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Impact of the change of the Atalah standard cut-off point to classify underweight nutritional status during pregnancy

Impacto del cambio de punto de corte en el estándar de Atalah en la clasificación del estado nutricional de bajo peso durante el embarazo

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ABSTRACT

Chile, and several Latin American countries, use the Atalah standard to assess nutritional status during pregnancy. However, this standard (underweight: pre-pregnancy body mass index (BMI)<20 kg/m^2 and normal weight: pre-pregnancy BMI= 20-24.9 kg/m^2) differ from those recommended by the US Institute of Medicine (IOM2009) (underweight: BMI<18.5 kg/m^2 and normal weight: 18.5-24.9 kg/m^2). Using a large population database from a Chilean public hospital, we compared the prevalence of underweight and normal weight at the beginning of pregnancy with Atalah and IOM2009 standards. Additionally, we evaluated the performance of both standards in detecting adverse neonatal outcomes and gestational weight gain. Methods: Data from clinical records of single birth pregnancies (n= 59,476) at the Sótero del Río Hospital, between 2003-2012 were collected. We compared 1. nutritional status, 2. proportion of excessive gestational weight gain, 3. association between nutritional status and neonatal outcomes (large/small for gestational age, low birth weight, preterm birth and macrosomia), using logistic regression models, and 4. Sensitivity, specificity, and predictive values to predict adverse neonatal outcomes per nutritional status. Results: Pre-pregnancy underweight decreased from 8.6% to 2.5% and women with BMI between 18.5-19.9kg/m^2, who exceeded the recommended gestational weight gain increased from 32.7% to 49.2% when using IOM2009 instead of Atalah. Both standards showed low sensitivity, but the IOM2009 cut-off points showed better specificity for identifying healthy newborns. Conclusion: The cut-off points recommended by the IOM2009 better identify the prevalence of underweight and normal weight during pregnancy without increasing neonatal risk. This

study supports the recent change of the Ministry of Health in adopting the WHO cut-off points during pregnancy.
Keywords: Gestational weight gain; IOM; Nutritional status assessment; Pregnancy; Pre-pregnancy underweight.

RESUMEN

Chile y diversos países Latinoaméricanos utilizan el estándar de Atalah para evaluar el estado nutricional (EN) durante el embarazo. Sin embargo, los puntos de corte de este estándar (bajo peso, BP: índice de masa corporal pre-gestacional (IMC)<20 kg/m² y normal, NP: IMC pregestacional= 20-24,9 kg/m²) difieren de los recomendados por el Instituto de Medicina de EE.UU. (IOM2009) (BP: BMI<18.5kg/m² and NP: 18,5-24,9 kg/m²). Con datos obtenidos desde el Hospital Sótero del Río, nosotros evaluamos la prevalencia de BP y NP al comienzo del embarazo con los estándares de Atalah e IOM2009. Adicionalmente, nosotros comparamos el comportamiento de ambos estándares en detectar resultados neonatales (RN) adversos y en la clasificación de la ganancia de peso gestacional (GPG). Métodos: Se obtuvieron datos de embarazos simples entre 2003-2012, (n= 59.476). Nosotros comparamos: 1. Prevalencia de EN, 2.Proporción de excesiva GPG, 3.Asociación entre EN y RN, usando modelos de regresión logística, y 4. Sensibilidad, especificidad y valores predictivos para predecir RN según EN. Resultados: La prevalencia de BP pregestacional disminuyó de 8,6% a 2,5% y las mujeres con IMC entre 18,5-19,9 kg/m² que excedieron la GPG recomendada, incrementaron desde 33% a 50% cuando se utilizó el estándar IOM2009 en vez de Atalah. Ambos estándares mostraron baja sensibilidad, pero IOM2009 mostró mejor especificidad para identificar recién nacidos saludables. Conclusión: Estandar IOM2009 identifica con mayor precisión la prevalencia de BP y NP durante la gestación sin incrementar el riesgo neonatal. Este estudio respalda el reciente cambio del MINSAL al adoptar los puntos de corte de la OMS durante el embarazo.
Palabras clave: Bajo peso pregestacional; Embarazo; Evaluación del estado nutricional; Ganancia de peso gestacional; OIM.

INTRODUCTION

Evaluating nutritional status during pregnancy is an effective tool for preventing death and disease in pregnant women and their newborns. Maternal underweight has been related to intrauterine growth restriction, low birth weight (LBW), small for gestational age (SGA), and preterm birth[1]. On the other hand, maternal obesity is associated with gestational diabetes and hypertensive disorders during pregnancy, cesarean section, macrosomia and large for gestational age (LGA) neonates[1,2]. Both maternal undernutrition and obesity increase the risk of non-communicable chronic diseases in the newborn in the long term[3,4,5].

Several standards have been used in order to evaluate nutritional status during pregnancy[6,7,8,9,10,11,12]. In 2005, the Chilean Ministry of Health (MINSAL) and some Central and Latin American countries (e.g., Guatemala and Uruguay)[9] adopted the Atalah standard to evaluate nutritional status during pregnancy[10]. This standard uses the cut-off points proposed by the Food and Agriculture Organization and World Health Organization during the 1980s, classifying nutritional status, from the beginning of pregnancy until the sixth week, as: underweight (UW), Body Mass Index (BMI) <20 kg/m²; normal weight (NW), 20-24.9 kg/m²; overweight (OW) 25–29.9 kg/m²; and obesity (O) ≥30 kg/m². Then, for the following gestational weeks (from the seventh week until the forty second week), there is a progressive increase in BMI according to data from the literature[10]. This standard was validated in a population of 883 pregnant adult women who were evaluated in antenatal check-up visits in Chilean health centres in the 1990s[11].

In 2009, the United States Institute of Medicine published gestational weight gain (GWG) recommendations for each pre-pregnancy nutritional status, based on the current World Health Organization (WHO) criteria for assessing nutritional status in adults: for UW, BMI<18.5 kg/m²; NW, 18.5-24.9 kg/m²; OW, 25-29.9 kg/m²; and O, ≥30 kg/m²[(13)]. This IOM2009 standard has been adopted not only by the USA but also several other countries[9].

The cut-off points of the IOM 2009 standard differ from those of the Atalah standard in the determination of UW and NW nutritional status. This difference has clinical relevance because, according to the Atalah standard, pregnant women with BMI between 18.5 and 20 are diagnosed as UW[10] and receive the recommendation to gain between 12.5-18 kg during their pregnancy. According to the IOM2009 standard, these same women should be classified as NW and the recommendation of gestational weight gain should be between 11.5-16 kg[13]. This acquires relevance since Chile is a country in the fourth stage of the Obstetric Transition[14] characterized by a low rate of maternal mortality, but with a high prevalence of obesity in pregnant women (32.4%)[15,16]. Furthermore, excessive gestational weight gain has been linked to higher risk of adverse neonatal outcomes[17,18,19,20], greater postpartum weight retention[21] and higher prevalence of obesity[22,23,24] in mothers, who would face a new pregnancy in worse nutritional conditions. In 2020, the Chilean Ministry of Health adopted the WHO cut-off points and the accompanying gestational weight gain recommendations to the Atalah standard for UW and NW[25].

Results from a Brazilian study which compared five diagnosis methods to determine NS (Rosso-Mardones [weight/height and BMI], Atalah, Latin American Center for Perinatology Women and Reproductive Health and IOM2009) showed that, compared to the IOM2019, the prevalence of UW was three and two times higher using the Rosso-Mardones and Atalah standards, respectively[26].

Few studies in Latin America have compared the accuracy of different standards when assessing neonatal risk. One study performed in Colombia showed that the Atalah standard showed the best diagnostic accuracy when identifying LBW, defined as <3 kg, compared to the Rosso-Mardones, Fescina, and the IOM 1990[8]. Another study showed higher sensitivity of the Rosso-Mardones standard than the Atalah standard to detect low (<3,000 g) and high birth weight (>4,250 g)[27]. Neither study evaluated the impact of using these different standards for inadequate gestational weight gain.

Using a large population database from a Chilean public hospital, we compared the prevalence of underweight and normal nutritional status at the beginning of pregnancy with Atalah and IOM2009 standards. Additionally, we compared the performance of both standards in detecting adverse neonatal outcomes and in classifying gestational weight gain.

MATERIALS AND METHODS

Setting and database

The present study is a secondary analysis of clinical records for the universe of single births (59,476 pregnant women) at the Dr. Sótero del Río Hospital in the South-East public health district of Santiago, Chile, during 2003-2012. The district study sample covers a population of 1,521,144 inhabitants (approximately 9% of the total population of Chile). In the country, 77% of the population receives care as part of the National Health Care Service System and the women included in this study are representative of this population (low- and middle-income Chilean population). Data related to pregnancy, delivery, and the newborn was extracted from medical charts.

Variables

Pre-pregnancy weight was self-reported and height was measured. Pre-pregnancy BMI was calculated dividing the pre-pregnancy weight by the squared height [pre-pregnancy weight (kg)/ height (m)^2]. Pre-pregnancy BMI was categorized according to both the Atalah and IOM 2009 standards[10,12]. Gestational weight gain (kg) was defined as the difference between weight at delivery and pre-pregnancy weight.

In order to compare the prevalence of underweight and NW at delivery between IOM2009 and Atalah standards, we added the increase in BMI proposed by the Atalah standard for each gestational age[10] to the pre-pregnancy cut-off points proposed by IOM2009. For underweight and NW, cut-off points for each gestational week were 1.5 BMI points lower for the IOM2009 than for the Atalah standard (Supplementary Table 1, S1).

We considered the following NO: SGA and LGA according to the Alarcón-Pittaluga curves[28], macrosomia: birth weight >4 000 g, LBW <2,500 g, and preterm birth: <37 weeks of gestation.

Other recorded variables were maternal age (≤15, ≤19, 20-35, and >35 years old), maternal height (m), smoking habits during pregnancy (yes/no), newborn height (cm), number of prior births (primiparous, multiparous), and maternal pathologies (pre-gestational and gestational diabetes, pre-gestational and gestational hypertension, preeclampsia, eclampsia) and type of delivery (vaginal/caesarean section).

Data analysis

Data analysis was performed in stages. First, an exploratory analysis was performed to evaluate missing or out-of-range values. From a total of 69,976 records, we excluded 14% due to missing values and 1.1% due to unlikely data, such as maternal height outside the 1.30-1.95 m range, weight at the beginning or at the end of pregnancy outside the 30-190 kg range, gestational weight gain outside the -3-39 kg range, birth weight outside the 400g-5 600g, and gestational age at birth outside the 20-42 weeks range. Statistical analysis was performed using the remaining 59,476 records (85.0% of the original data).

Second, a descriptive analysis was performed, including number of cases and percentages for categorical variables and mean and standard deviation (SD) for continuous variables. The prevalence and 95% confidence intervals (CI) of nutritional status categories were calculated according to both standards. To compare gestational weight gain between both standards we used the IOM 2009 recommendations (12.5–18 kg for underweight, 11.5–16 kg for NW, 7–11.5 kg for OW, and 5–9 kg for O) and then, we classified gestational weight gain as below, adequate or excessive[13].

Third, we compared separately in both standards the association between pre-pregnancy nutritional status (using NW as a reference) and neonatal outcomes using logistic regression models, crude and adjusted for covariables (maternal pathologies, smoking habits, maternal age, gestational weight gain, number of prior births, and year of delivery). Finally, we evaluated the sensitivity, specificity, and predictive values of underweight (calculated by Atalah and IOM2009 standards) on the NO. We used all age groups for the analysis because there are not specific recommendations for adolescent pregnant women. Stata v.13 software was used for statistical analysis.

Ethical Standards Disclosure

All data and personal information used in this present study were anonymised. Furthermore, the study was approved by the Ethic Committee of the South East Metropolitan Health Area.

RESULTS

The maternal and neonatal characteristics of the population are shown in table 1. Most of the women were multiparous, with an average BMI at the beginning of the pregnancy of 25.4 kg/m^2 (SD= 4.8). The average gestational weight gain was 13.5 kg (SD= 6.4), and the prevalence of smoking, caesarean section, diabetes, and hypertension disorders were 10.4%, 25%, 3.4%, and 4.8%, respectively. At the end of the pregnancy, maternal mean BMI was 30.8 kg/m2 (SD= 4.7) and average newborn birth weight was

Table 1. Maternal and neonatal characteristics of pregnant women who received care at the Sótero del Río Hospital during the 2003-2012 period (n= 59,476).

Variables	Mean or n	SD or %
Maternal		
Age (years), mean and SD	25.9	7.0
Height (m), mean and SD	1.57	0.06
Pre-pregnancy weight (kg), mean and SD	62.9	12.4
Pre-pregnancy BMI (kg/m2), mean and SD	25.4	4.8
Weight gain (kg), mean and SD	13.5	6.4
Increase in BMI (kg/m2), mean and SD	5.5	2.6
Gestational age (weeks), mean and SD	38.5	2.1
Weight at delivery (kg), mean and SD	76.4	12.7
BMI* at delivery (kg), mean and SD	30.8	4.7
Chronic hypertension, n and %	713	1.2
Gestational hypertension, n and %	1,061	1.8
Preeclampsia, n and %	1,091	1.8
Eclampsia, n and %	20	0.03
Pre-pregnancy diabetes, n and %	225	0.4
Gestational diabetes, n and %	1,754	3.0
Cesarean, n and %	14,881	25.0
Smoking, n and %	6,180	10.4
Primiparous, n and %	25,514	43.1
Multiparous, n and %	33,696	56.9
Newborn		
Birth weight (kg), mean and SD	3.328	560
Length at birth (cm), mean and SD	49.8	2.11
Small for gestational age, n and %	5,954	10.0
Large for gestational age, n and %	7,592	12.8
Low birth weight, n and %	3,472	5.8
Macrosomia, n and %	5,118	8.6
Preterm birth, n and %	5,334	9.0

*BMI: body mass index. BMI at delivery is adjusted by gestational week according MINSAL standard[9].

3,328 ± 560 g. The prevalence of SGA, LGA, macrosomia, LBW and preterm birth was 10%, 12.8%, 8.6%, 5.8% and 9.0%, respectively.

Compared to the Atalah standard, the prevalence of pre-pregnancy underweight using IOM2009 was 6 percentage points lower (8.6 vs 2.5%) (Table 2). When analyzed by maternal age categories, the prevalence of pre-pregnancy underweight dropped in all age groups with the IOM2009, with the largest difference among the adolescent group, from 16.8% to 5.3%, corresponding to 11 percentage points. In adult women, the prevalence of underweight with the IOM 2009 was three and four times lower in the group of 20-35 and >35 years, respectively, compared to the Atalah classification (Table 2). The prevalence of OW and O for the period was 15.7% and 29.4%, respectively. At delivery, the differences

in prevalence of underweight between both standards remained but in lower magnitude (4 percentage points).

Table 3 compared the changes in the percentage of the accomplishment of the IOM 2009 gestational weight gain recommendations according to the prevalence of underweight and NW in each standard. The percentage of excessive gestational weight gain in the group of underweight pregnant women was 33.5% using Atalah standard and 35.3% using the IOM 2009. However, when we compared excessive gestational weight gain in women who started pregnancy with a BMI between 18.5-19.9 kg/m^2, the proportion of excessive gestational weight gain was 17 percentage points lower with the Atalah standard. Conversely, in this group the proportion of adequate gestational weight gain was higher (50.9% by Atalah versus 33.3% by IOM 2009) (Table 3).

After adjusting for covariables, with both standards we found similar positive associations between pre-pregnancy underweight (using NW as reference group) and neonatal outcomes related to deficiency (SGA, LBW and preterm birth) and negative with those associated with overnutrition (macrosomia, LGA) (Table 4). Pre-gestational O (using NW as reference group) was positively associated with macrosomia (Atalah: 2.9 [2.7 - 3.2] and IOM2009: 3.0 [2.8 – 3.3]) and LGA (Atalah: 2.6 [2.4 - 2.8] and IOM2009: 2.7 [2.5 – 2.9]). The same trend was found for OW (Table 4).

The cut-off points proposed by IOM2009 showed higher specificity than the Atalah standard to identifying newborns without adverse neonatal outcomes when comparing maternal underweight versus NW nutritional status (average 95% vs. 84% for all neonatal outcomes, respectively). Conversely, sensitivities were higher for the Atalah standard (average 15.5% and 4.8%, respectively for all neonatal outcomes). Similar predictive values were found with both standards, showing low positive predictive values and high negative predictive values for all neonatal outcomes (Table 5).

Table 2. Nutritional status pre-pregnancy and at delivery by maternal age, according to Atalah standard and IOM2009 among single birth pregnancies at the Hospital Sótero del Río, Chile, 2003-2012 (n= 59,476).

Nutritional Status categories	**Total n= 59,476**	**≤15 years n= 1,385**	**≤19 years n= 12,574**	**20-35 years n= 39,756**	**>35 years n= 7,146**
			Pre-pregnancy (%)[95% CI]		
Underweight					
Atalah standard	8.6 [8.4, 8.9]	19.7 [17.7, 21.9]	16.8 [16.2, 17.5]	7.2 [7.0-7.5]	2.1[1.8, 2.5]
IOM2009 standard	2.5 [2.4, 2.6]	5.9 [4.7, 7.2]	5.3 [4.9, 5.7]	2.0 [1.9-2.1]	0.5[0.4, 0.7]
Normal weight					
Atalah standard	46.3 [45.9, 46.7]	61.5 [58.9, 64.1]	58.4 [57.6, 59.3]	45.1 [44.6, 45.6]	31.7 [30.6, 32.8]
IOM2009 standard	52.4 [52.0, 52.8]	75.4 [73.0, 77.6]	69.9 [69.1, 70.7]	50.3 [49.8, 50.8]	33.3[32.2, 34.4]
Overweight	29.4 [29.0, 29.7]	15.7 [13.8, 17.7]	19.1 [18.4, 19.8]	30.6 [30.1, 31.1]	40.5[39.4, 41.7]
Obesity	15.7 [15.4, 16.0]	3.1 [2.3, 4.2]	5.7 [5.3, 6.1]	17.1 [16.7, 17.5]	25.7[24.6, 26.7]
			At delivery (%)[95% CI]		
Underweight					
Atalah standard	6.8 [6.6, 7.1]	11.1 [9.5, 12.9]	11.9 [11.3, 12.4]	6.1 [5.8, 6.3]	2.4 [2.1, 2.8]
IOM2009 standard	2.5 [2.3, 2.6]	4.3 [3.3, 5.5]	4.5[4.1, 4.9]	2.1[2.0, 2.3]	0.8 [0.6, 1.1]
Normal weight					
Atalah standard	31.3 [31.0, 31.7]	44.2 [41.6, 46.8]	41.6 [40.8, 42.5]	29.8 [29.3, 30.2]	21.9 [20.9, 22.9]
IOM2009 standard	35.7 [35.3, 36.1]	51.1 [48.4, 53.7]	49.0 [48.1, 49.9]	33.7 [33.3, 34.2]	23.5 [22.5, 24.5]
Overweight	33.5 [33.1, 33.8]	32.3 [29.8, 34.8]	30.0 [29.2, 30.8]	33.8 [33.3, 34.3]	37.9 [36.8, 39.0]
Obesity	28.4 [28.0, 28.7]	12.4 [10.7, 14.3]	16.6 [15.9, 17.2]	30.4 [29.9, 30.8]	37.8 [36.7, 39.0]

Table 3. Adherence to gestational weight gain recommendations according to Atalah and IOM2009 standards.

Pre-pregnancy Body mass index (BMI)	Recommended GWG by pre-pregnancy BMI and Standard (kg)	Adherence to recommendations weight gain by BMI and standard % Below	% Adequate	% Excessive	Total
Atalah standard					
<20 kg/m² (UW[II])	12.5-18	15.6	50.0	33.5	5,143
18.5-19.9 kg/m² (UW[II])	12.5-18	16.4	50.9	32.7	3,644
20-24.9 kg/m² (NW[†])	11.5-16	22.7	33.8	43.5	27,549
25.0-29.9 kg/m² (OW[‡])	7–11.5	14.3	24.6	61.1	17,461
30 kg/m² (O[¶])	5–9	22.0	21.6	56.4	9,374
IOM 2009 standard					
<18.5 kg/m² (UW[II])	12.5-18	13.6	51.1	35.3	1,499
18.5-19.9 kg/m² (NW[†])	11.5-16	17.5	33.3	49.2	3,644
18.5-24.9 kg/m² (NW[†])	11.5-16	22.6	32.2	45.2	31,193
25.0-29.9 kg/m² (OW[‡])	7–11.5	14.3	24.6	61.1	17,461
30 kg/m² (O[¶])	5–9	22.0	21.6	56.4	9,374

[II]UW= underweight; [†]N= normal; [‡]OW= overweight; [¶]O= obesity. For the IOM standard, the BMI category <20 kg/m² includes women with UW (BMI<18.5 kg/m² and women with normal (BMI 18.5-19.9 kg/m²); GWG Recommendations are based on US Institute of Medicine 2009 guidelines.

Table 4. Associations between pre-pregnancy nutritional status and adverse neonatal outcomes according to Atalah and IOM2009 standards.

	SGA* OR [95% CI]		Low birth weight OR [95% CI]		Preterm birth OR [95% CI]		LGA[§] OR [95% CI]		Macrosomia OR [95% CI]	
	Atalah	IOM2009	Atalah	IOM2009	Atalah	IOM2009	Atalah	IOM2009	Atalah	IOM2009
UW[II]	1.5 [1.4, 1.7]	1.8 [1.6, 2.1]	1.7 [1.5, 1.9]	1.9 [1.6, 2.3]	1.3 [1.2, 1.5]	1.4 [1.2, 0.7]	0.7 [0.6, 0.8]	0.6 [0.5, 0.8]	0.6 [0.5, 0.7]	0.4 [0.3, 0.5]
NW[†]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OW[‡]	0.7 [0.6, 0.7]	0.6 [0.6, 0.7]	0.7 [0.6, 0.8]	0.7 [0.6, 0.7]	0.9 [0.8, 0.9]	0.8 [0.8,0.9]	1.6 [1.5, 1.7]	1.7 [1.6, 1.8]	1.8 [1.7, 1.9]	1.9 [1.8, 2.0]
O[¶]	0.4 [0.4, 0.5]	0.4 [0.4, 0.5]	0.4 [0.4, 0.5]	0.4 [0.4, 0.5]	0.7 [0.7, 0.8]	0.7 [0.7,0.8]	2.6 [2.4, 2.8]	2.7 [2.5, 2.9]	2.9 [2.7, 3.2]	3.0 [2.8, 3.3]

[*]SGA: small for gestational age; [§]LGA: large for gestational age;
Classification of pre-pregnancy nutritional status: [II]UW= underweight, [†]NW= normal weight; [‡]OW= overweight; [¶]O= Obesity. Logistic regression models (OR and 95% confidence intervals) are adjusted by maternal pathologies, smoking, maternal age, gestational weight gain, number of prior births, and year of the delivery.

Table 5. Sensitivity, specificity and predictive values for adverse neonatal outcomes among maternal underweight versus normal weight nutritional status according to Atalah and IOM2009 standards.

	Small for gestational age %	Low birth weight %	Preterm birth %	Large for gestational age %	Macrosomia %
Atalah standard					
Sensitivity	20.0	19.9	17.5	11.0	9.2
Specificity	84.7	84.5	84.4	83.7	83.8
Positive predictive value	15.3	8.0	10.0	6.0	3.0
Negative predictive value	88.7	93.3	90.6	90.3	93.7
IOM 2009 standard					
Sensitivity	6.9	6.4	5.6	3.0	2.0
Specificity	95.6	95.5	95.4	95.2	95.2
Positive predictive value	17.7	9.0	11.0	5.0	2.0
Negative predictive value	88.4	93.1	90.5	90.6	94.0

DISCUSSION

This study aimed to evaluate differences in the prevalence of underweight, excessive gestational weight gain and to detect adverse neonatal outcomes between the Atalah and IOM 2009 standards. Our results showed that when using the cut-off point <18.5 kg/m^2 (IOM 2009), the prevalence of underweight in Chile is three times lower than when using the Atalah standard (2.5% vs. 8.6%). The prevalence of underweight in pregnant women according to the IOM2009 was similar to the ones found in the Chilean National Health Surveys in childbearing women of 15-44 years old (2.6% in 2009-10 and 3.2% in 2016-17)[29,30]. These surveys as well the IOM2009 and Intergrowth use the WHO cut-off points to classify nutritional status[12,13]. A non-pregnant woman with a BMI between 18.5-19.9 was classified as NW, but as underweight, when started its pregnancy, with the Atalah standard. Although the prevalence of underweight according to Atalah standard has been decreasing in recent years (4.1% in 2017)[15], it would be even lower if IOM2009 standards had been used[13]. Our result is also consistent with a Brazilian study which showed that the prevalence of underweight in pregnant women according to Atalah standard was approximately two times higher than according to IOM201926.

The present study also showed differences in the underweight prevalence and between standards according to maternal age. For example, in women younger than 19-years-old, 16.8% were underweight according to the Atalah standard and 5.3% according to IOM 2009 and 2.1% and 0.5% respectively in women older than 35 years. Although the cut-off points to classify nutritional status in non-pregnant adolescents[31] differ from those of adults, both Atalah and IOM2009 do not differentiate by age[10,13]. This practice may lead to adolescents being classified into a lower nutritional status and, therefore, receiving recommendations for greater gestational weight gain than necessary[13]. In our analysis we included adults and adolescents, because they better represent the reality of Chilean pregnant women, although the Atalah standard has only been validated in adults. We found that, using the Atalah standard, two out of ten adolescents was classified as underweight. Using specific curves for the adolescent population may be useful, particularly in settings dedicated to caring for pregnant adolescents.

We also found differences in the proportion of meeting gestational weight gain recommendations according to each standard. When using the Atalah standard, one in three pregnant women exceeded gestational weight gain recommendations, while it was one in two with the IOM2009 standards for women with a pre-pregnancy BMI between 18.5 and 19.9 kg/m^2. Given the complications associated with excess gestational weight gain[17,18,19,20], underestimating the number of women who gain more than the recommended weight has important implications for the risks, recommendations, and behaviors of patients[32].

Given the low prevalence of neonatal pathologies in the sample analyzed, both standards showed low sensitivity to detect neonatal risk. On the other hand, specificities to detect newborns without adverse neonatal outcomes were high for both standards, though slightly higher for IOM2009

recommendations (95% for the IOM2009 recommendations vs. 84% for the Atalah standard). We did not find other studies analyzing the diagnostic accuracy for LBW risk comparing the Atalah and IOM2009 standards.

We found similar associations between underweight and adverse neonatal outcomes when both standards were used. Therefore, lowering the cut-off point for underweight pregnant women would not affect the prevalence of adverse neonatal outcomes among the group of pregnant women with a BMI between 18.5 and 19.9 kg/m^2, who would be classified within a normal nutritional status according to the IOM2009 recommendations.

Strengths and limitations

We would like to acknowledge some limitations for this study. First, pre-pregnancy weight was reported by the patient, leading to potential bias[33]. However, many studies have validated the use of self-reported weight in adults, with correlations over 0.90[34]. Secondly, it is possible that the rates of some pregnancy complications were lower than expected because they may have been underreported, leading to residual confounding in the regression models. In addition, other variables related with intrauterine growth, such as drug and alcohol consumption, were not considered; neither were the causes of interruption of pregnancy or newborn diseases.

The strength of our study lies in the fact that it includes a large database, which is representative of the national population who receive care in National Public Health Care System and that the anthropometric data (weight and height) of the newborns and pregnant woman were collected by professionals using standardized protocols.

CONCLUSION

According to data for Chilean childbearing women, non-pregnant women, the cut-off points recommended by the U.S.A. IOM 2009 report better identified the prevalence of underweight and normal nutritional status in pregnant women without increasing neonatal risk. Consequently, identifying more accurately the risk group would allow the health system to provide better gestational weight gain recommendations to avoid excessive gestational weight gain and preventing a greater postpartum weight retention, especially in adolescent pregnant women. This study supports the recent change of the Ministry of Health in adopting the WHO cut-off points for pregnant women. Future studies are needed to evaluate the proportion of excessive gestational weight gain and complications according this new classification.

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