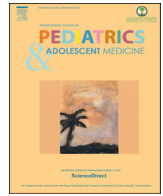


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## Maternal awareness to the timing of allergenic food introduction in Saudi infants: A cross-sectional study

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### ABSTRACT

**Background:** Current guidelines recommend the introduction of allergenic foods as early as 4–6 months of age to decrease the risk of food allergy. However, caregivers' knowledge about such practices and adherence to them is ambiguous.

**Objectives:** The purpose of this study was to evaluate the timing of introduction of potentially allergenic foods into children's diet and the level of maternal awareness about and degree of compliance with current recommendations.

**Materials and methods:** We conducted a cross-sectional study from May 2019 to January 2020 at Imam Mohammad Ibn Saud Islamic University Medical Center, Riyadh, Saudi Arabia. Data were collected through questionnaire-based surveys, and a total of 405 mothers were enrolled in the study. The eligibility criteria included mothers of children between the ages of 12 and 36 months.

**Results:** Most mothers in this study had initiated allergenic foods, and the average time of introduction was  $9.84 \pm 3.16$  months for eggs,  $14.6 \pm 5.78$  months for peanuts, and  $13.6 \pm 5.37$  months for fish. Around one-quarter ( $n = 102$ , 25.2%) of the children were identified as being in the high-risk group. Most mothers did not know or disagreed that the timing of introducing allergenic foods might help in preventing food allergy, but there was no difference between the risk groups (33.8% and 26.2%, respectively). Moreover, only 18.6% and 13.2% of the high- and low-risk groups, respectively, received correct information from their health care providers ( $P = .004$ ). Mothers with only one child were less likely to start eggs at an early age (odds ratio [OR] = 0.5 and  $P = .005$ ). Furthermore, children at a high risk of food allergy were two times more likely to start eggs at an earlier age (OR = 2.12 and  $P = .003$ ).

**Conclusion:** In this study, the allergenic food feeding practices being followed for infants and young children were found to be suboptimal. Parental education level and the number of siblings were identified as potential barriers to the implementation of and adherence to recent guidelines. There is a need for corrective measures to ensure safe and appropriate feeding practices in the Saudi community.

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### 1. Introduction

Food allergies and other atopic diseases such as asthma, allergic rhinitis, and atopic dermatitis are common, and their prevalence has increased dramatically in the last decade, which is a major

public health concern in many countries worldwide [1]. In the United States, the prevalence of childhood food allergies was 8% according to a study by Gupta et al. [2] An accurate estimation of the prevalence of childhood food allergies in the Kingdom of Saudi Arabia is not known. Only a few studies have been conducted to evaluate food allergies in the Saudi community. El-Rab conducted a study on 217 adult patients, reporting that 17.5% of those suffering from asthma, allergic rhinitis, and urticaria have Immunoglobulin E antibodies in a variety of foods, and the most frequently encountered allergies include those in peanuts (23%), eggs (15%), and cow's milk (13%) [3]. Food allergies place a significant emotional, social,

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and financial burden on both the affected pediatric patients and their families, which result in a decreased quality of life [4,5]. Moreover, they are responsible to create a substantial economic burden on the health care system [6]. Infants at a higher risk of developing food allergy include those who have a first-degree relative (a parent or sibling) with allergic diseases, preexisting food allergies, and other atopic diseases, such as asthma, allergic rhinitis, and atopic dermatitis [7,8]. An increase in food allergies has resulted in the need to encourage the reconsideration of prevention strategies [1]. Recent literature has shown that the avoidance of potentially allergenic foods during the first year of life significantly increased the odds of sensitization to corresponding foods [9]. Moderate-certainty evidence has found that the early versus late introduction of eggs and peanuts was associated with reduced allergies to both [10]. Current recommendations suggest that introducing allergenic foods as early as 4–6 months of age decreases the risk of food allergy [11–13]. Despite recent recommendations and guidelines in terms of emphasis on the early introduction of potential allergenic foods, a new study reports no maternal compliance with introducing potentially allergenic foods into the diet of infants having a positive family history of food allergy; mothers with a positive family history of food allergy were not aware of current recommendations [14]. Also, a previous study by Vandenas et al. found that a considerable number of physicians from selected Middle Eastern and North African countries do not follow current recommendations on the prevention of food allergy through the early introduction of allergenic foods [15]. To our knowledge and on the basis of literature review, no similar studies have been carried out to shed light on this issue in the region. Therefore, this study aimed to assess the timing of the introduction of potentially allergenic foods into the diet of children and maternal awareness of and adherence to current recommendations.

## 2. Material and methods

### 2.1. Study design and subjects

This is an observational, cross-sectional study carried out from May 2019 to January 2020 at Imam Mohammad Ibn Saud Islamic University (IMSIU) Medical Center, Riyadh, Saudi Arabia. The study was designed to investigate the timing of introduction of allergenic foods into children's diet and the level of maternal awareness about and degree of compliance with current recommendations, which promote the early introduction of high allergenic foods into the infants' diet. Data were collected from all eligible participants, including the mothers of children between the ages of 12 and 36 months, who visited the outpatient clinic of the General Pediatrics Department at IMSIU Medical Center. The mothers of children >36 months or <12 months of age, those who are not primary caregivers of children, or those unwilling to participate were excluded from this study. We only included children between the ages of 12 and 36 months to minimize the likelihood of recall bias. The participants were divided into two groups, high- and low-risk, on the basis of children's history of food allergy, eczema, or family history of first-degree relatives with food allergies. Children with a history of self-diagnosed food allergy, eczema, or a family history of food allergy were not considered high risk.

### 2.2. Data collection

Data collection was performed through questionnaire-based surveys using a custom-structured questionnaire that was developed by the research team specifically for this study, and it was reviewed and modified by a panel of experts. The questionnaire was first written in English and then translated into the local

language (Arabic). To ensure reliability and validity, a pilot study was carried out with 15 mothers prior to data collection. The questionnaire was subdivided into three main sections: The first section was dedicated to obtain the demographic profile of the participants. The second section included questions to assess the children's history of food allergy, eczema, and family history of first-degree relatives with food allergies. The last section was designated to evaluate maternal awareness and practices regarding the timing of introducing potentially allergenic foods.

### 2.3. Data analysis

Data analysis was performed using R software (v.3.6.2). Continuous variables were described with a mean and standard deviation and categorical variables with counts and percentages. Statistical analysis was conducted to assess whether maternal perception or practice was significantly different between the high- and low-risk groups. The high-risk group included children with eczema, food allergies, or a family history of first-degree relatives with food allergies. A chi-squared test of independence was used to determine associations between different categorical variables. Independent samples *t*-test and one-way analysis of variance were conducted to assess whether or not the means were significantly different between the groups. Multivariate analysis was performed using binary logistic regression to examine factors associated with knowledge about the benefit of modifying the introduction of allergenic foods as well as factors associated with the introduction of peanuts, eggs, and seafood at  $\leq 11$  months of age. The recommendation is to introduce early, starting between 4 and 6 months of age; however, there is no specific agreement for a cut of age for labeling an introduction late to fit all allergenic foods together. We consider 11 months as a cut for us as shown by the included infants in the Learning Early About Peanut Allergy (LEAP) study as it will give a broader time window and simplify the description [16]. The following variables were included as independent variables: child's age, maternal age, parental education level (classified as high if the parents completed university education), maternal occupation, number of children (single vs. multiple), risk groups (high vs. low), and source of information. Backward stepwise elimination using Type III sum of squares was applied to remove statistically nonsignificant variables ( $P < .05$ ) so that only significant variables were retained in the final model. Hypothesis testing was performed at a 5% level of significance.

### 2.4. Ethical approval

Institutional Review Board approval was obtained from the Research Ethical Committee, College of Medicine, IMSIU. All the participants were informed of the objectives of the study, and informed consent was embedded at the beginning of the questionnaire. The participation of respondents was voluntary, and research was conducted ensuring their anonymity and confidentiality.

## 3. Results

A total of 405 mothers were enrolled in the study. Male and female children represented 48.1% ( $n = 195$ ) and 51.9% ( $n = 210$ ), respectively, of the study sample. The average age of the included children was 20.4 (6.0) months, whereas the average age of the mothers was 31.7 (5.47) years. In terms of education levels, the majority of the fathers and mothers either completed university (50.6% and 65.7%, respectively) or postgraduate education (35.8% and 16%, respectively). The details of other characteristics of the participants are presented in Table 1.

**Table 1**  
Sociodemographic characteristics of the study population.

Characteristic	Value
<b>Child gender, n (%)</b>	
Male	195 (48.1)
Female	210 (51.9)
<b>Child age (months), mean <math>\pm</math> SD</b>	20.4 $\pm$ 6
<b>Maternal age (years), mean <math>\pm</math> SD</b>	31.7 $\pm$ 5.47
<b>Nationality, n (%)</b>	
Non-Saudi	59 (14.6)
Saudi	346 (85.4)
<b>Marital status, n (%)</b>	
Divorced	3 (0.74)
Married	400 (98.8)
Widowed	2 (0.49)
<b>Residence, n (%)</b>	
Urban	401 (99.0)
Rural	4 (0.99)
<b>Mother's level of education, n (%)</b>	
Illiterate	3 (0.74)
Primary school	7 (1.73)
Intermediate school	4 (0.99)
Secondary school	60 (14.8)
University or college	266 (65.7)
Postgraduate	65 (16.0)
<b>Father's level of education, n (%)</b>	
Primary school	2 (0.49)
Intermediate school	4 (0.99)
Secondary school	49 (12.1)
University or college	205 (50.6)
Postgraduate	145 (35.8)
<b>Mother's occupation, n (%)</b>	
Working	160 (39.5)
Not working	245 (60.5)
<b>First child, n (%)</b>	
No	287 (70.9)
Yes	118 (29.1)
<b>Number of other children, n (%)</b>	
1	59 (20.6)
2	87 (30.3)
3	72 (25.1)
$\geq 4$	69 (24)

Food allergy was reported in 8.4% ( $n = 34$ ) of the children. The diagnosis was made by a physician in 88.2% ( $n = 30$ ). Eczema was reported in 15.3% ( $n = 62$ ) of the children. A physician diagnosed 90.3% ( $n = 56$ ) of the cases. A family history of food allergy was reported by 19.5% ( $n = 79$ ) of the included mothers. A physician diagnosed 69.6% ( $n = 55$ ) of the cases. About one-quarter ( $n = 102$ , 25.2%) of the children were identified as being at high risk (Table 2).

The average time of introducing foods was 7.03  $\pm$  2.61 months for solids, 9.84  $\pm$  3.16 months for eggs, 14.6 (5.78) months for peanuts, and 13.6 (5.37) months for fish. Eggs, peanuts, and fish were not introduced in 14.1%, 47.9%, and 31.9%, respectively, of the included children. The majority of the mothers did not know or disagreed that the timing of introducing allergenic foods might help in preventing food allergies (33.8% and 26.2%, respectively). However, there was no difference between the high- and low-risk groups. Most of the mothers did not receive any health care advice to early introduce potentially allergenic foods ( $n = 301$ , 74.3%). Moreover, the proportion of mothers who were advised by health care professionals to early introduce potentially allergenic foods was higher in the high-risk group (18.6%) than in the low-risk group (13.2%;  $P = .004$ ) (Table 3).

The most commonly used resource among the mothers on the introduction of allergenic foods are health care professionals ( $n = 119$ , 29.4%), followed by nonhealth care professionals ( $n = 100$ , 24.7%). Social media and written information were used by 53 (13.1%) and 38 (9.4%) mothers, respectively (Table 4).

It was noted that only maternal education levels were

significantly associated with knowledge about the benefit of modifying the introduction of allergenic foods. Mothers with university education were three times more likely to agree to time modification as compared to those without university education (odds ratio [OR] = 3.16; confidence interval [CI] = 1.74–5.99; and  $P < .001$ ). Higher paternal education levels were correlated with lower odds of introducing peanuts before the age of 11 months (OR = 0.13; CI = 0.05–0.36; and  $P < .001$ ). Higher maternal education levels were linked to higher odds of starting eggs earlier (OR = 3.66; CI = 1.92–7.33; and  $P < .001$ ). Furthermore, mothers with only one child were less likely to start eggs at an early age as compared to those with more than one child (OR = 0.5; CI = 0.30–0.81; and  $P = .005$ ). Moreover, children at high risk of food allergy were two times more likely to start eggs at an earlier age as compared to those at low risk (OR = 2.12; CI = 1.29–3.51; and  $P = .003$ ). Additionally, the source of information also showed a statistically significant association with starting eggs earlier. Mothers who obtained their information from nonhealth care professionals were 2.58 times more likely to have their children start eggs at an earlier age as compared to those who did not have any source of information (OR = 2.58; CI = 1.22–5.68; and  $P = .016$ ). Higher maternal education levels were correlated to higher odds of starting fish earlier (OR = 3.41; CI = 1.26–11.09; and  $P = 0.025$ ). None of the remaining factors showed a statistically significant association (Table 5).

#### 4. Discussion

In this study, it was found that most of the included mothers did not introduce high allergenic foods early as recommended by international guidelines [13,17]. The average age for the introduction of peanut butter and seafood was after the infancy period, whereas the average age for eggs was around 10 months. The age for introducing some high allergenic foods is later than that reported by other studies among Arab communities [18,19]. The lack of maternal awareness could be the explanation for such an attitude, as we found that more than half of the participants did not know that the timing of introducing foods might help in preventing food allergy. We are not aware of the opinion of the remaining participants who agree with time modification—whether they encourage or discourage the practice of early introduction of high allergenic foods, although one report showed that 29% of the expecting or current parents have reduced or limited awareness about the benefits of early introduction of high allergenic foods [20], whereas another report stated that approximately one-third of mothers might avoid the early introduction for fear of allergy [21].

Poor knowledge could be attributed to not receiving the correct advice during well-child visits. Although we found that the most common source of maternal information was health care professionals, we noted that only 18.6% and 13.2% among both the at-risk food allergy group and the one without risk, respectively, received proper information about the timing of the introduction of allergenic foods. These findings were consistent with those reported among some Middle Eastern countries, including Saudi Arabia, which showed that their physicians do not adhere to the clinical practice guidelines of infant food counseling [15]. It would be beneficial if primary health care centers provide a generalized checklist of counseling topics to be filled during each well-baby visit. A similar practice would help organize health promotion messages and ensure sufficiency in maternal knowledge, particularly on the 4-month well-baby visit.

The importance of early allergenic food introduction in the prevention of food allergy, in general, was supported by the current literature [22]. A meta-analysis of six randomized controlled trials focusing on eggs showed the benefit of its early introduction

**Table 2**  
Prevalence of food allergy, eczema, and family history of 1st degree relative with food allergy in the study sample.

	Value, n (%)
<b>Children diagnosed with food allergy</b>	34 (8.40)
<b>Diagnosis of food allergy made by</b>	
An allergy specialist	17 (50.0)
Nonallergy physician	11 (32.4)
Not sure about the physician's specialty	2 (5.88)
Self-diagnosis	4 (11.8)
<b>Children diagnosed with eczema</b>	62 (15.3)
<b>Diagnosis of eczema made by</b>	
Pediatrician	25 (40.3)
Dermatologist	25 (40.3)
Family physician	1 (1.61)
General practitioner	3 (4.84)
Not sure about the physician's specialty	2 (3.23)
Self-diagnosis	6 (9.68)
<b>Children who have family history of 1st degree relative with food allergy</b>	79 (19.5)
<b>Family member with food allergy</b>	
Father	28 (35.4)
Mother	23 (29.1)
Siblings of the child	28 (35.4)
<b>Diagnosis of family member made by</b>	
An allergy specialist	38 (48.1%)
Nonallergy physician	9 (11.4)
Not sure about the physician's specialty	8 (10.1)
Self-diagnosis	24 (30.)
<b>Risk groups</b>	
High risk	102 (25.2)
Low risk	303 (74.8)

**Table 3**  
Timing of food introduction and maternal awareness and compliance with current recommendations.

	Value	High risk (n=102)	Low risk (n=303)	P value
<b>Introduction of solid food to the child diet, n (%)</b>				.119
Yes, and know when	359 (88.6)	96 (94.1)	263 (86.8)	
Yes, but do not know when	43 (10.6)	6 (5.88)	37 (12.2)	
No	3 (0.74)	0 (0.00)	3 (0.99)	
<b>Age (months) when solid food was introduced, mean ± SD</b>	7.03 ± 2.61	6.84 ± 2.38	7.10 ± 2.68	.380
<b>Introduction of eggs to the child diet, n (%)</b>				<b>.028</b>
Yes, and know when	270 (66.7)	79 (77.5)	191 (63.)	
Yes, but do not know when	78 (19.3)	13 (12.7)	65 (21.5)	
No	57 (14.1)	10 (9.80)	47 (15.5)	
<b>Age (months) when eggs were introduced, mean ± SD</b>	9.84 ± 3.16	9.58 ± 2.83	9.95 ± 3.29	.352
<b>Introduction of peanut to the child diet, n (%)</b>				.717
Yes, and know when	119 (29.4)	27 (26.5)	92 (30.4)	
Yes, but do not know when	92 (22.7)	23 (22.5)	69 (22.8)	
No	194 (47.9)	52 (51.0)	142 (46.9)	
<b>Age (months) when peanut was introduced, mean ± SD</b>	14.6 ± 5.78	14.2 ± 5.69	14.7 ± 5.84	.673
<b>Introduction of fish or seafood to the child diet, n (%)</b>				<b>.019</b>
Yes, and know when	196 (48.4)	61 (59.8)	135 (44.6)	
Yes, but do not know when	80 (19.8)	13 (12.7)	67 (22.1)	
No	129 (31.9)	28 (27.5)	101 (33.3)	
<b>Age (months) when fish was introduced, mean ± SD</b>	13.6 ± 5.37	12.8 ± 4.61	14.0 ± 5.65	.114
<b>Modification of the time of allergenic food introduction to the child diet might help in the prevention of food allergy, n (%)</b>				.598
Yes	162 (40.0)	44 (43.1)	118 (38.9)	
No	137 (33.8)	35 (34.3)	102 (33.7)	
Do not know	106 (26.2)	23 (22.5)	83 (27.4)	
<b>Health care provider of the child advised mother to early introduce potentially allergenic foods, n (%)</b>				<b>.004</b>
Yes	59 (14.6)	19 (18.6)	40 (13.2)	
No	301 (74.3)	64 (62.7)	237 (78.2)	
Do not know	45 (11.1)	19 (18.6)	26 (8.58)	

Statistical analysis was performed by using the Chi-square test of independence for categorical variables and independent samples t-test for continuous variables.

between 4 and 6 months [23]. Despite this advantage, 14% of included children have not received eggs yet. It is interesting to find that mothers with only one child were less likely to start eggs at an early age as compared to those with more than one child. In

contrast, a recent study reported no difference between the number of siblings and the avoidance of allergenic foods [21]. Further, Eggesbø et al. observed that children with older siblings have significantly been subject to unwarranted dietary restrictions

**Table 4**  
Source of information regarding the introduction of allergenic food.

	Value, n (%)
Health professional	119 (29.4)
Nonhealth professional	100 (24.7)
Written information (for example: books, leaflets, brochures, etc.)	38 (9.4)
Social media content and websites	53 (13.1)
None	95 (23.5)

**Table 5**  
Binary logistic regression for the predictors associated with awareness regarding the benefit of modifying allergenic food introduction, early introduction of peanuts, eggs, and fish.

Variables	OR	95% CI	P value
<b>Awareness regarding the benefit of modifying allergenic food introduction</b>			
<b>Mother's level of education</b>			
Less than university	Reference		
University	3.16	1.74–5.99	<.001
<b>Early introduction of peanuts</b>			
<b>Father's level of education</b>			
Less than university	Reference		
University	0.13	0.05–0.36	<.001
<b>Early introduction of eggs</b>			
<b>Mother's level of education</b>			
Less than university	Reference		
University	3.66	1.92–7.33	<.001
<b>First child</b>			
No	Reference		
Yes	0.50	0.30–0.81	.005
<b>Risk groups</b>			
Low risk	Reference		
High risk	2.12	1.29–3.51	.003
<b>Source of information</b>			
None	Reference		
Health professional	1.88	0.89–4.13	.104
Nonhealth professional	2.58	1.22–5.68	.016
Written information (for example: books, leaflets, brochures, etc.)	2.44	0.97–6.35	.062
Social media content and websites	1.18	0.54–2.66	.678
<b>Early introduction of fish</b>			
<b>Mother's level of education</b>			
Less than university	Reference		
University	3.41	1.26–11.09	.025

because of parental fear and suspicion of food allergy [24]. This difference could be attributed to the fact that mothers with their first children are more likely to be cautious about their children's diet, whereas those with more than one child might act on the basis of their expectations and experiences with previous children.

This study has been unable to demonstrate a significant relationship between maternal age and avoidance of allergenic foods. Similar findings were reported by a Norwegian study [21]. However, these results differ from those of Eggesbø et al., who identified a significant correlation between lower maternal age and diet restriction for the child [24]. Also, we noted that parental education levels were significantly correlated with the level of awareness and pattern of introduction of food. Higher maternal education levels were associated with a more favorable response toward the introduction of allergenic foods as compared to higher paternal education levels. These results are inconsistent with those of Eggesbø et al., who reported a significant relationship between a high maternal education level and unwarranted diets. However, no significant difference was observed in a recent publication [21]. This inconsistency may be due to several reasons, including the difference in sample size, studied population, and study design.

Regardless of the risk of food allergy, awareness needs to be raised for all families. Even infants with low risk could benefit from the early introduction of allergenic food, as shown by Simons et al. [25], who examined 2669 participants using the data from the

original Canadian cohort Study [9]. In our study, 8.4% of the mothers reported their children to have food allergy or hypersensitivity. In contrast to other reports that did not specify the source of such diagnosis, we found that allergy specialists diagnosed only half of them. Regarding the allergic predisposition group, we noted that they started eggs earlier than those without predisposition, and this is in contrast to what is mentioned in another report, which showed adverse results [14]. This difference can be explained by the higher chance of receiving correct advice among the at-risk group. Another report supports this finding by showing that parents who have a family history of food allergy were more likely to have a higher awareness level of the new introduction guidelines [20]. One significant challenge that could be a barrier for high-risk children is accessibility to specialized health care services. Parents must have support in terms of providing and ensuring a safe health care environment. Such factors need to be monitored by pediatric allergists.

#### 4.1. Study limitations

The study methodology has various limitations because the data on food introduction were collected in a retrospective manner and relied mainly on maternal memory and reporting, which may have subsequently introduced recall bias. To omit this bias as much as possible, children >3 years of age were not included during data

collection and analysis. That being said, some reports showed that the introduction of few allergenic foods (e.g., peanuts) might be recalled correctly by mothers over 10 years [26]. Furthermore, the cross-sectional, single-center study design may hinder the generalizability of our findings. Thus, further multicenter—preferably prospective—studies in the Saudi community are suggested to establish such a relationship as conferred antecedently. Although this study included all children with any type of food allergies, we only addressed in this study survey the timing of the introduction of eggs, peanuts, and fish. We did not include specific questions for the introduction of cow's milk and sesame. Previous research had shown conflicting evidence regarding the protective effect of early cow's milk formula exposure in preventing cow's milk allergy, and most of this information was from observational studies [27–29]. However, a recent multicenter randomized controlled trial conducted by Sakihara et al. showed an early cow's milk introduction between the age of one and two months, which could prevent cow's milk allergy development [30]. We do not expect parents to know about this recent change in our information. Additionally, although sesame is a common allergenic food in our community, its early introduction has not been studied sufficiently as other foods.

## 5. Conclusion

We conclude that the early introduction of high allergenic foods is crucial in the prevention of food allergy as per current guidelines and has to be encouraged among Saudi mothers. However, most mothers in this study have limited knowledge about the significantly beneficial health-related outcomes of the aforementioned recommendations. One of the most significant findings to emerge from this study is that parental education level, risk groups, number of siblings, and the source of information are considerable potential barriers to the implementation of and adherence to current guidelines on the prevention of food allergy. Lastly, we emphasize the need for corrective measures to ensure safe and correct feeding practices among Saudi mothers. Such logistic strategies should include the implementation of educational programs for pediatric health care providers, which are aimed to spread updated knowledge about infant nutrition. Health-related policymakers should consider securing safe and specialized outpatient care for infants at the risk of food allergy.

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## Declaration of competing interest

There is no conflict of interest.

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## Visual abstract

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijpam.2021.01.003>.

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