

Clinical Study

Poor Perception of Body Weight Category amongst the Overweight and Obese with Chronic Hepatitis C: A Target for Intervention

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Obesity in chronic hepatitis C (CHC) is associated with adverse hepatic and metabolic outcomes. This prospective study evaluates the agreement between self-perceived body weight (BW) status and measured body mass index (BMI) category and factors associated with its underestimation in CHC. Body size perception was measured with the Contour Drawing Rating Scale. Two hundred and seventy-three patients with CHC (overweight 45%, obese 18%) participated in this study. Although both overweight and obese demonstrated good body size perception, agreement between perceived BW and measured BMI categories was poor ($\kappa = 0.315$, 95% CI 0.231–0.399); 33% of overweight/obese respondents considered themselves normal or underweight. Male gender (OR 2.84) and overweight (OR 2.42) or obese BMI (OR 14.19) were associated with underestimation of BW category. Targeted interventions are needed to improve body weight perception, thereby enhancing the uptake of health advice on management of excess body weight in CHC.

1. Introduction

Obesity (body mass index, BMI ≥ 30 kg/m²) is a worldwide health hazard, the prevalence of which has increased steadily over time. Hepatitis C virus (HCV) chronically infects 170 million worldwide [1]. Untreated, CHC is associated with significant long-term clinical consequences including cirrhosis, liver failure and hepatocellular cancer (HCC). Recent observations suggest a mechanistic link between hepatitis C viremia and the development of obesity. The prevalence of obesity amongst patients with CHC in a tertiary referral unit in Canada was reported to be 28.8%, over double that of the general population [2]. Obesity was observed significantly more often amongst viremic patients with CHC than in matched patients exposed to hepatitis C (i.e., HCV antibody positive) but who were not viremic [2].

Furthermore, leptin receptor expression has been observed to be increased in hepatocyte cell cultures transfected with the hepatitis C viral core protein [3].

Body weight influences both the hepatic and metabolic outcomes in CHC in that obesity in CHC is associated with nonresponse to antiviral therapy and higher risk of HCC [4, 5]. Both obesity and CHC are independently associated with a range of metabolic manifestations including hepatic steatosis, insulin resistance (IR), and type 2 diabetes [6, 7]. These metabolic complications also impair response to peginterferon and ribavirin (the standard of care) and are associated with more rapid progression of liver disease thereby increasing the risk for the development of cirrhosis and HCC [8, 9]. Obese individuals who go on to liver transplantation experience higher rates of posttransplant diabetes and reduced survival [6, 10].

Obesity is an important potentially modifiable risk factor, which if identified and intervened upon may lead to a reduction in these adverse outcomes in CHC. However, overweight or obese individuals who do not perceive themselves to be overweight or obese may fail to seek or respond to such interventions. Self-perceived weight status correlates more strongly than actual BMI with intentions and actions to avoid weight gain [11]. Population studies from the USA and Europe indicate that male gender, age, lower socioeconomic status, ethnic origin, level of education, and rural (versus urban) area of residence influence subjective weight status [11–14]. To date, body weight perception has not been studied specifically in patients with CHC.

Brief intervention administered through pamphlet mail-out led to increased awareness of healthy weight ranges and improved eating habits in a population-based cohort [15]. In the primary care setting, brief low intensity face-to-face intervention achieves benefits similar to those achieved by more intensive interventions and pharmacotherapy [16]. Such interventions aimed at improving perception, thereby promoting a change in behavior, may be helpful in overweight and obese patients with CHC who are at high risk for hepatic and metabolic complications specifically related to their infection.

Therefore, the primary aim of this study was to determine whether agreement exists between perceived body weight status and measured BMI category in patients with chronic hepatitis C. We hypothesized that BW category underestimation would occur more often amongst the overweight and obese as compared to their counterparts with a normal BMI. We aimed to identify any additional patient characteristics associated with underestimation of BW category thereby identifying patient subgroups that may require targeted education. The secondary aim was to determine whether a brief educational intervention might improve the accuracy of body weight perception, as measured via a change in agreement over time.

2. Subjects and Methods

This prospective study conforms to the ethical guidelines of the 1975 Declaration of Helsinki and its amendments as reflected in a priori approval by the Research Ethics Board of the University Health Network; informed consent was obtained from each patient included in the study. Between March 2009 and August 2009, all patients with CHC attending the liver clinic of Toronto Western Hospital were eligible for inclusion. Patients with ascites, hepatoma, or pregnancy were excluded from participation as body weight is influenced by these conditions. As the overweight/obese were the target for intervention, patients who were identified as underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$) were also excluded.

During the study period, 736 patients with CHC attended the liver clinic. A convenience sample of 305 patients was approached to participate in the study, of which 22 refused (7.2%). Ten patients were excluded (1 pregnant, 5 ascites and/or hepatoma, 4 underweight). Hence 273 (37% of hepatitis C clinic attendees) patients initiated the study.

Height in metres (m) to the nearest 0.01 m and body weight (BW) in kilograms (kg) to the nearest 0.1 kg are routinely measured at each clinic visit. Patients were informed of their measurements and then completed a structured questionnaire designed for the purposes of the study. Based on their current weight, participants were asked to classify themselves as “underweight,” “about the right weight,” “overweight,” or “very overweight.” Moreover, they were asked to report their perception of the absolute body weight (in pounds or kilograms) that they would have to be in order to be considered “about the right weight,” “overweight,” or “very overweight (obese).” Thirdly, perception of “self” and “healthy” body size was performed with the use of the Contour Drawing Rating Scale (CDRS) [17]. This is a validated tool consisting of 9 male and 9 female contour drawings increasing size/body contour marked 1 (thinnest) to 9 (widest) allowing an ordinal value to be assigned to the image selected. Participants were asked to put a cross over the body shape image that they perceived to best represent their “current body shape,” and a subsequently a “healthy body shape.” As no definition for “healthy” exists on this scale, the ordinal scale was to be used to compare respondents’ relative perceptions of body size.

Actual BMI was calculated for each patient using the equation: measured weight (kg) divided by the square of height (m). Respondents’ were categorised by the World Health Organization (WHO) definitions of normal (BMI 18.5–24.9), overweight (BMI 25–29.9), and obese (BMI ≥ 30) [18].

Demographic and clinical data collected included age, gender, ethnicity, years of education, area of residence, employment status, antiviral treatment status, stage of liver disease (cirrhotic or noncirrhotic), and presence of any concurrent metabolic diseases (diabetes, hypertension, hyperlipidemia, or cardiovascular disease). These characteristics were selected because they have previously been reported to be associated with overweight/obesity, hence their influence on body weight perception was to be determined.

After completion of the questionnaire, participants were given immediate feedback by the investigators in the form of a printed “fact sheet” and face-to-face education administered over 5–10 minutes. The intervention was designed both for the evidence supporting the utility of brief interventions [15, 16] and to ensure the feasibility of its administration in a hepatology clinic. The fact sheet combined both general and tailored information, as tailoring has been shown to positively influence health behaviour change when compared to nontailored methods [19, 20]. This fact sheet outlined the WHO definitions of body mass index (BMI) categories and information specific to the respondent (the calculated body weight ranges that would correspond to normal, overweight, and very overweight (obese) for their height). The significance of body weight in CHC was also explained, as were recommendations for simple measures to attain or maintain healthy body weight based on the Health Canada guidelines [21, 22].

A follow-up questionnaire was mailed to participants 4–6 weeks later (comprising the same questions regarding perception as the initial questionnaire) to determine how

perception of body weight changed with the intervention. Of the 273 patients that initiated the study, 104 (38%) returned the follow-up questionnaire.

Statistical analyses were performed using SPSS 17.0 (Chicago, USA) and WinBUGS (MRC Biostatistics, Cambridge, UK). The primary outcome for analysis was underestimation of BW category. Participants were categorised as underestimators if their self-perceived BW category was lower than their measured BMI category. Cohen's kappa statistics were computed to measure agreement. Univariate logistic regression was used to determine variables associated with underestimation of BW category; factors significantly associated with underestimation of BW category at univariate analysis (i.e., 95% confidence interval not crossing 1.0) were entered into the multiple logistic regression model. Collinearity between variables was evaluated using pseudo-R-square test. The "goodness of fit" of final model was confirmed with the Akaike information criterion (AIC); the covariates included in the final model minimized the AIC. The results of the postintervention questionnaire were compared with those at baseline only for those patients who completed both questionnaires.

3. Results

Table 1 lists the demographic and clinical characteristics of the 273 patients who completed the baseline questionnaire. Calculated from weight and height measurements at baseline, 37% had a normal BMI, 45% were overweight, and 18% were obese.

3.1. Perception of Body Size. With regard to the respondents' selection of body contour image associated with their current body size (i.e., "self"), there was a wide range of responses across each of the BMI categories (Figure 1(a)). Overall, obese respondents tended to select images higher (i.e., larger) on the CDRS than overweight respondents, who in turn selected images higher on the scale than normal BMI respondents. This indicated that respondents had good perceptions of their body size relative to others. Across all BMI categories, respondents most frequently identified "healthy" body size with images in the centre of the CDRS (Figure 1(b)), suggesting that regardless of their current weight status, respondents had similar perceptions of healthy body size.

3.2. Agreement between Self-Perceived Body Weight Category and Measured BMI Category (Table 2). There was poor agreement between respondents' perceived BW category and their measured BMI category ($\kappa = 0.315$, 95% CI 0.231–0.399). Only 56% of respondents' perceived BW categories corresponded to their measured BMI category. Fifty percent of overweight and obese respondents underestimated their BW category, 2/3 of these considering themselves normal or even underweight. Although the majority of obese individuals considered themselves to be in a category higher than "normal", almost 2/3 of obese did not recognise the degree of their overweight, categorising themselves as only overweight rather than very overweight (obese).

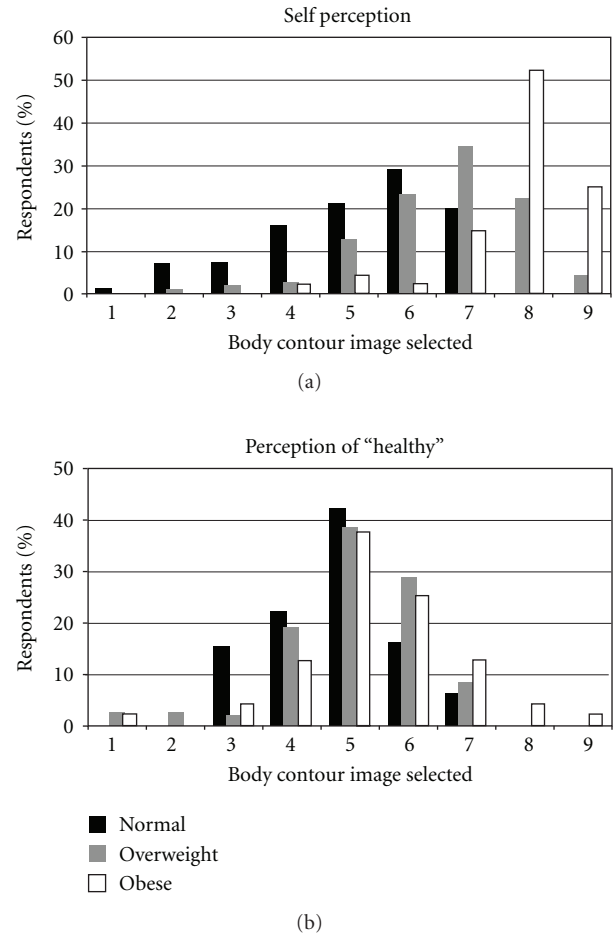


FIGURE 1: Contour Drawing Rating Scale results. Body shape perceived to be associated with (a) "self" and (b) "healthy".

3.3. Body Weights Perceived to Be Associated with Normal, Overweight, and Very Overweight (Obese). Amongst respondents with normal BMI, the mean BMI calculated from weights perceived to be associated with normal, overweight, and very overweight (obese) closely corresponded to BMI categories as defined by WHO (Table 3). However, amongst overweight and obese respondents, the weights perceived to be associated with the BW categories corresponded to higher BMIs. For example, obese respondents reported weights perceived to be associated with "very overweight (obese)" corresponding to a mean BMI of $36 \pm 6.4 \text{ kg/m}^2$, whilst the corresponding mean BMI for overweight and normal respondents were $32.9 \pm 11.7 \text{ kg/m}^2$ and $29.4 \pm 6.5 \text{ kg/m}^2$, respectively. These results indicate that overweight and obese individuals have poor perceptions of the absolute weights associated with being overweight and obese and that the magnitude of the discrepancy is larger for obese compared to overweight and normal subjects.

3.4. Factors Associated with Underestimation of Body Weight Category (Table 4). Univariate analysis of the demographic and clinical characteristics (from Table 1) was performed to

TABLE 1: Demographic and clinical characteristics of patients answering baseline questionnaire.

Characteristic	Measured BMI category		
	Normal <i>n</i> = 101 (37%)	Overweight <i>n</i> = 124 (45%)	Obese <i>n</i> = 48 (18%)
BMI (kg/m ²)	22.2 ± 1.9	27.2 ± 1.4	33.6 ± 3.9
<i>Demographic characteristics</i>			
Age (years)	51.4 ± 11.8	53.5 ± 10.9	53.0 ± 9.8
Gender (male)	53 (52%)	83 (67%)	30 (62%)
Ethnicity			
Caucasian	74 (73%)	88 (72%)	34 (70%)
East/South-East Asian	15 (15%)	7 (6%)	1 (2%)
South Asian	3 (3%)	13 (10%)	6 (13%)
Other	9 (9%)	15 (12%)	7 (15%)
Canadian born	54 (53%)	64 (52%)	31 (65%)
Area of residence (urban)	77 (76%)	87 (70%)	28 (58%)
Years of education	13.1 ± 3.64	12.8 ± 4.0	11.7 ± 3.4
Employment (employed)	51 (51%)	70 (56%)	17 (35%)
<i>Clinical Characteristics</i>			
Treatment status			
Naïve	57 (56%)	53 (43%)	17 (35%)
Nonresponder/relapser	27 (27%)	36 (29%)	19 (40%)
SVR	9 (9%)	25 (20%)	8 (17%)
On treatment	3 (3%)	5 (4%)	3 (6%)
Spontaneous clearance (untreated)	4 (4%)	5 (4%)	1 (2%)
HCV RNA positive	88 (87%)	94 (76%)	39 (81%)
Cirrhosis	31 (31%)	54 (44%)	25 (52%)
Diabetes	6 (6%)	14 (11%)	6 (12%)
Hypertension	16 (16%)	30 (24%)	13 (27%)
Hyperlipidemia	6 (6%)	11 (9%)	5 (10%)
Cardiovascular disease	4 (4%)	4 (3%)	3 (6%)
Any metabolic disease	24 (24%)	41 (33%)	19 (40%)

Results are expressed as mean ± standard deviation or *n* (%) where appropriate.

TABLE 2: Survey responses—measured BMI category versus perceived body weight category.

		Measured BMI category			
		Underweight	Normal <i>n</i> = 101 (37%)	Overweight <i>n</i> = 123 (45%)	Obese <i>n</i> = 48 (18%)
Considering your <i>current</i> weight, how would you classify yourself? <i>n</i> = 272	Underweight	0 (0%)	21 (21%)	2 (2%)	0 (0%)
	About right (normal)	0 (0%)	69 (68%)	47 (38%)	7 (14.5%)
	Overweight	0 (0%)	11 (11%)	74 (60%)	30 (62.5%)
	Very overweight (obese)	0 (0%)	0 (0%)	0 (0%)	11 (23%)

Cases in bold represent numbers (%) of respondents who underestimated their BMI category. $\kappa = 0.315$, 95% CI 0.231–0.399.

identify factors associated with underestimation of BW category. Demographic characteristics associated with underestimation included male gender, rural area of residence, fewer years of education, and unemployment. Clinical factors associated with underestimation included obese or

overweight BMI and a history of diabetes, hypertension, or “any metabolic disease”.

The final multivariate model included the covariates found to be significant at univariate analysis with the exception of diabetes and hypertension (as hypertension

TABLE 3: Survey responses—corresponding BMI calculated from weights perceived to be associated with body weight categories.

		Measured BMI category		
		Normal <i>n</i> = 101	Overweight <i>n</i> = 124	Obese <i>n</i> = 48
BMI (kg/m ²) calculated from perceived weight	What do you think your weight <i>should</i> be to be considered <i>about right (normal)</i> ?	22.3 ± 1.8 <i>n</i> = 99	25.11 ± 1.77 <i>n</i> = 123	27.2 ± 2.8 <i>n</i> = 48
	What do you think your weight <i>would</i> have to be to be considered <i>overweight</i> ?	25.5 ± 2.8 <i>n</i> = 96	28.5 ± 4.1 <i>n</i> = 120	30.5 ± 4.3 <i>n</i> = 47
	What do you think your weight <i>would</i> have to be to be considered <i>very overweight (obese)</i> ?	29.4 ± 6.5 <i>n</i> = 95	32.9 ± 11.7 <i>n</i> = 120	36.0 ± 6.4 <i>n</i> = 47

Results are expressed as mean ± SD and number of respondents (*n*) for each item.

and diabetes were subsets of “any metabolic disease”, and collinearity with “any metabolic disease” was confirmed) and area of residence (because of its marginal contribution to the overall model fit). Multivariate analysis demonstrated that overweight and obese BMI and male gender were significantly associated with underestimation of BW category.

We explored whether the findings would change if Asian participants were recategorised using WHO-suggested race-specific (i.e., lower) BMI cut-offs for overweight and obese [23]. An additional 7 Asian respondents would have been categorised as “underestimators”, thereby further reducing the agreement between actual BMI category and perceived BW category. The factors found to be significant by univariate and multivariate analysis were unchanged (data not shown), therefore not affecting the overall observations of the present study.

3.5. Impact of the Brief Educational Intervention. One hundred and four respondents returned the follow-up questionnaire (38.1%). This follow-up cohort was not significantly different in any of the baseline clinical or demographic characteristics to the cohort who declined to participate in the follow-up questionnaire.

The rate of underestimation of body weight category was 38.5% (40/104) preintervention and 41.3% (43/104) postintervention; when comparing the agreement between perceived BW category and measured BMI category before and after the educational intervention, no significant change was observed ($\kappa = 0.366$, 95% CI 0.253–0.501 versus 0.309, 95% CI 0.182–0.442). Although the BMIs calculated from weights perceived to be associated with normal, overweight, and very overweight (obese) at followup were still discrepant to the WHO cut-offs, mean BMIs calculated from perceived weights tended to be lower (i.e., closer to the WHO cut-offs) suggesting a trend to improvement in BW perception across the groups after the brief educational intervention (Figure 2).

4. Discussion

Attaining and maintaining healthy body weight is a vital consideration in the management of patients with CHC. This study demonstrates that although patients with CHC

TABLE 4: Logistic regression for predictors of BMI category underestimation.

Characteristic	Univariate OR (95% CI)	Multivariate OR (95% CI)
BMI		
Normal	Ref	Ref
Overweight	2.57 (1.41–4.69)	2.42 (1.29–4.55)
Obese	12.81 (4.69–29.30)	14.19 (5.71–35.28)
Gender (Male)	2.28 (1.35–3.83)	2.84 (1.52–5.30)
Area of residence		
Urban	Ref	—
Rural	1.77 (1.05–3.01)	
Years of education	0.92 (0.86–0.98)	0.94 (0.86–1.01)
Employment		
Employed	Ref	Ref
Unemployed	1.83 (1.12–3.00)	1.59 (0.87–2.89)
Any metabolic disease	2.15 (1.27–3.62)	1.50 (0.82–2.74)
Diabetes	3.23 (1.39–7.56)	—
Hypertension	1.8 (1.01–3.23)	—

CI: confidence interval.

have good perception of their body size in relation to a “healthy” body size, one third perceived that they were normal or underweight. The majority of obese that recognise their excess body weight do not recognise their *degree* of overweight. Overweight and obese had poor perceptions of the absolute body weights associated with normal, overweight, and obese as demonstrated by the higher BMIs calculated from the perceived weights. By obtaining quantitative measures of perception of body weight with regard to BW category, we have demonstrated that the overweight/obese with CHC do not appreciate when substantial excess body weight is already present. Although studies have examined body weight perception in the general population, diabetics, children and adolescents, and in cohorts with eating disorders, no studies prior to ours have studied body weight perception in CHC. In view of the important adverse hepatic and metabolic sequelae of obesity in the setting of CHC, the findings of this study need to be addressed.

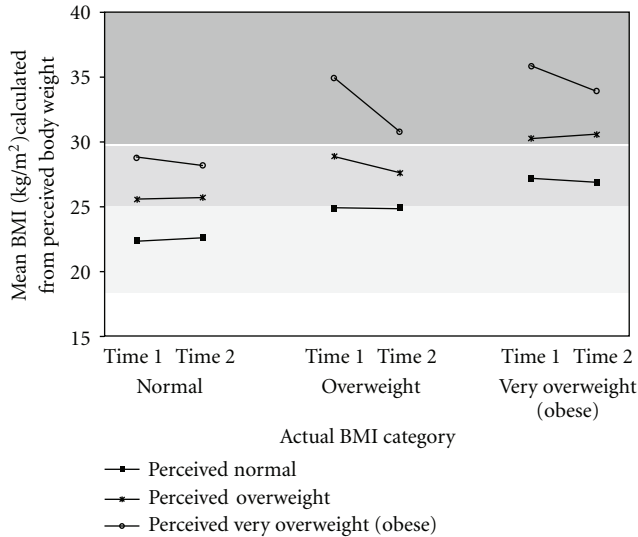


FIGURE 2: Pre- and postintervention calculated BMIs perceived to be associated with normal, overweight and very overweight including only the participants responding to both pre- and postintervention questionnaires. There is a trend to reduction in calculated BMI from perceived body weights, but responses from overweight and obese respondents are still discrepant from WHO cut-offs after the educational intervention.

An important aspect of our study design was the actual measurement of weight and height at the time of questionnaire, rather than relying on self-reported weight and height as done by some population studies examining this field [11, 12]. Self-reported weight and height may themselves be subject to mis-perception and hence be inaccurate, potentially biasing the findings of obesity studies [24–26]. Being overweight or obese was independently associated with underestimation of BW category implying that poor perception or awareness of appropriate body weight likely contributes to behaviours that directly lead to an individual's body weight excess. There is clear evidence that the prevalence of overweight/obesity continues to increase, and overweight and obese individuals now comprise the overwhelming majority worldwide [18]. The “obesity epidemic” may in itself contribute to the misperceptions, as overweight and obese individuals are surrounded by more people of like body habitus, thereby shifting their frames of reference as to what is “normal.” This has been demonstrated in school-aged children and adolescents [27] and may explain why some respondents in our population did not recognise the presence and/or degree of overweight/obesity. In our population with CHC, raising the awareness or improving the perception of an individual's body weight has the potential to improve patients' adherence to weight management strategies and lead to long-term improvements in liver and non-liver related health outcomes.

A Cochrane systematic review concluded that the overweight and obese benefit from psychological interventions to enhance weight reduction achieved through combined dietary and exercise strategies [28]. Numerous studies examine the effect of educational and psychological interventions

on *behaviour change* aimed towards weight loss; however interventions focused on the *misperceptions* regarding body weight which may underlie an individual's behavior also need to be considered. Brief cognitive-behavioural interventions improve body image misperceptions in women with high levels of body shape concern [29]. Similar principles may be needed to shift misperceptions amongst the overweight and obese with CHC who *underappreciate* the significance of their body weight. Self-perceived weight status most strongly correlates with intentions and actions to avoid weight gain [11], therefore the misperceptions of body weight need to be addressed before an individual will institute such a change in behaviour. Improving perception may allow an individual to progress through the first stages of the transtheoretical theory of behaviour change: precontemplation, contemplation, preparation, and action [30].

In this initial exploratory study of the perception of body weight amongst patients with CHC, a control group was not recruited; rather, the obese and overweight with CHC have been compared with their normal BMI counterparts. Patients with other liver conditions who attend the liver clinic (e.g., nonalcoholic fatty liver disease, hepatitis B and autoimmune liver disease) have markedly different characteristics to patients with CHC, hence they are unsuitable comparators [31–33]. Within the local community, the recruitment of a “healthy” control group of suitable sample size matched for BMI, age, gender, ethnicity, education, and metabolic comorbidity was also considered unfeasible. Therefore, the observations made in the present study stand alone as the first report of body weight perception in CHC. Despite this potential limitation, our findings may be interpreted in comparison to studies concerning body weight perception in diabetics and in larger population-based cohorts.

In line with the findings of large US population studies [13, 14], we demonstrated that males are more likely to underestimate their BW category and therefore are at risk of underestimating their health and liver-related risk. It has been postulated that males may be less likely to recognise their own overweight/obesity than women because, at the same BMI, males have a higher muscle:fat ratio [13]. This gender difference in body weight perception in our population is particularly important as male gender independent of body weight is associated with more rapid progression of liver disease in CHC [34], hence overweight/obese men are at high risk of the complications of overweight/obesity and CHC. Future-targeted education programs should recognise the impact of gender on the accuracy of weight self-perception. In contrast to large population studies, we did not demonstrate any association between misperception of BW category and age, socioeconomic status, ethnic origin, level of education, or area of residence; this may have been the result of the limited sample size of the present study.

Despite a relatively short period of time between the intervention and the followup (4–6 weeks), and the combination of tailored printed material and face-to-face education, the brief intervention failed to yield significant improvements in BW perception; these findings highlight the stability of the body weight misperceptions in this

cohort of patients with CHC. Opportunistic reinforcement at future consultations should be attempted; however, more structured and focused counseling and education may be warranted. Interventions may include advice on habit formation [35], the provision of more detailed general and tailored printed matter [20], group educational sessions, and follow-up sessions specifically for the management of overweight/obesity in CHC.

Although body composition (% body fat relative to lean body mass) could be considered to potentially influence self-perceptions of body weight, anthropometric measures of body fat (such as bioelectrical impedance, total body water, or skinfolds) were not included in the design of the present study. The BMI cut-off value for the diagnosis of obesity has a high specificity, but low sensitivity to identify adiposity [36]. Adipose tissue-derived mediators are likely to play a role in the pathophysiology of the adverse outcomes in CHC; however body mass index was deliberately selected as the primary outcome measure because of the reported association between elevated BMI and aforementioned adverse hepatic and metabolic outcomes in numerous clinical studies of CHC [2, 4–10, 37]. As no clear associations have been made between body fat mass and outcomes in CHC, achieving a normal BMI (in part through improved perceptions of body weight) remains a goal in the management of excess body weight in CHC. Furthermore, utilizing the WHO BMI cut-offs for BMI categories allowed us to provide clear tailored health advice to the participants rather than measures of body adiposity for which there are currently no studies reporting cut-off levels associated with improved or poor outcomes in CHC. The latter is a potential area for further study.

5. Conclusion

Body weight category underestimation is common in patients with CHC. Longitudinal studies will be required to determine which strategies will change perception and behaviour towards weight loss and weight maintenance, with the long-term goal of reducing the metabolic and hepatic morbidity and mortality associated with excess body weight in CHC.

Abbreviations

CHC: Chronic hepatitis C
 BMI: Body mass index
 BW: Body weight
 CDRS: Contour drawing rating scale
 HCV: Hepatitis C virus
 HCC: Hepatocellular carcinoma
 IR: Insulin resistance
 WHO: World Health Organization.

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