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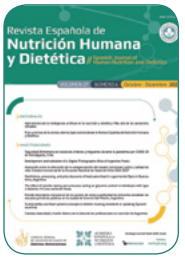

RESEARCH ARTICLE

Development and validation of a Digital Photographic Atlas of Argentine Foods

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KEYWORDS

Portion Size;

Surveys and Questionnaires;

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Weights and Measures;

Photograph.

Development and validation of a Digital Photographic Atlas of Argentine Foods

ABSTRACT

Introduction: Before the Second National Health and Nutrition Survey in Argentina, it was necessary to create a digital visual tool to help participants in the quantification of intake. This study describes the development of a Digital Photographic Atlas of Argentinean Foods (AFDAA) and evaluates its accuracy in visually estimating the amounts of foods consumed in Argentina.

Methodology: A total of 292 photographs of food/dishes were taken in standardized conditions and classified into 103 series according to food group. Thirty series were selected for validation. Adults ≥18 years of age were invited to participate in three validation sessions that were conducted at "blinded" between 2016 and 2018. During each session, the participant´s ability to visually relate a real amount of food presented on a plate to an amount depicted in a photograph series was assessed. The difference between the participant's perception of the weight of foods/dishes in photographs and the real weight was expressed as a percentage. The average percentage difference was estimated, and 95% confidence intervals were used. When ≥50% of the differences were outside the ±30% range, the set of pictures was removed from the final version.

Results: This free-to-use digital Atlas is a valuable tool that can be employed in future dietary surveys to quantify the consumption of foods similar to those depicted in the images.

Conclusions: The degree of BMI tends to increase the level of sleepiness.

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PALABRAS CLAVE

Tamaño de la Porción;

Encuestas y Cuestionarios;

Evaluación Nutricional;

Pesos y Medidas;

Fotografía.

Desarrollo y validación de un atlas fotográfico digital de alimentos argentinos

RESUMEN

Introducción: Previo a la Segunda Encuesta Nacional de Salud y Nutrición en Argentina, era necesario crear una herramienta ayudar a los participantes en la cuantificación de la ingesta. Este estudio describe el desarrollo de un Atlas Fotográfico Digital de Alimentos Argentinos (AFDAA) y evalúa su precisión para estimar visualmente las cantidades de alimentos consumidos en Argentina.

Metodología: Se tomaron un total de 292 fotografías de alimentos/platos en condiciones estandarizadas y se clasificaron en 103 series según el grupo de alimentos. Se seleccionaron treinta series para su validación. Se invitó a adultos ≥18 años a participar en 3 sesiones de validación que se llevaron a cabo en la "blinded" entre 2016 y 2018. Durante cada sesión, se evaluó la capacidad de los participantes para relacionar visualmente una cantidad real de alimentos presentados en un plato con una cantidad representada en una serie de fotografías. La diferencia entre la percepción de los participantes del peso de los alimentos/platos en las fotografías y el peso real se expresó como un porcentaje. Se estimó el promedio de la diferencia porcentual y se utilizaron intervalos de confianza del 95%. Cuando ≥50% de las diferencias estaban fuera del rango de ±30%, se eliminaron las series de imágenes de la versión final.

Resultados: El estudio incluyó a 277 participantes. Diecisiete alimentos/platos tuvieron una diferencia porcentual promedio igual o inferior al 20%, 19 tuvieron 50% o más de observaciones con diferencias dentro del 30% del peso real. Catorce cantidades de alimentos/platos fueron subestimadas y 8 fueron sobreestimadas.

Conclusiónes: Este atlas digital y gratuito es una herramienta valiosa que puede utilizarse en futuras encuestas dietéticas para cuantificar el consumo de alimentos similares a los representados en las imágenes.

Financiación: Esta investigación recibió apoyo financiero de UNICEF y la Universidad Nacional de La Matanza (Subsidio C2SAL012).

KEY MESSAGES

1. A Digital Photographic Atlas of Argentinean Foods (AFDAA) was developed to aid participants in the quantification of food intake.
2. 277 participants were involved in three validation sessions between 2016 and 2018 consisting on the assessment of the difference between the participants' perception of the weight of foods/dishes in photographs and the real weight.
3. Among the 30 food/dishes evaluated, mean differences were ≤10% for 8, between 10 and 20% for 9 and over 20 (and up to 30%) for 3 foods/dishes, and over >30% for the rest of the foods/dishes.
4. The AFDAA is a free-to-use digital Atlas and can be utilized in future dietary surveys to quantify the consumption of foods similar to those depicted in the images.

CITATION

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INTRODUCTION

Monitoring existing public policies and programs in nutrition requires knowledge of the foods and amounts consumed. From birth to adulthood, recall of dietary intakes gives useful information for the prevention or treatment of chronic health diseases and maternal and infant health promotion, among others. The accuracy of intake recalls is limited by factors such as the respondent's memory, ability to estimate food amounts, food types, age, education level, and other variables, resulting in a gap between the actual intake and the reported information in the survey[1]. Visual aids, such as household measures, photographs or food replicas are helpful in the conceptualization of portion sizes and quantities[2–7]. Photo atlases have been recognized as reliable and easy-to-use tools for surveys, providing the opportunity to show foods in different serving sizes according to the types and amounts commonly consumed in a region or country. Additionally, photos are simpler to transport than three-dimensional models, which is crucial for national face-to-face surveys[8]. Thus, a validated food atlas including commonly consumed foods (ideally by age and gender) is particularly valuable for any country[1,9].

The First National Health and Nutrition Survey (ENNyS) conducted in Argentina between 2004 and 2005 collected dietary data by using 24-hour dietary recalls. A paper-based atlas of photographs for Argentinian foods was used to help in estimating portion sizes[10]. The Second National Health and Nutrition Survey (ENNyS2) conducted in Argentina between 2018 and 2019[11], also collected dietary data by using 24-hour dietary recalls, but the development of a validated digital atlas was considered due to several vantages. It would enable the inclusion of a vast collection of high-quality colour photographs at low cost, facilitate portability with reduced burden on field researchers and allow periodic updates. In addition, it may enable free web downloads. The objective of this article is to describe the development of the Digital Photographic Atlas of Argentinean Foods (AFDAA) used for ENNyS2 and to assess its accuracy in visually estimating the amounts of foods commonly consumed in Argentina.

METHODOLOGY

Development and design

Photograph series were planned for commonly consumed foods in Argentina following the recommendations of Nelson *et al.*[12]. For most of them, information about usual food intake was obtained from the first ENNyS, which was conducted in 2005 and was the only national and representative data at the time[13,14]. All the foods consumed by at least 1% of the population were considered for inclusion in the AFDAA. That initial list was completed with other foods and dishes of nutritional importance at a population level.

The AFDAA contained both foods and dishes prioritizing foods difficult to quantify by a description or other means (i.e.: whole fruits)[12]. Whenever possible, servings were presented in 4 pictures representing different weights (size 8x5 cm). In most cases, the first photograph represented the 50th percentile of the intake of children between 6 and 24 months; and the other 3 pictures represented the 25th, 50th and 75th percentiles of adult intakes (Figure 1). When 2 percentiles were too similar, intermediate points were selected taking into consideration an adequate visual perception and the plausibility of the intake. In the case a percentile represented a portion size too small or too big for visual perception, its weight was also modified to make the pictures more meaningful. For some foods (i.e.: cookies) or preparations (i.e.: jello), it did not make sense to take more than one picture, therefore several serving sizes were placed into the same image and the different serving sizes were identified with letters to avoid selection bias[12].

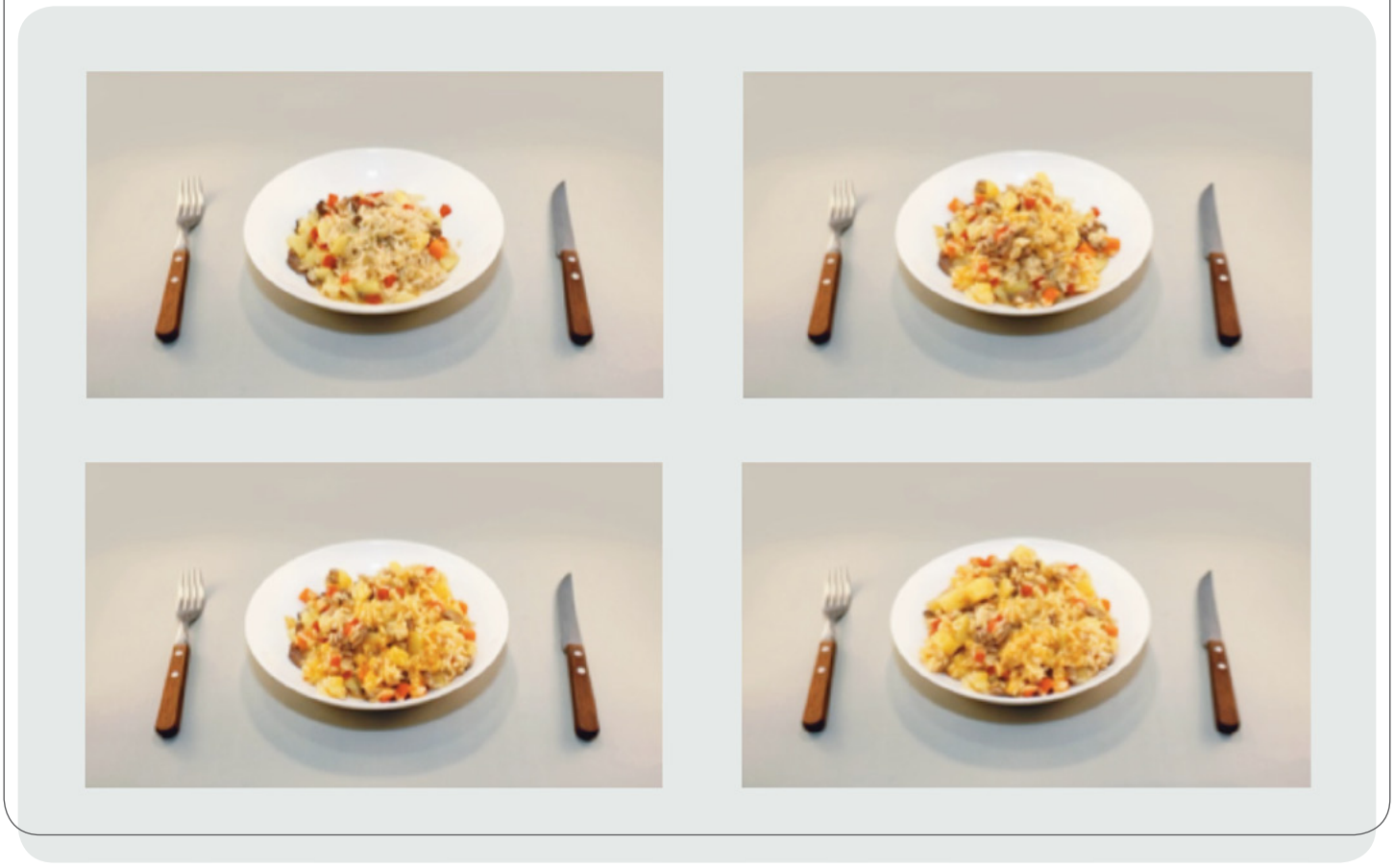
The atlas contained a final count of 292 photographs classified according to the Argentinean Food Guide (vegetables and fruits: 15 series; legumes, cereals, potatoes, bread and pasta: 34 series; milk, yoghurt and cheese: 5 series; meats and eggs: 15 series; oils, nuts and seeds: 8 series; optional foods, sweets and fats: 20 series, and water and beverages: 6 series)[15]. In supplementary (https://www.renhyd.org/renhyd/article/view/1925/1163) material we present the full set of pictures included in the AFDAA used during ENNyS2.

Photographs were taken in standardized and controlled conditions following the recommendations available on this matter[12,16]. Several working days were needed to photograph all the foods and dishes prepared by a professional team right before the shooting session. A professional photographer was in charge of the photograph setting following precise instructions to ensure standardized lighting, angle, and distance. All the pictures from the same series were taken with a fixed camera maintaining the shooting angle (45 or 90 angle degree depending on the type of food), the distance from the plate and the general layout. Plates and surfaces for the photographs were carefully selected to guarantee good color contrast. Knives, forks, or spoons were placed on the sides of the plates in most series to improve the real perception of sizes and shapes (see figure). Each food to be photographed was weighed using a digital electronic scale model Sistel Clipse 5 V2,5 kg (precision 1 g).

Validation Process

Subjects and setting. Three validation sessions were conducted between 2016 and 2018 at the "blinded" premises. Thirty series of photographs were selected for evaluation out of a total of 103

Figure 1. Example of series of 4 dishes which represent different amounts of rice stew.



series contained in the AFDAA; the selection was based on foods considered more difficult to estimate due to their shape.

Convenience samples of participants were used for each validation session, inviting people ≥18 years of age who were on the premises of the University (students, visitors, teachers, employees, etc.). An exclusion criterion was working in or studying any food or nutrition-related field[17]. To participate, the objectives were read, and an informed consent was signed. Age, sex, education background and self-reported weight and height were collected. Once those steps were over, a trained interviewer took each participant throughout the assessment procedure.

Ethical approval. The Universidad Nacional de La Matanza authorized the present study to be conducted on their facilities. Approval of the protocol (including the analytic plan), procedures and informed consent was obtained from the Municipal Committee of Bioethics of "La Matanza" (Protocol number 32/16, approval date: 11/02/2016). Written consent to participate was obtained from all subjects before validation activities.

Assessment procedure. The validation process focused on evaluating the participant´s ability to visually relate a real amount of food presented on a plate to an amount depicted in a photograph series[5]. The process consisted of showing participants plates with pre-weighed amounts of food (weighed on Sistel Clipse scale) and asking them to estimate the real amount using the correspondent series of photographs shown in a 10' screen tablet. In most of the evaluated foods, the real weight of the plate shown to participants was within the range of the weights of the series of photographs. Trained interviewers (blinded to the amount of food in the plates) accompanied the participants to the experimental room showing each plate and recording the answers.

Since weight was assumed a continuous variable, the participants could link the amount of the real plate to a particular picture of the series or quantify amounts indicating any of the following options: amounts between pictures; amounts as the sum of pictures; amounts larger than the largest picture or smaller than

the smallest picture; a fraction or multiple of a specific photograph (i.e.: a quarter, a half or two times a particular picture); or any other option that could be quantifiable.

The plates chosen for the validation were different in shape, size and color from the ones on the photographs; in addition, none of the real plates had the exact weight of any of the pictures of the corresponding series given that, as it was previously reported, there was greater agreement when real plates were similar in appearance to the ones on the pictures[18].

Variables. Sex, age, education, body weight and height were self-reported at the beginning of each validation session; then the body mass index (BMI) was calculated as weight (kg)/height^2 (m^2).

Participants' perception regarding the amount of food on the photographs was used to calculate the estimated weight for each evaluated food /dish. The difference between the estimated weight and the real weight was then calculated in grams and expressed as a percentage of the real weight.

Data Analysis. Sociodemographic variables and BMI were categorized and summarized using frequencies. The average percentage difference between the estimated and real weights of the evaluated foods and dishes, 95% confidence intervals (95%CI), as well as the minimum and maximum difference values were calculated for each set of photographs. Also, in order to describe the direction of the differences, mean estimated weights below 90% and 110% of the real weight were considered an underestimation or an overestimation, respectively. The average percentage difference was estimated using the following calculation: Σ [(estimated weight by each subject – real weight of the plate) / real weight of the plate] * 100 / number of observations.

In addition, the proportion of weight differences within 30% of the actual weight was recorded for each food/dish. When ≥50% of the differences were outside that range, the set of pictures was removed from the final version of the atlas, and a new series was photographed for further validation. All the analyses were conducted according to the analytic plan. Statistical analyses were carried out using the IBM SPSS version 24 statistical package.

RESULTS

After three validation sessions, a total of 277 participants were interviewed. Sociodemographic information is presented in Table 1. Participants` mean age was 26.8 years. A total of 2,761 observations were made across the three validation sessions for 30 different foods or dishes.

Table 1. Participants` pooled sociodemographic and anthropometric characteristics (n=277).

Characteristics	n	%
Sex		
Female	137	49.5
Male	140	50.5
Age (years)		
18-25	173	62.5
26-35	71	25.6
36-50	20	7.2
>50	13	4.7
Higher educational level attained		
Elementary school	5	1.8
Middle school	226	81.6
Higher education	46	16.6
BMI		
<18.5	5	2.16
18.5-24.9	137	59.3
≥25.0	89	38.5

BMI: Body mass index; **n=231** due to missing data.

The real mean estimated weights and average weight differences of each evaluated food/dish are shown in Table 2. Fruit rings and gnocchi presented the lowest and highest average percentage difference, -1.2% and 58.5% respectively. Over half (17/30) of the evaluated foods and dishes had an average percentage difference equal to or lower than 20%. Mean differences were ≤10% for 8 foods/dishes (grapes, lettuce and tomato salad, peas, cereal fruit rings, french fries, farfalle with and without sauce and breaded meat), between 10 and 20% for 9 foods/dishes (grated carrot, tomato fresh cubes, beans, mashed potatoes, potato boiled in cubes, oil, quince paste, rice and rice stew); over 20 and up to 30% for 3 foods/dishes (fruit salad, cacao powder and jam) and over >30% for the rest of the foods/dishes.

The range (minimum and maximum) of percentage differences of estimated weight differed by food or dish. The largest range was for cereal fruit rings (-58.3 to 650.0) and the smallest for French fries (-28.4 to 20.9).

As per the average percentage difference, 14 foods/dishes quantities were underestimated and 8 were overestimated. For

Table 2. Real and estimated weight of 30 foods and dishes, average absolute and percentage differences.

Food Group	Food	Number of participants	Real weight (g)	Mean estimated weight (g)	Average weight difference (g)	Average percentage difference (%)	Average percentage difference (95%CI)	Range percentage difference (minimum and maximum)
Vegetables and fruits	Corn kernel	74	30	16.6	-13.4	-44.6	(-49.1;-40.1)	(-68.3;31.3)
	Fruit salad	100	192	152.8	-39.2	-20.4	(-24.6;-16.3)	(-79.7;69.3)
	Grapes	100	237	243.2	6.2	2.6	(-0.3;5.5)	(-68.4;26.6)
	Grated carrot	74	25	20.6	-4.4	-17.6	(-22.8;-12.4)	(-62.0;68.0)
	Lettuce and tomato salad	100	81	77.6	-3.3	-4.1	(-10.5;2.3)	(-50.9;151.9)
	Mashed butternut squash[a]	100	255	174.1	-80.9	-31.7	(-34.3;-29.2)	(-70.6;4.3)
	Peas	74	53	54.1	1.1	2.0	(-4.8;8.8)	(-58.5;65.1)
	Tomato – fresh cubes	103	60	49.3	-10.7	-17.8	(-22.4;-13.1)	(-66.7;70.0)
	Tomato – fresh slices	100	77	107.1	30.1	39.1	(29.6;48.5)	(-9.1;372.7)
Legumes, cereals, potato, bread and pasta	Beans	103	85	95.6	10.6	12.5	(8.4;16.6)	(-43.6;65.9)
	Cereal – fruit rings	100	24	23.7	-0.3	-1.2	(-15.6;13.3)	(-58.3;650.0)
	Cereal – corn flakes	100	45	23.4	-21.6	-48.0	(-51.6;-44.5)	(-77.8;33.3)
	Farm bread[a]	100	29	40.5	11.5	39.6	(30.0;49.2)	(-20.3;313.8)
	French fries	74	115	111.6	-3.4	-3.0	(-5.1;-0.8)	(-28.4;20.9)
	Gnocchi	74	100	158.5	58.5	58.5	(50.6;66.5)	(4.5;224.0)
	Mashed potatoes[a]	100	291	252.9	-38.1	-13.1	(-19.5;-6.7)	(-84.5;61.5)
	Pasta – farfalle with tomato sauce[a]	100	342	317.5	-24.5	-7.2	(-12.0;-2.3)	(-80.3;79.0)
	Pasta – farfalle without sauce[a]	103	100	103.7	3.7	3.7	(-1.1;8.6)	(-65.6;74.3)
	Potato – boiled in cubes	103	150	179.3	29.3	19.5	(15.3;23.8)	(-36.7;55.5)
	Potato salad	74	260	341.5	81.5	31.3	(25.2; 37.4)	(-4.6;152.3)
	Rice[a]	100	255	220.6	-34.4	-13.5	(-19.8;-7.2)	(-84.7;26.7)
	Rice stew	103	310	355.5	45.5	14.7	(10.4;19.0)	(-27.7;85.1)
Milk, yogurth and cheese	Grated cheese[a]	74	15	6.5	-8.5	-56.5	(-59.7;-53.3)	(-76.7;-26.7)
Meats and eggs	Breaded meat	103	100	107.2	7.2	7.2	(0.1;14.3)	(-84.1;111.0)
Oils, nuts and seeds	Roasted peanuts	100	37	22.8	-14.2	-38.3	(-46.9;-29.7)	(-73.0;305.4)
	Oil	74	30	25.5	-4.5	-15.1	(-21.1;-9.2)	(-73.3;60.0)
Optional foods, sweets and fats	Cacao poder	100	40	31.3	-8.7	-21.8	(-27.0;-16.6)	(-94.0;125.0)
	Jam[a]	74	15	10.8	-4.2	-28.0	(-33.4;-22.6)	(-66.7;100.0)
	Jello	103	70	107.1	37.1	52.9	(43.9;62.0)	(-28.6;185.7)
	Quince paste[a]	74	100	86.0	-14.0	-14.0	(-25.3;-2.8)	(-87.5;170.0)

[a] For those foods, the actual weight used during the validation exceeded to some degree (by more or less) the range of weights of the pictures to validate.

underestimation, the largest mean difference was -56.5% (grated cheese); for overestimation the largest mean difference was 58.5% (gnocchi).

Among the 30 foods/dishes evaluated, 19 had 50% or more observations with differences within 30% of the real weight; out of those 30, gnocchi had the lowest proportion and french fries had the highest (2.73% and 100% respectively). Those 11 series that had more than 50% of the observations outside the +/- 30% range were excluded from the atlas and are shown in (Table 3).

Table 3. Percentage of the observations with estimated weights within ±30% of the real weight, in adults at the "blinded".

Food Group	Food	Number of participants	Observations with estimated weights within ±30% of the real weight (%)
Vegetables and fruits	Corn kernel[a]	74	5.5
	Fruit salad	100	81.6
	Grapes	100	94.0
	Grated carrot	74	84.9
	Lettuce and tomato salad	100	66.7
	Mashed butternut squash[a]	100	44.0
	Peas	74	58.9
	Tomato – fresh cubes[a]	103	42.7
	Tomato – fresh slices[a]	100	40.69
Legumes, cereals, potato, bread and pasta	Beans	103	77.7
	Cereal – fruit rings	100	87.6
	Cereal – corn flakes[a]	100	4.1
	Farm bread	100	65.3
	French fries	74	100.0
	Gnocchi[a]	74	2.7
	Mashed potatoes	100	65.3
	Pasta – farfalle with tomato sauce	100	69.0
	Pasta – farfalle without sauce	103	88.3
	Potato – boiled in cubes	103	58.2
	Potato salad	74	61.6
	Rice	100	62.2
	Rice stew	103	68.9
Milk, yogurth and cheese	Grated cheese[a]	74	1.49
Meats and eggs	Breaded meat	103	51.5
Oils, nuts and seeds	Roasted peanuts[a]	100	8.1
	Oil	74	68.5
Optional foods, sweets and fats	Cacao powder	100	76.3
	Jam[a]	74	19.2
	Jello[a]	103	14.6
	Quince paste[a]	74	47.9

[a] Sets of pictures excluded from the atlas.

DISCUSSION

We developed a photographic atlas of Argentinean foods using dietary data from the first ENNyS. A set of 30 photographs of foods and dishes was evaluated to visually estimate amounts of foods. The average percentage difference observed was less than 20% for 57% of the evaluated sets (17/30) and at least 50% of the observations were within ±30% of the real weight range for 63% (19/30) of the evaluated foods and dishes. Finally, pictures outside that range (11 sets) were eliminated from the tool used for ENNyS2.

Comparing results among studies is challenging because validation procedures, sample sizes, types and numbers of foods validated, quality and quantity of pictures displayed, skills tested, and other characteristics widely vary across studies; therefore, any generalization has to be made with caution[5,19]. For example, some studies compared pictures with real intake[20], while others used experimental designs[18]. Some studies tested a limited number of pictures and others a large number (from 6 to 45)[16,21]. Some studies allowed participants to choose one particular picture[18] while others offered a continuum of weights to select from[16]. Our study focused on depicting a realistic scenario anticipating the use of this tool in a 24-hour dietary survey during the ENNyS2 the participants were given the freedom to choose any amount of food to describe the plates shown. Moreover, none of the real plates had similar characteristics or weights to any of the pictures to reduce selection bias as described by other authors[18].

The proportion of sets with differences within the range of ±30% stipulated for this study was generally in agreement with the proportion of differences considered adequate or acceptable in several studies[3,4,18,22,23]. Not many studies reported differences as percentages. Nevertheless, Frobisher in his study with a similar population found a range between -11% and 73%[24]; in our study the percentage of difference was between 1.2% and 58.5%.

By observing the range of the differences between the real and the estimated weight, it seems evident that there is a large variability in individual capability of photograph perception; however, the AFDAA proved useful to estimate population mean intakes, as pointed by other authors as well[18,25].

Tendency for over or underestimation was different among reports. Vereecken in a study with a similar design but conducted on a different population, showed a comparable percentage of estimations within 10% difference with the real weight to our study (29% and 26% respectively)[22]. Robson did not show a clear tendency to over or underestimation[26], Frobisher reported a tendency of overestimation data[24], lastly, Lazarte reported a tendency of underestimation across subjects as our findings[27]. The over or under-estimation may differ according to the type of food. Some studies reported similar foods to the ones tested for the AFDAA that make comparisons possible; Faggiano and coworkers found that rice and mixed salad were underestimated by participants and our data were similar to those findings; however, carrots and potatoes performed in opposite directions in both studies[28].

Two previous studies assessed the performance of food atlases in Argentinean populations[3,4]. Overall, our study found a similar percentage of acceptable sets to López´s (63% and 56% respectively). However, in their study, breaded meat was one of the worst estimated foods, whereas in our study its average percentage difference was less than 10% and more than 50% of observations were between a range of differences equal to or less than 30% of the real weight. On the other hand, in both studies, rice had a similar percentage of correct answers. As for tomato, our results were worse than López; however, this author did not specify the way the tomato was served. This difference could be due to the different presentations of the tomato in each study[3]. In Navarro´s, 8 out of the 118 items tested (potato, french fries, mashed potato, tomato, grated carrots, peanuts, rice, and gnocchi) are comparable with our study. Their general agreement percentage (51%) was in concordance with ours and the foods with a better agreement were similar to ours except for tomato, peanuts and gnocchi[4].

The validation process permitted to identify of pictures to be included in the tool used in the 24HR during ENNyS2. There is agreement that the use of tools, such as photographs reduces misinformation during dietary recall[29]; however, caution should be given to the fact that error can be introduced if a biased tool is used[30]. Therefore, our decision to eliminate pictures that did not meet the minimum criteria seemed appropriate for the intended use of the tool.

Some limitations of our work include the small number of foods evaluated (30 out of 103 series). Even though it may be desirable to evaluate more pictures, the whole process is not only expensive, but also time consuming as it requires a large amount of equipment and personnel. Also, we cannot rule out the potential bias of central tendency for some of the sets of photographs for which an uneven number of pictures was shown. Even when we made all efforts to have four pictures of each meal to avoid that central tendency, in some cases it was not possible given that the grams estimated from percentiles of intake from the first ENNyS were identical[6]. Another limitation of this study is that participants were only adults, mostly educated. Therefore, it remains to know how useful this tool is in helping children and teenagers to report their intakes, as well as other populations. Also, since the participants had a real amount of food in front of them to make the comparison, skills like conceptualization and memory were not tested in this study. Given that some authors

also recommend testing atlases in the same conditions that they will be used, it is still necessary to validate the AFDAA in a context like a 24-hour recall[12]. Finally, given that weight and height data were self-reported and voluntary, some were missing limiting the possibility to evaluate the performance of the pictures according to BMI.

To our understanding, the study design has some strengths as well. First of all, the AFDAA was built with intakes from national data, providing the tool with a real range of amounts of foods consumed. Another strength is that during the evaluation sessions, participants were allowed to select a particular picture or any amount in between pictures as it would happen in a real-life situation. Finally, since this atlas is digital, it is possible to eliminate some series based on their performance during the evaluation sessions.

CONCLUSIONS

The information used to construct the AFDAA, the depuration process for the pictures that did not perform as expected, and the general results of the series during the evaluation sessions make this atlas a valuable tool for the estimation of group intakes. This tool developed and validated in this study was available for the Argentinean National Nutrition and Health Survey. Also, given that this is the first digital and free-to-use atlas in our country, it is expected to be a useful tool in other research settings in the future. Further research should focus on testing this tool in a more diverse population sample, as well as the inclusion of new photographs, to increase its validity and scope. Finally, it would be advisable to evaluate the perception of the usefulness of the tool among users like nutrition-related professionals.

AUTHORS' CONTRIBUTIONS

The authors are responsible for the research and have participated in the concept, design, analysis and interpretation of the data, writing and correction of the manuscript.

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COMPETING INTERESTS

Authors state that there are no conflicts of interest in preparing the manuscript.

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