and the WHR. Thus, authors consider a method that can be used as substitute to measure visceral fat.

Therefore, from the observed results it is suggested that health professionals may employ WHR parameter, for it is practical methods, of low cost, easy measurement and considered useful measuring for the visceral fat identification and, consequently, CV risk. Once the more effective parameters employed for measurement are instruments less accessible due to its high cost, such as bioimpedance, magnetic resonance imaging (MRI) and dual energy X-ray absorptiometry (DEXA).

Notwithstanding, this present study presents as limitation being a transversal research with non-probabilistic sampling by convenience, exposing the necessity of more research which investigate the relation between such anthropometric parameters in hepatitis C patients. In addition, equipments of high technology were not used, such as bioimpedance, DEXA, MRI or ultrasound, which present with higher precision the individuals body composition, thus our study cannot determine the accuracy of substitute anthropometric parameters for the visceral fat evaluation.

5. Final Considerations

This study verified the presence of CV risk factors in HCV patients when evaluated the anthropometric parameters. In addition, our result shows that WRH is independently associated with 10-year CVD risk. Therefore, it is suggested the use of WHR because it indicated a probability for the development of cardiovascular events in individuals with hepatitis C.

However, it is important highlighting the research's scarcity that evaluate the anthropometric parameters specifically in patients diagnosed with hepatitis C, more studies being necessary to clarify this relation, once such information are fundamental to the identification of anthropometric measurements that can be used by health professionals in a practical way to precocious identification and consequently prevention of CVD.

Therefore, it is suggested new studies of nutritional intervention that evaluate body composition through anthropometric parameters and more technological equipment, besides investigating the patients' eating habits in order to verify the impact in the hepatitis C patients' nutritional state and thus confirming this study's results.

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