Original Article

Resting energy expenditure in patients with liver cirrhosis: Indirect calorimetry vs. predictive equations

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Background and Objectives: The objective of our study was to explore the accuracy of previously published prediction equations in predicting resting energy expenditure (REE) in patients with liver cirrhosis (LC). We also aimed to develop a novel equation to estimate REE for Chinese patients with LC. **Methods and Study Design:** In 90 patients with LC, the agreement between REE measured by Indirect calorimetry (IC) and predictive equations was quantified using paired T-test and visualized using a Bland-Altman Plot. Pearson correlation coefficient (R) was used to measure a linear correlation between REE measured by IC and different predictive equations. Stepwise multiple regression analysis was used to create a new REE equation. **Results:** The estimated REEs of previous equations were underestimated against REE measured by IC (1610 ± 334 kcal). Lean body mass (LBM) was positively correlated with REE measured by IC ($r = 0.723$, $p < 0.01$). The newly derived estimation equation for REE (kcal) was 1274.3 – 209.0 * sex – 5.73 * age + 3.69 * waist circumference + 22.89 * LBM. The newly derived estimation equation was found to have a Pearson-r value of 0.765 compared with REE measured by IC. **Conclusions:** REE in liver cirrhosis was underestimated by using predictive equations. The new predictive equation developed by using age, sex, waist circumference, and LBM may help estimate REE in Chinese patients with LC accurately and easily.

Key Words: resting energy expenditure, indirect calorimetry, lean body mass, liver cirrhosis, bioelectrical impedance analysis

INTRODUCTION

It was estimated that there were 2.20 million deaths caused by liver cirrhosis (LC) globally in 2017. The substantial health burden imposed by LC has increased in the last thirty years.[1] In China, the prevalence of liver cirrhosis increased by 73.7% from 1990 to 2016 mainly due to the Hepatitis B virus.[2] The incidence of malnutrition in patients with LC is high, up to 65%-90%.[3] The pathogenesis of malnutrition in LC is multifactorial.[4] Reduced energy and protein intake caused by anorexia, nausea, loss of appetite, impaired gastric expansion and protein/salt restriction was the main reason of malnutrition in LC.[5-7] In addition, malnutrition in LC was exacerbated by malabsorption, alteration in the metabolism of both macronutrients and micronutrients, and the gut microbiome dysbiosis.[8,9]

Malnutrition has been shown to lead to adverse health outcomes, contribute to physical deconditioning, and increase the overall risk of death.[7,10] In patients with LC, malnutrition was confirmed as an independent predictor of complications.[11] Patients with LC who were malnourished may experience more than a doubling in mortality rates.[12] In the multicenter research, regardless of the therapeutic interventions applied, a lower caloric intake was observed and correlated with poorer clinical outcomes.[13]

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Therefore, nutrition therapy plays an important role in the treatment of LC and its complications.[14] A systematic review and meta-analysis also showed that nutritional therapy reduced mortality and prevented overt hepatic encephalopathy in patients with LC.[15] Nutrition therapy including, lifestyle modification, has been clearly demonstrated to improve the prognosis of LC.[16] For undernourished patients with LC, the aim of nutrition therapy was to supply adequate substrates related to the requirements of various nutrients. Adequate nutrient intake during the early stage or progression of the LC will help maintain the nutritional status, reduce the incidence of complications, and improve the prognosis.[14,17] Therefore, it is essential to achieve adequate energy intake and maintain an energy balance to correct malnutrition for patients with LC in clinical practice.[18]

Calculating total energy consumption and requirements is the first step to conducting precision nutrition therapy. In energy metabolism, resting energy expenditure (REE) represents up to 70% of the total energy consumption.[19,20] Currently, a variety of predictive equations have been applied to patients with LC to calculate REE traditionally, such as the Harris-Benedict equation,[21] Cunningham equation,[22] World Health Organization (WHO) equation,[23] Schofield equation,[24] the Institute of Medicine (IOM) equation,[25] and The European Society for Clinical Nutrition and Metabolism (ESPEN) guideline-recommended equation.[26] These equations mainly relied on body weight, age, and sex to predict REE and are also widely used in clinical practice. However, the accuracy of these equations may be limited due to the metabolic abnormalities in patients with chronic diseases.[27] Moreover, there are few studies on the differences between predicted REE based on the above equations and measured REE in patients with chronic diseases.

REE can be measured by Indirect calorimetry (IC) by detecting pulmonary gas exchanges. IC is also considered as the gold standard to measure energy expenditure.[28] As both under and over-feeding are detrimental to disease progression for many diseases, the measurement of REE by IC is also recommended by many guidelines in order to optimize nutritional support for LC.[29,30] But in most areas and many situations, measuring energy expenditure by IC is costly and not widely available. Therefore, the prediction of REE with an appropriate equation is still widely used in clinical practice. Previous studies explored the comparison results of REE and other equations in patients with LC, and the results suggested that a few tools were consistent with REE, such as FAO/WHO/UNU equation and IOM equation.[31-33] Considering accurately estimating the energy requirements is of utmost importance, the limitations of traditional estimating equations should be further explored to guide clinical practice. In the absence of IC, validated estimating tools should also be developed for specific populations with cirrhosis, such as Chinese patients with cirrhosis. This pilot study, therefore, aims to explore which equation can best predict REE among the commonly used prediction equations and guideline-recommended equations, as well as to develop a novel equation to accurately predict REE in Chinese patients with LC.

METHODS

Subjects and data collection

A total of 90 patients with LC who had received treatment between April 2020 and December 2020 were enrolled in Henan People's Hospital. The exclusion criteria comprised: (a) hepatic encephalopathy; (b) cardiac or renal insufficiency; (c) metabolic-related diseases such as diabetes and thyroid diseases; (d) malignant tumors; (e) inability to comply with study measurements; (f) physical mobility disorders; (g) fasting for more than four days; (h) moderate or higher anemia. Clinical data, including age, sex, biochemical tests, height, and weight were collected after hospitalization. This study was approved by the Research Ethics Committee of Henan People's Hospital (No. 141 of the Ethical Review in 2022). As the data were anonymous, and the requirement for informed consent was waived.

REE measurements with IC

Resting energy expenditure was measured using an indirect calorimeter (CCM Express, USA). The machine was preheated and corrected prior to each measurement to ensure accuracy. Subjects were fasted for at least two hours in a room with a temperature of 24-26℃, humidity of 45%-60%, and an atmospheric pressure of 101.0-102.4kPa. After lying or sitting quietly for 30 minutes, the patients were placed in a supine position on the examination bed and connected to the mask and sensor. The test was then conducted for 15-20 min and stopped once three steady states were reached. During this period, sputum suction, turning over, and changing clothes were avoided as much as possible, and the entire process was completed by trained professionals.

Predictive formulas for REE estimation

The energy expenditure predictive formulas of Harris-Benedict equation,[21] Cunningham equation,[22] WHO equation, Schofield equation,[24] IOM equation,[25] Müller et al. equation[34] and ESPEN guideline-recommended equation[26] were used for the comparison. The Harris-Benedict equation, Cunningham equation, Müller et al. equation, WHO equation, Schofield equation were estimated based on data from healthy individuals. The ESPEN recommendations were derived from two studies: one involving 15 patients with cirrhosis[35] and the other involving 25 patients.[36] The specific calculation method of the equations was presented in Table 1

Bioelectrical Impedance Analysis (BIA) and anthropometric measures

Body composition was accurately measured using a Biodynamics model S10 BIA device (Inbody, Korea). After confirming that the participants had adhered to a fast of no less than 4-6 h, had emptied their bowels and bladder, and were wearing light clothing and barefoot, the skin was meticulously cleaned with 75% ethanol to reduce skin contact resistance prior to electrode placement. Weight, LBM, fat mass (FM), and phase angle were then measured. Anthropometric measures of waist circumference (WC) were collected according to clinical technical operation standard By the Chinese medical doctor association. The subject stands naturally, looking straight

Table 1. Resting energy expenditure predictive equations

Equations	Publication year	Factors	Predictive equations
Harris-Benedict equation	1918	Sex Age Weight Height	Male: 66.4730 + 13.7516W + 5.0033S - 6.7550A Female: 655.0955 + 9.5634W + 1.8496S - 4.6756A
Cunningham equation	1980	LBM	500 + 22LBM
WHO equation	1985	Age Sex Weight Height	10-18 yr: Male: 16.6W + 77H + 572; Female: 7.4W + 482H + 217 18-30 yr Male: 15.4W - 27H + 717; Female: 13.3W + 334H + 35 30-60 yr Male: 11.3W + 16H + 901; Female :8.7W - 25H + 865 >60 yr Male: 8.8W + 1 128H - 1 071; Female :9.2W + 637H - 302
Schofield equation	1985	Age Weight Sex	10-17 yr: Male: (0.074W + 2.754) * 239; Female: (0.056W + 2.898) * 239 18-29 yr Male: (0.063W + 2.896) * 239; Female: (0.062W + 2.036) * 239 30-59 yr Male: (0.048W + 3.653) * 239; Female: (0.034W + 3.538) * 239 >60 yr Male: (0.049W + 2.459) * 239; Female: (0.038W + 2.755) * 239
IOM equation	2005	Sex Age Weight Height	Male: 293 - 3.8A + 401.5H + 8.6W Female: 247 – 2.67A + 456.4H + 10.12W
Müller et al. equation	2004	Sex Age Weight	(0.047W + 1.009S + 0.01452A + 3.21) * 1000/4.18
ESPEN equation	2019	Weight	24W
New equation	2024	Sex Age WC LBM	1274.3 – 209.0 * sex – 5.73 * age + 3.69 * WC + 22.89 * LBM

W: Weight; S: Sex; A: Age; H: Height; LBM: Lean body mass; yr: years; WC: Waist circumference; WHO: World Health Organization; IOM: the Institute of Medicine; ESPEN: the European Society for Clinical Nutrition and Metabolism ahead, and maintains a normal breathing pattern. Tester selects the lowest point of the lower rib margin and the highest point of the anterior superior iliac spine, finds the midpoint of the line connecting these points, and uses this midpoint to wrap the measuring tape horizontally around the waist for one full circle. The measurement is taken at the end of the subject's exhalation and the beginning of their inhalation.

Statistical analysis

R software package (version 4.4.2) was used to analyse the data. Pearson correlation was performed to compare the mean value of REE measured by IC and predictive formulas, with the Pearson correlation coefficient (R) used to express the strength of the relationship. The agreement between these two measures was quantified using paired t-test and visualized using a scatter plot and Bland-Altman plot. Stepwise multiple regression analysis was employed to create a new REE equation, with factors such as age, sex, height, weight, waist circumference (WC), LBM, FM, and phase angle used to predict REE. The linear regression with backwards selection method was used to identify the best model for predicting REE. This method incrementally refines the model by including or excluding predictors based on statistical significance, with the aim of incorporating only those variables that are significantly associated with REE. A p-value < 0.05 was adopted as statistically significant.

RESULTS

Subjects' characteristics

A total of 90 patients with LC were analysed. Table 2 presents the bassline of the clinical characteristics. The mean age of the patients was 54.8 years. 64.4% of the patients were men. The mean weight was 64.2 kg. The mean height was 165.0 cm. All patients completed the IC and BIA measurements at the same time. The mean measured REE by IC, LBM, FM, and phase angle were 1610 kcal, 26.6 kg, 15.6 kg, and 5.16 respectively.

Association of measured REE and body composition

LBM and phase angle were positively correlated with REE measured by IC (LBM: $r = 0.723$, $p < 0.01$; phase angle: $r = 0.340$, $p = 0.001$). FM was not correlated with REE measured by IC ($r = 0.136$, $p = 0.200$).

Association of measured REE and predictive equation calculated REE

The published resting energy expenditure predictive equations were presented in Table 1. The mean values of REE were 1400kcal, 1470kcal, 1510kcal, 1320kcal, 1240kcal, 1240kcal, 1540kcal, and 1080kcal calculated by the Harris-Benedict equation, Schofield equation, WHO equation, IOM equation, Müller et al. equation, ESPEN guideline-recommended equation, and Cunningham equations, respectively. The differences of predictive equations and IC calculated REE ranged from -65.9kcal (by ESPEN) to -522kcal (by Cunningham). Figure 1 showed the association between measured and estimated REE. REE measured by IC was correlated with all estimated REE ($p < 0.01$). The significant differences between REE measured by IC and all REE measured by published equations were observed using paired samples t-test. The detailed results of Pearson correlation coefficient (R) and p values for t-test were presented in the Table 3.

Table 2. Characteristics of patients

	Overall (n=90)
Gender, Male (n, %)	58 (64.4%)
Stage (n, %)	
Child A	37 (41.1%)
Child B	33 (36.7%)
Child C	20 (22.2%)
Type of liver cirrhosis (n, %)	
Hepatitis B virus-related cirrhosis	57 (63.3%)
Hepatitis C virus-related cirrhosis	7 (7.8%)
Alcoholic cirrhosis	6 (6.7%)
Autoimmune hepatitis with cirrhosis	12 (13.3%)
Others	9 (10.0%)
Age (year)	54.8 ± 11.4
Height (cm)	165 ± 8.3
Weight (kg)	64.0 ± 12.3
Waist circumference (cm)	86.9 ± 10.6
Fat mass (kg)	15.6 ± 6.8
Lean body mass (kg)	26.6 ± 5.8
Phase angle	5.2 ± 1.0
Prealbumin(mg/L)	93.4 ± 51.0
Albumin(g/L)	31.7 ± 5.4
Triglycerides (mmol/L)	1.0 ± 0.6
Cholesterol (mmol/L)	3.4 ± 1.0
HDL-Cholesterol (mmol/L)	0.8 ± 0.4
LDL-Cholesterol (mmol/L)	2.0 ± 0.8
Fasting blood glucose(mmol/L)	6.3 ±3.4
REE measured by IC (kcal)	1610 ± 334

REE: resting energy expenditure; IC: indirect calorimetry
Data are presented as mean ± standard deviation (SD) or percentage.

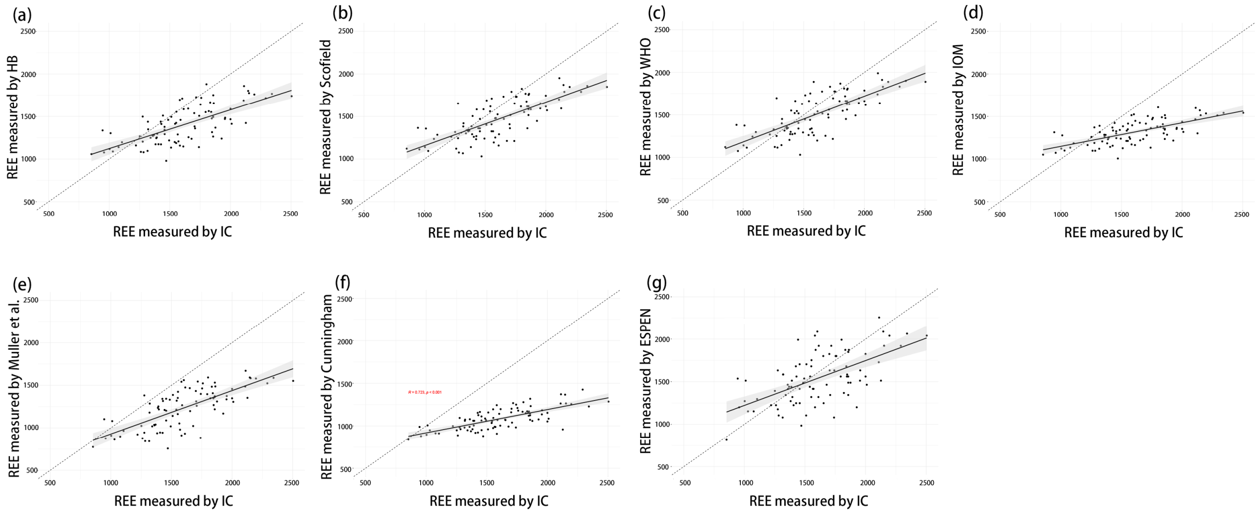

Figure 1. Relationship between resting energy expenditure measured by Indirect calorimetry (IC) and published prediction equations on a total of 90 subjects with liver cirrhosis. (a) IC vs Harris-Benedict (b) IC vs Schofield equation (c) IC vs World Health Organization (WHO) equation (d) IC vs the Institute of Medicine (IOM) equation (e) IC vs Müller et al. equation (f) IC vs Cunningham equation (g) IC vs the European Society for Clinical Nutrition and Metabolism (ESPEN) equation

Table 3. Comparisons and correlations between REE measured by IC and different predictive equations

REE estimate	Measured value	Difference vs IC	R	*p*
IC	1610 ± 334	-	-	-
Harris-Benedict equation	1400 ± 219	-207 ± 241	0.696	< 0.01
Schofield equation	1470 ± 229	-140 ± 223	0.747	< 0.01
WHO equation	1510 ± 241	-98.2 ± 222	0.747	< 0.01
IOM equation	1320 ± 139	-290 ± 263	0.667	< 0.01
Müller et al. equation	1240 ± 236	-369 ± 231	0.723	< 0.01
ESPEN equation	1540 ± 295	-65.9 ± 285	0.595	0.031
Cunningham equation	1080 ± 127	-522 ± 258	0.723	< 0.01
New equation	1610 ± 256	-0.105 ± 215	0.765	0.996

IC: indirect calorimetry; REE: Resting energy expenditure; WHO: World Health Organization; IOM: the Institute of Medicine; ESPEN: the European Society for Clinical Nutrition and Metabolism.
Data are presented as mean ± standard deviation (SD). Pearson correlation coefficient (R) is used to measure a linear correlation between REE measured by IC and different predictive equations. A paired samples t-test is used to compare the means of REE measured by IC and different predictive equations.

The results of the Bland-Altman plots revealed discrepancies between the measured REE and the equation-calculated REE, with increasing energy expenditure. Additionally, the plots showed that all estimation formulas underestimated REE. The correlation between measured REE and equation-calculated REE is visualized in Figure 2.

Development of new equations for estimating REE

The newly derived estimation equation for REE was obtained from a stepwise multiple regression analysis using age, sex, height, weight, WC, LBM, FM, and phase angle as independent variables. Four variables including sex, age, WC and LBM were included in the model after linear regression with backwards selection method. The intercept was 1274.3. The coefficients were -209.0, -5.73, 3.69 and 22.89 for sex, age, WC and LBM respectively, with the equation being:

REE (kcal) = 1274.3 – 209.0 * sex – 5.73 * age + 3.69 * WC + 22.89 * LBM.

A value of 1 for male and 2 for female was used for sex in the equation.

The correlation between the new estimation equation and the IC was classified as strong, with a Pearson-R value of 0.765 ($p < 0.001$). The Bland-Altman plot and paired samples t-test showed that measurements of REE by the new estimation equation and IC were similar and statistically comparable (p=0.996) (Figure 3).

DISCUSSION

Energy intake in LC requires balancing total energy expenditure, which includes REE.[29] Our findings indicated that the REE in patients with LC is underestimated by existing prediction equations. To address this issue, we developed a new prediction equation to estimate REE, which has good agreement with the measured REE by IC. Our new equation provided a more accurate estimation of REE in Chinese patients with LC.

Malnutrition in patients with LC was common in clinical practice. Nutrients intake, digestion and absorption processes are all affected by the disease. First of all, the deficient nutrients intake was the main reason of malnutrition in LC.[37] The altered energy/protein metabolism caused by hypermetabolic state, maldigestion caused by bile salt/

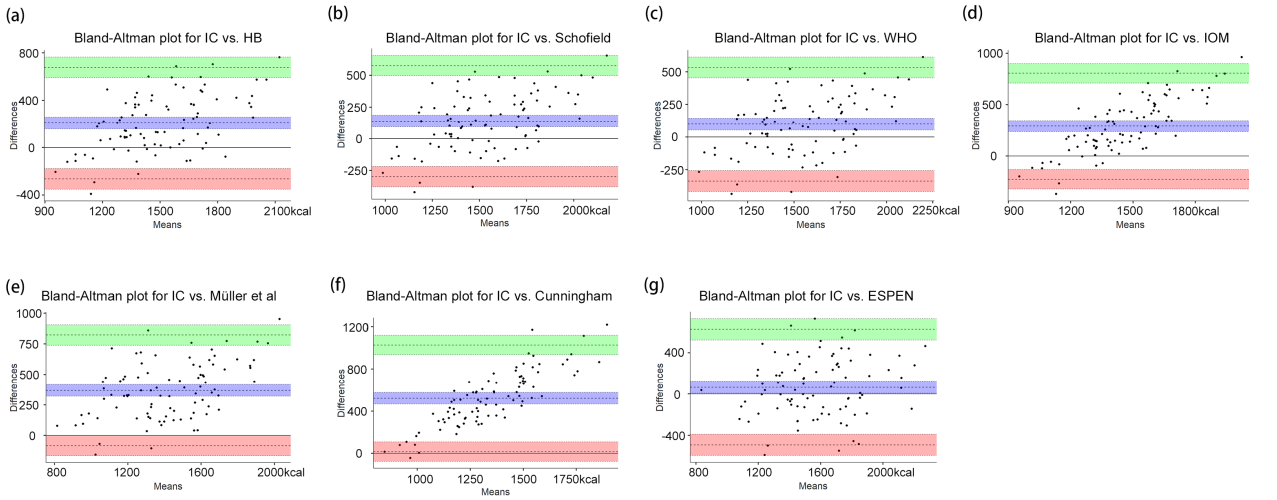

Figure 2. Bland-Altman plot of the agreement for resting energy expenditure measured by Indirect calorimetry (IC) vs. published prediction equations on a total of 90 subjects with liver cirrhosis. The horizontal and vertical axes respectively show the mean and difference between resting energy expenditure measured by IC and prediction equations. (a) IC vs Harris-Benedict (b) IC vs Schofield equation (c) IC vs World Health Organization (WHO) equation (d) IC vs the Institute of Medicine (IOM) equation (e) IC vs Müller et al. equation (f) IC vs Cunningham equation (g) IC vs the European Society for Clinical Nutrition and Metabolism (ESPEN) equation

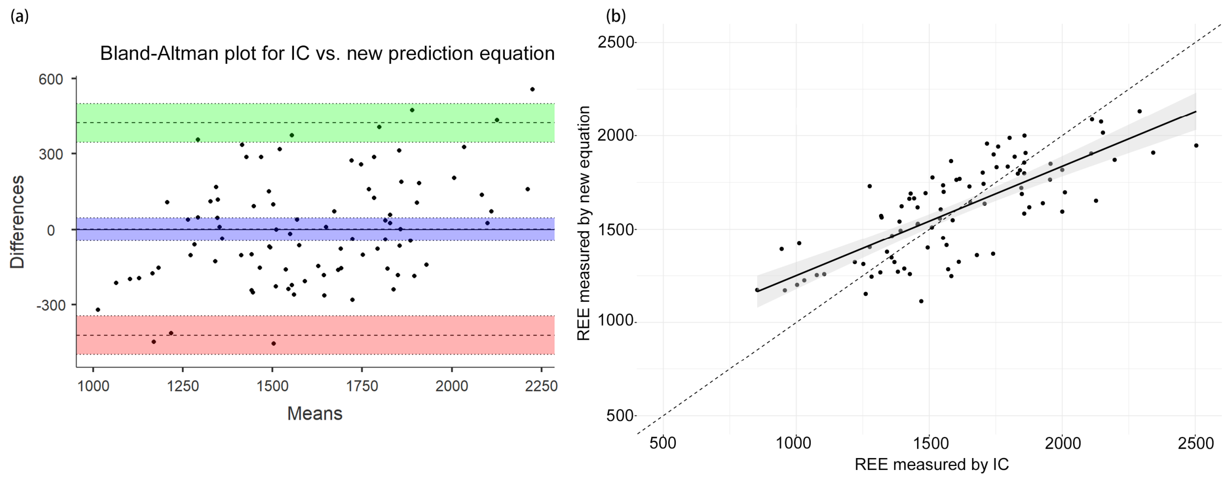

Figure 3. Relationship between resting energy expenditure measured by Indirect calorimetry (IC) and new prediction equation. (a) Scatter plot (b) Bland-Altman plot

pancreatic enzymes deficiency, malabsorption caused by imbalance of intestinal flora and external factors such as infection all contributed the malnutrition in LC.[7,38] In addition, changes in epinephrine and norepinephrine also led malnutrition in LC.[39] Moreover, despite the high incidence of malnutrition in patients with cirrhosis, it is frequently underdiagnosed.[7] Malnutrition can be hidden by obesity, making it even more difficult to diagnose.[29] Previous studies have demonstrated that malnutrition was a significant negative predictor of prognosis in patients with LC.[40] Surgical patients who were malnourished were at an increased risk of postoperative complications,[11] while other undernourished patients with LC with symptomatic treatment may be at a higher risk of mortality.[41]

Targeted nutrition interventions were essential for enhancing the quality of life and improving survival rates in patients with cirrhosis.[17] Adequate nutritional supplementation for patients with cirrhosis was the key of nutrition intervention. Although effective, it is difficult to achieve adequate energy intake during the treatment. Failure to meet energy needs may be one reason that some studies have shown no benefit of nutritional therapy.[42] Before ascertaining whether the energy supply was adequate, it was necessary to determine the patient's energy requirements. Therefore, estimating the energy needs to provide an optimal supply of nutritional supplementation is of the utmost.

Guidelines for the treatment of LC, such as the guidelines of the European Association for the Study of the Liver (EASL),[29] the Japanese Society of Gastroenterology (JSGE),[43] and the ESPEN practical guideline[26] make recommendations for energy intake for patients with cirrhosis. Some guidelines recommend determining energy intake by IC measurement.[30] Although REE can be obtained by handheld calorimetry devices in an objective and non-invasive method,[42] IC measurement is not available in many areas and is expensive, making it difficult to implement in clinical settings. Most guidelines recommend a scale of energy intake based on body weight.[44] For example, EASL recommends supplying at least 35 kcal/kg per day and JSGE 25~30 kcal/kg per day in the absence of glucose intolerance to provide adequate energy. However, these recommendations for energy needs are often imprecise. Belarmino's study showed that calculated REE values according to European guidelines and Brazilian guidelines differed substantially from the IC-measured REE for patients with LC.[32] To solve this problem, predictive equations have been used to estimate the REE of these patients in clinical practice. Considering that REE of patients with LC is not only related to body weight but also other factors,[45] many factors such as height, sex, and age are used to predict REE. We have summarized and analysed the published equations predicting REE outcomes in patients with LC and compared them with IC-measured REE. Our results demonstrated that most of the equations predicting REE outcomes were lower than the IC measurements.

Altered metabolism in LC was the main reason for this discrepancy. The liver plays a crucial role in regulating glucose homeostasis and protein synthesis. Due to rapid post-absorptive physiology, cirrhosis is considered a state of accelerated starvation.[16,29] On one hand, in patients with LC, increased rates of gluconeogenesis were observed, which would contribute to the increase of REE in the body.[29] On the other hand, LC is characterized by decreased respiratory quotients, as a result, the rate of glucose oxidation significantly decreases, and the fat oxidation compensatory increased.[46,47] Therefore, these published equations for REE estimation which were designed for healthy individuals would underestimate REE in patients with LC. Similar results were found in patients with cancer presenting with metabolic abnormalities.[48] Furthermore, the REE may also be affected by the cause of LC such as hepatitis B virus, non-alcoholic fatty liver disease, and long-term poor energy intake.[49,50]

Notably, there is no specific REE prediction equation for Chinese patients with LC so far. In this trial, we used the linear regression with backwards selection method to develop a new prediction equation for REE estimating, especially for Chinese patients with LC. Our findings showed that the model for estimating REE using LBM, age, and WC achieved an r-value of 0.765, which was higher than that of other estimation equations for predicting REE. Our results demonstrated that age and sex were independent predictors of REE, which is consistent with other equations.[51] Unlike the published prediction equations, which mostly use body weight as the main factor, our regression analysis found that LBM is the main predictor of REE. Similar results were obtained in other studies.[51-53] As the metabolically active tissue, LBM has been proven to be correlated primarily to REE. Studies showed that 72% of the total variance in REE could be explained by LBM.[54] Moreover, body weight sometimes does not reflect energy requirement, such as in patients with sarcopenic obesity,[55] whose REE may not be as high as predicted. For patients with ascites, the prediction of REE also cannot be calculated based on body weight.[56] Therefore, LBM acts as a more accurate predictor of REE than body weight. Moreover, LBM is easily obtained by body composition analysis using a BIA device and is cheap to implement in clinical practice. As a result, the LBM-based equation is more accurate than the body weight-based equation in predicting REE in patients with LC. In addition, waist circumference was found to be associated with REE in LC. This result was consistent with previous studies. Bruna Cherubini Alves's study indicated that abdominal circumference, height and weight can be used to predict dry weight in patients with cirrhotic ascites.[57] A study conducted in Germany also showed that abdomen circumference was the main predictor of REE in older males.[58] On one hand, fat distribution in the abdomen is related to metabolic rate. On the other hand, moderate and large amounts fluid within the abdomen may increase the WC. WC can be an important clinical monitoring indicator in patients with ascites. The ascites has been shown to increase the REE in LC.[59] Therefore, WC may be associated with REE in LC. These were the potential reasons explaining why WC can predict REE in LC.

To our knowledge, this was the first study to compare REE measured by IC with predictive equations in Chinese patients with LC. It is found that the REE values were underestimated by predictive equations. Our research also innovatively proposed a new equation for REE prediction. This prediction equation used LBM to predict REE, which was more accurate than other equations to be applied in clinical practice.

Our research has several limitations. First, the patients were only from one hospital. Second, the number of patients included in this study was also small. A larger LC sample from different hospitals is needed to promote our work. Third, REE was affected by many factors, such as liver function, decompensated states, and infection. The dietary-induced thermogenesis may also impact REE. Our study only includes patients with stable stats as the REE can be greatly affected by acute complications. Therefore, there was a big challenge when applying this equation to predict REE in Chinese patients with LC with different conditions. In addition, we cannot rule out that other unmeasured factors may have influenced REE, such as insulin resistance, causes of cirrhosis and degrees of ascites. Later, multi-center studies with larger samples are needed to verify the new REE prediction equation and further explore the limitation of the application for patients with LC. Finally, given that the new formula primarily relies on data from patients with LC, its applicability to other disease populations remains uncertain. Nevertheless, the results also indicated that using BIA results to predict REE is a potential avenue for future research.

Conclusion

In conclusion, the estimated REEs of previous body-weight-based equations were underestimated against REE measured by IC in LC. A new predictive equation was developed for estimating the REE for Chinese patients with LC by using age, sex, WC, and LBM.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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