



Trabajo Original

Epidemiología y dietética

Online pilot intervention to improve nutritional and lifestyle in Spanish breastfeeding women

Intervención piloto "online" para mejorar el patrón nutricional y el estilo de vida de las mujeres españolas durante la lactancia

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Abstract

Introduction: breastfeeding women often cannot adequately follow dietary and healthy habits recommendations. In addition, after delivery, their care is usually focused on the newborn and the mother's health may be neglected. The Mediterranean Diet is the standard of healthy eating, with the Healthy Food Pyramid (HFP) being its graphic representation.

Objective: the aim of this study was to determine whether a nutritional and lifestyle online intervention may improve HFP adherence in breastfeeding women.

Methods: a total of 181 breastfeeding women in the first sixth months postpartum were enrolled in a non-randomized interventional pilot study. These women answered three questionnaires: sociodemographic and for adherence to Healthy Food Pyramid (APQ), before and after an online intervention for 13 weeks, providing information about nutrition and healthy habits. The APQ ranges from 0 to 10, with higher scores corresponding to greater adherence to HFP. The intervention consisted of lifestyle and nutritional information, which was provided through e-mail.

Results: a low adherence to HFP was found, which was improved after 13 weeks of intervention. The online intervention significantly increased the scores for physical activity, grain, seeds and legumes consumption, olive oil use, dairy products, and ani-mal proteins, as well as the HFP adherence global score. The adjusted models showed that the online intervention was associated with adherence to the HFP and physical activity.

Conclusion: we conclude that an online intervention for breastfeeding women had an impact on their lifestyle, improving nutritional and healthy habits, and can be a useful tool to monitor their health status. Given the importance of this stage for women and their newborns, this is an aspect postnatal healthcare professionals should consider.

Keywords:

Breastfeeding. Online intervention. Lifestyle. Healthy food pyramid. Nutritional pattern.

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Resumen

Introducción: a menudo, las mujeres durante la lactancia no pueden seguir unas recomendaciones dietéticas y de hábitos saludables adecuadas. Tras el parto, la atención médica suele centrarse en el recién nacido y la salud de la mujer puede descuidarse. La dieta mediterránea es el estándar de alimentación saludable, siendo la pirámide de la alimentación saludable (PAS) su representación gráfica.

Objetivo: el objetivo de este estudio fue determinar si una intervención 'online' nutricional y de estilo de vida mejora la adherencia a la PAS en mujeres durante la lactancia.

Métodos: se reclutaron 181 mujeres durante los primeros seis meses posparto de forma no aleatorizada. Las mujeres respondieron a tres cuestionarios: sociodemográfico y de adherencia a la pirámide de la alimentación saludable (IGAPAS), antes y después de una intervención en línea durante 13 semanas, que proporcionaba información sobre nutrición y hábitos saludables. El IGAPAS oscila entre 0 y 10: a mayor puntuación, mayor adherencia a la PAS. La intervención consistió en información nutricional y de estilos de vida proporcionados por correo electrónico.

Resultados: se encontró una baja adherencia a la PAS que mejoró tras 13 semanas de intervención. Demostramos que esta intervención aumentó significativamente las puntuaciones de actividad física, consumo de cereales, semillas y legumbres, uso de aceite de oliva, productos lácteos y proteínas animales, así como la puntuación global del IGAPAS. Los modelos ajustados mostraron que la intervención estaba asociada con la adherencia a la PAS y con la actividad física.

Conclusión: concluimos que las intervenciones online pueden mejorar los hábitos nutricionales y saludables de las mujeres en periodo de lactancia y pueden ser una herramienta útil para monitorizar su estado de salud. Dada la importancia de esta etapa para la mujer y el recién nacido, se trata de un aspecto a afrontar y manejar por los profesionales sanitarios del puerperio.

Palabras clave:

Lactancia materna.
Intervención en línea.
Estilo de vida. Pirámide
alimentaria saludable.
Patrón nutricional.

INTRODUCTION

Several studies have observed that the adherence of breastfeeding women to healthy habits decreases after delivery (1). Furthermore, it has been reported that breastfeeding women do not follow optimally the available recommendations on diet and lifestyle, especially compared to pregnant and not-pregnant/non-lactating women (2). Additionally, after delivery, the health system usually focuses on children and tends to neglect the health and lifestyle of their mothers, including their mental health. It has been observed that women's optimism decreases during the breastfeeding period, and that this is related to lower adherence to healthy habits (3). Therefore, nutritional and lifestyle recommendations during the breastfeeding period are needed to improve women's health. At present, in Spain, there are no specific guidelines for the breastfeeding period, since the present recommendations focus on the pregnancy period and newborn health (4). It could be necessary to ensure that breastfeeding women receive proper nutritional and lifestyle advice, since it affects not only their health status but also the composition of milk (5), which is the gold-standard nourishment of the child (6). For these reasons, we hypothesize that a nutritional intervention and follow-up can improve the health status of women.

The Mediterranean diet (MD) has been proven a healthiest dietary pattern, being strongly associated with a lower incidence of chronic diseases (7). The Healthy Food Pyramid (HFP) is a simplified representation of MD developed by the Spanish Society of Community Nutrition (8), and is used as a reference in many Mediterranean regions and cultures. MD is characterized not only by its use of healthy foods ensuring diversity of nutrients but also by the use of ecological and preferably local products (9), as well as adequate hydration, physical activity, and social aspects related to the culture of eating with family and friends (10,11). Based on the above-mentioned characteristics, MD conforms an adequate nutritional pattern for breastfeeding women in order to improve their health status.

In nutritional epidemiology, dietary patterns and lifestyle must be evaluated. Therefore, some instruments have been developed

for this purpose and some questionnaires have been used to assess adherence to MD (12,13), such as the Trichopoulou questionnaire (14), although it has arbitrary cut-offs (15). Another tool would be the KIDMED questionnaire (16). However, this instrument is principally validated in children and young populations, and does not measure individual dietary patterns.

We have previously developed a questionnaire to assess the degree of adherence to the Healthy Food Pyramid (AP-Q). This instrument evaluates not only the dietary pattern but also physical activity, lifestyle, and healthy habits, and is validated for breastfeeding women (17). Using this tool, the present study aims to assess the capacity of 13 weeks of a nutritional and lifestyle online intervention to improve in breastfeeding women their degree of adherence to HFP, which is the gold-standard healthy dietary and lifestyle pattern in our region. We also analyzed the impact of socioeconomic factors on lifestyle and diet. Considering the importance of women's health during breastfeeding for the mother-newborn dyads, and the research gap in the promotion of women's nutrition, we intend to perform an online health education intervention, determining its effectiveness in an online intervention for women during the breastfeeding period.

MATERIALS AND METHODS

STUDY DESIGN

The HFP adherence was measured with a self-reported questionnaire AP-Q pre-intervention and 13 weeks afterwards (post-intervention). In this non-randomized interventional pilot study the recruitment was carried out by the Service of Neonatology of Hospital Universitario La Paz (HULP, Madrid, Spain) between October and December 2021. The recruitment involved women whose newborns had routine medical check-ups in this service.

Women were invited to participate if they had internet access, they were Spanish-speaking or had a good understanding of the Spanish language, were ≥ 18 years, were not under diet control

by a health specialist, and were in the first six months of breastfeeding. We chose this lapse time since it is the exclusive breastfeeding period recommended by the World Health Organization (18), and we have previously demonstrated that during this lapse time women worsen their healthy habits (2). The 236 women who achieved inclusion criteria were voluntarily introduced into the study protocol. From those, we excluded from the statistical analysis the women who did not respond to four or more items in the AP-Q, the final number being 181 breastfeeding women.

The women provided their email address to receive nutritional information for 13 weeks (1 document/week; see below). A randomized code, derived from their four last digits in the national identification number, was assigned to each woman for follow-up between the two time responses. No IP addresses were recorded.

The questionnaire was administered in Spanish using the online tool SurveyMonkey (<https://es.surveymonkey.com/>, December 2021 to February 2022). The women could finish the survey or end their participation in the intervention at any time of the study. From the initial cohort, a total of 31 women completed the questionnaire at both time points (tracking rate = 17.1 %; Fig. 1).

This study was conducted in accordance with the principles of the Declaration of Helsinki, with the approval of the Ethical Committee of La Paz University Hospital (Ref. PI-5149, approved date on 10 February 2022). This design adheres to EQUATOR guidelines, following the checklist for online survey studies CHERRIES (19). The questionnaire was accompanied by the following information: age (years), type of breastfeeding (exclusive/mixed), comorbidities (obesity, hypertension, diabetes mellitus, cancer, mood disorders, and inflammation-related diseases), and sociodemographic characteristics: origin (Spanish/non-Spanish), educational level (middle school or lower, high school, university degree or post-graduate studies), monthly income (categorized as no income; < € 1000; € 1000-2500, € 2500-4000, ≥ € 4000), and current employment status (studying, working, unemployed or on maternity leave). At post-intervention time, the type of breastfeeding was implemented with a "breastfeeding cessation" option.

ADHERENCE TO THE HEALTHY FOOD PYRAMID QUESTIONNAIRE (AP-Q)

The AP-Q is composed of 27 multiple-choice items and was previously validated in an adult population (20), and in pregnant and breastfeeding women (2). The answers to each item evaluate ten categories, including 1) physical activity, 2) healthy habits and culinary techniques, 3) hydration, 4) grains, seed, and legumes, 5) fruits, 6) vegetables, 7) oil type, 8) dairy products, 9) animal proteins, and 10) snacks. The category of healthy habits includes four dimensions: lifestyle, emotional balance, sleep hygiene, and culinary technique. Additionally, the hydration category also includes the dimensions for water intake, alcoholic beverages, wine & beer intakes, and distilled beverages.

Each category and dimension were scored on a scale from 0 to 1. The dimensions of soft drinks, wines & beers, and alcoholic beverages were recorded on a scale of 0 and 1. In the HFP, the food categories at the bottom of the pyramid have positive scores and represent daily practice, including physical activity, healthy culinary techniques, adequate hydration, consuming whole grains, seed and legumes, fruit, and vegetables; while the categories in the upper part (foods not included in the HFP) provide negative points. In addition to individual categories, the AP-Q overall score provides information about the global HFP adherence. The overall AP-Q score ranges from 0 to 10 and the higher the score, the greater the adherence to the HFP.

NUTRITIONAL AND LIFESTYLE ONLINE INTERVENTION

After the women answered the pre-intervention questionnaires, they were analyzed, and the weakness of the different categories were detected based on the AP-Q scores segmented by quartiles, as we previously described (17). Thereafter, the online intervention was performed, developing specific documents and infographics with nutritional and lifestyle recommendations based on the HFP and the Mediterranean diet pattern. These

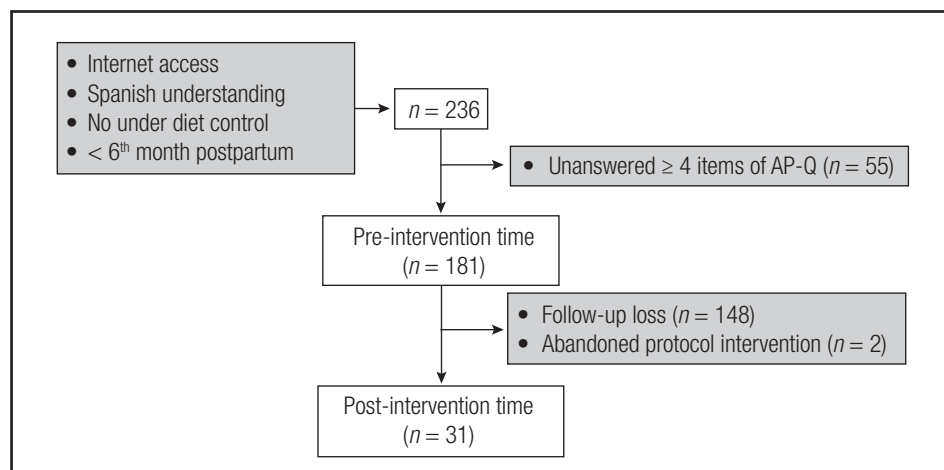


Figure 1.

Flow chart of study recruitment and loss to follow-up during the intervention time (n = sample size).

documents were weekly sent to the women by e-mail, and during the week, they could ask questions or doubts related to the information given. They received information related to the following categories 1st week: “grains, seeds and legumes”; 2nd week: “physical activity”; 3rd week: “dairy products”; 4th week: “sleep hygiene”; 5-6th weeks: “types of oil and its use”; 7-8th weeks: “vegetables”; 9-10th weeks: “fruits”; 11-12th weeks: “animal proteins”, and 13th week: “cooking techniques” and overall health recommendation (Fig. 2; 13 consecutive weeks).

STATISTICAL ANALYSIS

The Shapiro-Wild test was used to determine the distribution of variables. Quantitative variables were expressed as mean and standard error (SE), and qualitative variables were expressed as relative frequency (%) and sample size (*n*). Student's t-test for paired data was used to analyze the differences between groups in quantitative variables, and qualitative variables were analyzed using Fisher's exact test. Correlation was tested by Pearson's coefficient (*r*).

To test the association between the AP-Q scores and the effect of the nutritional intervention, multivariate linear regression models were performed considering the pre-intervention time as the reference group. All models were adjusted by maternal age (continuous), income (categorical), education (categorical), employment status (categorical), and origin (categorical). Significance levels were set at $p < 0.05$. Missing data were approached by simple imputation (21).

Data were entered in STATA BE (version 17.0; StataCorp LLC, College Station, TX, USA) for analysis. Plots were generated using the R software (version 4.1.3) within RStudio (version 4.2.1; RStudio, Inc., Vienna; Austria) using the *rio*, *compare-Groups*, *ggpubr*, and *ggplot* packages.

RESULTS

STUDY POPULATION CHARACTERISTICS

The questionnaire had a response rate of 76.4 % (181/237) with a tracking rate of 17.1 % (31/181) at post-intervention time.

Table I shows the sociodemographic data of the breastfeeding women at pre-intervention and post-intervention times (after 13 weeks). Maternal age was 32.8 ± 0.4 years. Most of the women were Spanish; 77.6 % of the women had a university degree, and 90.6 % of the cohort had incomes below € 2500 per month. Employment status was significantly different between pre- and post-intervention time. At pre-intervention time most of the cohort was on maternity leave whereas at post-intervention time most were back at work ($p = 0.013$).

At the end of the intervention period, 150 women had left the study. No differences were detected in sociodemographic variables between this group and the subset of women who continued in the study protocol ($n = 31$; Supplementary table I).

ADHERENCE TO THE HEALTHY FOOD PYRAMID

The analysis of the effects of the intervention was performed for all 31 women who completed the study. At pre-intervention time their overall AP-Q score was 5.23 ± 0.09 . Women with university degrees had a significantly higher score (5.39 ± 0.10) compared to women with high school (4.67 ± 0.23 ; $p = 0.010$) and middle school education (4.58 ± 0.32 ; $p = 0.047$). Women with a lower income scored less in the AP-Q (4.71 ± 0.11) compared to women with monthly incomes at € 1000-2500 (5.65 ± 0.13 ; $p < 0.001$), € 2500-4000 (5.92 ± 0.39 ; $p = 0.004$), and $< € 4000$ (6.04 ± 0.22 ; $p = 0.027$). Regarding employment status, women on maternity leave had a significantly higher score (5.58 ± 0.13) than those unemployed (4.53 ± 0.19 ; $p < 0.001$) or currently studying (4.05 ± 0.40 ; $p = 0.039$). The AP-Q score was significantly higher for Spanish women (5.79 ± 11) compared to non-Spanish women (4.62 ± 0.10 ; $p < 0.001$). The women exclusively breastfeeding showed a higher adherence to HFP (5.31 ± 0.10) than those on mixed breastfeeding (4.93 ± 0.18), although this was not significant ($p = 0.074$). The AP-Q score showed a positive and significant correlation with maternal age ($r = 0.36$; $p < 0.001$).

At post-intervention time, the AP-Q score was 5.77 ± 0.21 , significantly higher than at pre-intervention time ($p = 0.012$). In the healthy habits and hydration categories the wine & beer dimension score was significantly lower at post-intervention time

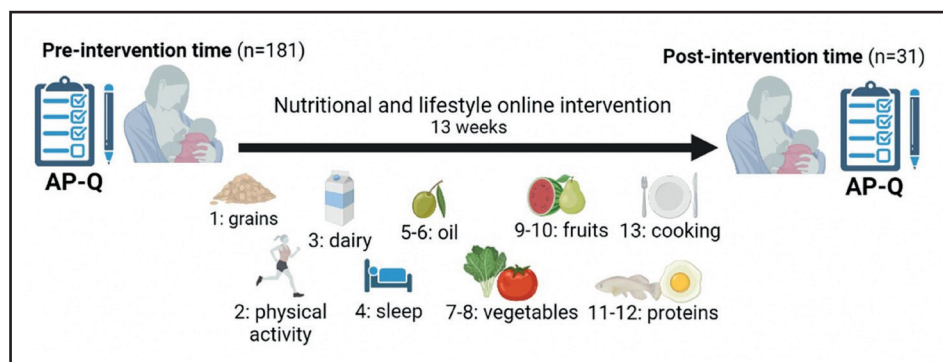


Figure 2.

Nutritional and lifestyle intervention diagram during study protocol. Pre-intervention time was related to nutritional pattern analysis to detect areas for intervention.

Table I. Sociodemographic characteristics between pre- and post-intervention times

	Pre-intervention (n = 181)	Post-intervention (n = 31)	p-value
Maternal age (years)	32.8 ± 0.38	34.6 ± 0.95	0.073
Breastfeeding time (month)	3.5 ± 1.9	5.7 ± 0.8	< 0.001
<i>Breastfeeding pattern</i>			
Exclusive breastfeeding	140 (77.3 %)	26 (76.3 %)	0.817
Mixed breastfeeding	41 (22.6 %)	6 (18.4 %)	
Breastfeeding cessation	–	0	
<i>Income</i>			
No income	33 (18.2 %)	4 (12.9 %)	0.831
< € 1000/month	55 (30.3 %)	10 (32.2 %)	
€ 1000-2500/month	76 (41.9 %)	16 (51.6 %)	
€ 2500-4000/month	11 (6.0 %)	1 (3.2 %)	
> € 4000/month	6 (3.3 %)	0	
<i>Educational level</i>			
No formal education	0	0	0.840
Middle school	13 (7.1 %)	2 (5.2 %)	
High school	27 (14.9 %)	6 (15.7 %)	
University degree	86 (77.6 %)	30 (78.9 %)	
<i>Origin</i>			
Spanish	93 (51.3 %)	19 (61.2 %)	0.244
Non-Spanish	88 (48.6 %)	12 (38.7 %)	
<i>Employment status</i>			
Working	59 (32.6 %)	20 (64.5 %)	0.013
Studying	5 (2.7 %)	0	
Unemployed	27 (14.9 %)	2 (6.4 %)	
Other situations	8 (4.4 %)	2 (6.4 %)	
Maternity leave	82 (45.3 %)	7 (22.5 %)	

Data show mean ± standard error values for quantitative variables and sample size (n), and relative frequency (%) for qualitative variables. The p-value was extracted by Student's t-test or Fisher's exact test, respectively.

than at pre-intervention (Table II), indicating higher consumption. No differences were detected between times in the rest of the analyzed variables.

The scores of the other categories that conform the AP-Q are shown in figure 3. All categories showed greater adherence to the HFP after 13 weeks of nutritional intervention.

Physical activity at pre-intervention was 0.25 ± 0.04 and at post-intervention was 0.5 ± 0.05 , these results being significantly different (Fig. 3A). The grains, seed and legumes score also significantly increased (pre-intervention = 0.48 ± 0.04 , post-intervention = 0.57 ± 0.05 , $p = 0.024$; Fig. 3B). However, the categories of fruits (Fig. 3C) and vegetables (Fig. 3D) were not significantly different.

Other significant differences categories were oil type (pre-intervention = 0.41 ± 0.07 , post-intervention = 0.60 ± 0.08 ,

$p = 0.028$; Fig. 3E), dairy products (pre-intervention = 0.38 ± 0.01 , post-intervention = 0.43 ± 0.02 , $p = 0.023$; Fig. 3F), and the category of animal protein consumption (pre-intervention = 0.41 ± 0.02 , post-intervention = 0.47 ± 0.02 , $p = 0.008$; Fig. 3G).

ASSOCIATION OF NUTRITIONAL INTERVENTION WITH ADHERENCE OF HEALTHY FOOD PYRAMID

Regression models were used to assess the association between AP-Q categories, which were significant in the univariate analysis, and the nutritional intervention (considering pre-intervention time as the reference). A positive and significant association was found between the global AP-Q and the intervention,

Table II. Healthy habits and hydration categories between pre- and post-intervention

	Pre-intervention (n = 31)	Post-intervention (n = 31)	p-value
Healthy habits	0.62 ± 0.13	0.62 ± 0.15	0.859
Lifestyle	0.96 ± 0.22	0.96 ± 0.22	0.999
Emotional balance	0.64 ± 0.21	0.58 ± 0.24	0.067
Sleep hygiene	0.38 ± 0.26	0.42 ± 0.25	0.289
Culinary techniques	0.46 ± 0.26	0.50 ± 0.31	0.462
Hydration	0.54 ± 0.32	0.57 ± 0.26	0.590
Water intake	0.72 ± 0.36	0.83 ± 0.26	0.066
Soft drinks	-0.44 ± 0.42	-0.40 ± 0.39	0.579
Wine & beers	-0.02 ± 0.09	-0.36 ± 0.15	< 0.001
Distilled beverages	-0.05 ± 0.08	-0.03 ± 0.06	0.057

Data show mean ± standard error values. The p-value was extracted by Student's t-test for paired data.

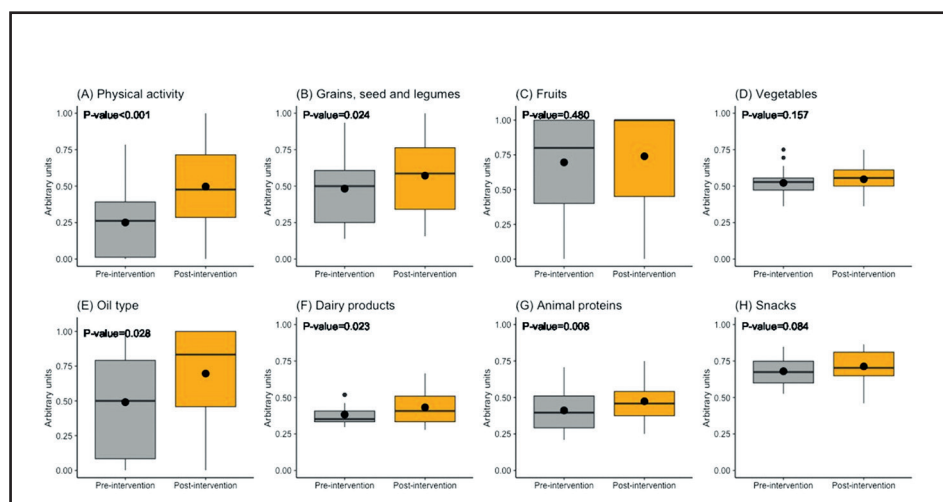


Figure 3.

The categories of the AP-Q: physical activity (A), grains, seed, and legumes (B), fruits (C), vegetables (D), oil type (E), dairy products (F), animal proteins (G) and snacks (H). Data are shown as a box plot with median and inter-quartile range. Mean is shown as a center dot. The p-value was extracted by Student's t-test comparison of adherence between pre-intervention and post-intervention.

evidencing an improvement of the HFP adherence. Physical activity was also significantly increased at post-intervention time. Additionally, the wine & beers dimension scored significantly lower after 13 weeks of intervention (Table III).

DISCUSSION

In this study we analyzed the effect of an online nutritional and lifestyle intervention on breastfeeding women, since their healthy habits may worsen during the lactation period (2,22). Given the importance of this stage for women and newborns, the objective was to improve their adherence to a healthy nutritional and life style based on the MD pattern, with an online intervention. According to our data at pre-intervention time, a low adherence to HFP was found, which was improved after 13 weeks of intervention.

Table III. Models to explore the effect of nutritional intervention on AP-Q categories

	β ± SE	p-value
Global APQ	0.87 ± 0.32	0.008
Physical activity	0.26 ± 0.08	0.001
Grains, seed, and legumes	0.10 ± 0.07	0.172
Oil type	0.15 ± 0.11	0.161
Dairy products	0.04 ± 0.07	0.146
Animal proteins	0.05 ± 0.03	0.147
Wine & beers	-0.33 ± 0.04	< 0.001

Data show coefficients (β) ± standard error (SE) and associated p-value. Pre-intervention was considered as the reference group. Models were adjusted by maternal age, origin, educational level, financial income, and employment status.

Socioeconomic factors appear to have a strong influence on adherence to a healthy lifestyle, especially regarding nutrition. Our data at pre-intervention time evidenced that the AP-Q score increased with educational level and economical status as previously reported in the general population with MD, particularly regarding the educational level (23). We have previously described the same trend in other cohort of breastfeeding women and in pregnant women (2). As in the present study, our previous work also found that the older age, the greater the adherence to HFP, with AP-Q scores being higher in Spanish women compared to women from other countries. Therefore, these data indicate that sociodemographic factors need to be considered in a nutritional and lifestyle intervention, placing the focus on vulnerable populations. Additionally, it appears that women in maternity leave tend to have a higher adherence to HFP. This tendency supports the benefits of increasing the maternity leave period for mothers to be able to give exclusive breastfeeding during the six months recommended by the World Health Organization and UNICEF (24).

Our study found that the diet of breastfeeding women did not follow the lifestyle and nutritional recommendations by HFP. However, with the applied intervention, it was shown that a nutritional and lifestyle program can improve adherence to HFP. Together with the improvement in maternal health, a better adherence to recommendations will positively affect the infant. It has been observed that the knowledge of the mothers about nutrition and a healthy lifestyle may be a determinant of their infants health (25). Ensuring nutritional education in breastfeeding women is of key importance given that a mother's lifestyle influences the composition of breastmilk (26), which is the main nourishment of the newborn. Usually, health interventions have focused on pregnancy (27,28), leaving aside the breastfeeding woman. Other trials have been conducted after the labor period, but they mainly perform interventions to diminish weight after delivery (29,30).

Physical activity has been postulated as a determinant of level of adherence to MD (23). Regarding breastfeeding women, evidence shows that not only physical activity decreases after delivery (31) but also decreases compared to pregnancy (22), which can affect both their physical and mental health (32). One category of the AP-Q is physical activity, which was significantly improved after the online intervention, it being able to increase the health score. These findings are in agreement with those of other interventional study with breastfeeding middle-aged women, where two months of intervention increased physical activity (33). Additionally, a systematic review reported the effectiveness of the health interventions to increase physical activity in breastfeeding women (28).

We observed an increase in wine and beer consumption along lactation. We did not include this category in our intervention plan since we did not detect a relevant deviation in the pre-intervention analysis. We suggest that this increase in consumption could be related to the end of maternity leave and the resumption of an active work-life, as demonstrated by the higher rate in employment status at post-intervention time. Spain is one of the countries in Europe with the highest consumption of wine and beer (34), this being highly related to the social environ-

ment (35). These changes in social behavior could explain why breastfeeding women increase their ingestion of these drinks. This fact should be considered in future interventions with specific information.

Overall, our study demonstrated an improvement in most of the categories of the AP-Q, showing that an online intervention would be useful to increase nutrition- and health-related knowledge in breastfeeding women. Concerning the models, this association is maintained in the adherence to HFP and physical activity. However, it was lost in the grains, seed, and legumes, oil type, dairy products, and animal proteins categories, probably due to the reduced sample size. Although we did not detect associations between intervention and dairy products, it is important to note that these products tended to improve after the intervention. Dairy products increase blood vitamin D levels, especially if they are fortified (36), with their consumption being particularly important during the breastfeeding period since some studies report that mother-child pairs do not achieve vitamin D requirements (37). Other important consideration after the intervention would be improvement in the animal protein category, which includes fish consumption, since oily fish is a relevant source of omega(*n*)-3 and *n*-6 long chain polyunsaturated fatty acids (LCPUFAs), which are crucial for neurodevelopment and neonatal growth (38). It was demonstrated that oily fish intake increases maternal blood *n*-3 and *n*-6 LCPUFAs (39), with transferability into breast milk (40).

This study demonstrates that an online intervention is effective to improve healthy habits in breastfeeding women. Our main methodological weakness was the high drop-out rate, which is a common issue in an online intervention. This may be the reason why we did not find statistical significance in some of the categories. However, it is an online and effective nutritional intervention study focused on women during the breastfeeding period. In future studies, it would be interesting to perform an online intervention in a large population, including other aspects such as alcohol intake and emotional balance. On the other hand, it would be relevant to evaluate whether the knowledge gained by means of the intervention can persist and contribute to nutritional behavior in the offspring. Finally, it would be interesting to analyze whether changes in nutritional patterns and lifestyles have an impact on maternal biochemical variables, on the bioactive components of breast milk, and on clinical or neonatal growth parameters.

CONCLUSIONS

Overall, our study demonstrated that an online nutritional and lifestyle intervention in breastfeeding women improved adherence to HFP, particularly physical activity. Therefore, an online intervention can be a tool to complement onsite nutritional follow-up, enhancing knowledge about nutritional and healthy habits, these being two key points generally reduced during lactation. The largest benefit of an online intervention would be on women with social vulnerability, such as women from non-Spanish origin and women with a low socio-economic and educational background.

Supplementary table I. Sociodemographic characteristics in pre-intervention time between women who continued in the study protocol at post-intervention time and those who dropped out of the cohort

	Pre-intervention (n = 31)	Dropped out women (n = 150)	p-value
Maternal age (years)	34.1 ± 5.34	32.6 ± 5.88	0.123
Breastfeeding time (months)	3.1 ± 1.9	3.6 ± 2.0	0.172
<i>Breastfeeding pattern</i>			
Exclusive breastfeeding	26 (81.2 %)	115 (76.7 %)	0.741
Mixed breastfeeding	5 (16.7 %)	35 (23.3 %)	
Breastfeeding cessation	0	0	
<i>Income</i>			
No income	2 (6.5 %)	31 (20.7 %)	0.301
< € 1000	10 (32.3 %)	45 (30.0 %)	
€ 1000-2500	14 (45.2 %)	62 (41.3 %)	
€ 2500-4000	4 (12.9 %)	7 (4.7 %)	
> € 4000	1 (3.2 %)	5 (3.3 %)	
<i>Educational level</i>			
No education	0	0	0.570
Middle school	0	13 (8.7 %)	
High school	4 (12.9 %)	23 (15.3 %)	
University degree	27 (87.1 %)	114 (76.0 %)	
<i>Origin</i>			
Spanish	19 (61.3 %)	70 (46.7 %)	0.244
Non-Spanish	12 (38.7 %)	80 (53.3 %)	
<i>Employment status</i>			
Working	9 (29.0 %)	50 (33.3 %)	0.801
Studying	0	5 (3.3 %)	
Unemployed	4 (12.9 %)	23 (15.3 %)	
Other situations	1 (3.2 %)	7 (4.7 %)	
Maternity leave	17 (54.8 %)	65 (43.3 %)	

Data show are means ± standard deviations for quantitative variables, and sample size (n) and relative frequency (%) for qualitative variables. The p-value was extracted using Student's t-test or Fisher's exact test, respectively.

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