

REVIEW ARTICLE

Obstetrics

Knowledge, attitudes, and practices of prenatal care practitioners regarding oral health in pregnancy—A systematic review

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Abstract

Background: Hormonal and behavioral changes during pregnancy may impact the oral health of women, which can influence the pregnancy course. Prenatal care practitioners (PCP) must be aware of this bidirectional relation in order to include an oral assessment in routine prenatal care.

Objectives: To characterize the knowledge and attitudes of PCP regarding oral health in pregnant women.

Search Strategy: The search was carried out in PubMed, Web of Science, Lilacs, Scopus, and Embase on May 2022.

Selection Criteria: Peer-reviewed cross-sectional studies published in English within the last 5 years that assessed the knowledge, attitudes, and practices of PCP towards oral health in pregnancy were selected.

Data Collection and Analysis: Data were standardly extracted by the three reviewers from the selected articles and their bias was assessed.

Main Results: From a total of 996 articles, 24 were selected. Overall, most PCP have an adequate level of knowledge regarding the importance of oral health during pregnancy. Although several professionals reported referring their patients to a dentist, the attitudes and practices of the majority of PCP were still inadequate.

Conclusions: PCP are aware of the importance of oral health during pregnancy but still lack translating this knowledge into clinical practice.

KEYWORDS

attitudes, knowledge, Oral health, pregnant women, prenatal care practitioners, prevention

1 | INTRODUCTION

Women undergo multiple stages in the course of their life, such as puberty, pregnancy, and menopause, and these can influence their oral health due to hormonal changes.¹ During pregnancy, there is an increase in the secretion of progesterone and estrogen, leading

to periodontal hypervascularization, alterations in the production of collagen, and increased susceptibility to oral biofilm, which may exacerbate pre-existing gingivitis or periodontitis.^{1,2} The relationship between periodontal diseases and adverse pregnancy outcomes has been the subject of numerous studies in the last decade and it is currently suggested as a risk factor for the development of some

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of the main causes of infant mortality and morbidity, namely pre-eclampsia, preterm birth, and low birth weight.^{3,4} There are two main mechanisms suggested to explain this association, namely the direct migration of oral microorganisms or their sub-products to the placenta, or the migration of inflammatory mediators produced in response to these microorganisms to the placenta.⁵ Therefore, the American Academy of Periodontology, the American Dental Association, and the European Federation of Periodontology recognize that dental procedures are safe during pregnancy and strongly recommend their implementation even before gestation to prevent potential adverse pregnancy outcomes.⁶⁻⁸

Moreover, the prevalence of dental caries may increase during pregnancy. In contrast to periodontal diseases, this is not only linked to physiologic shifts that occur during pregnancy, but also to an increased appetite for and consumption of sugary foods, the difficulty in maintaining correct oral hygiene, and nausea.⁹ Although some studies reported a lack of association between dental caries and adverse pregnancy outcomes, this oral disease may lead to a decrease in the oral-health-related quality of life and an increased risk of early childhood dental caries.¹⁰⁻¹² Moreover, dental caries can lead to apical periodontitis which, according to a recent meta-analysis by Jakovljevic et al.,¹³ may be associated with adverse pregnancy outcomes due to mechanisms similar to periodontal disease. Considering this higher susceptibility to oral diseases, reinforcing preventive measures during this period is of the utmost importance.¹⁴

As gynecologists, obstetricians, nurses/midwives, and general practitioners actively monitor the course of pregnancy, they must be aware of the importance of keeping good oral health, recognizing the most common diseases, and referring pregnant women to the dentist to reduce the risk of possible complications. Despite this, George et al.¹⁵ described that although prenatal care practitioners (PCP) are informed about oral diseases and their association with possible pregnancy complications, this may not translate into clinical practice.

Given the lack of systematized literature in this field and the fact that the last review on this topic dates to 2012, this systematic review aimed to characterize the knowledge and attitudes of PCP (gynecologists, obstetricians, nurses, midwives, family physicians, and general practitioners) regarding oral health in pregnant women.

2 | MATERIALS AND METHODS

2.1 | Search strategy

This systematic review was conducted through the PRISMA checklist (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)¹⁶ and was registered in the International Prospective Register of Systematic Reviews (CRD42021234331).¹⁷

Two PICO questions were formulated. (1) Do PCP know the importance of prevention of oral health in pregnancy? (2) Do PCP apply this knowledge in their daily work (attitudes and practices)?

The research questions were based on the modified PICO strategy (PCO), where P means population (PCP), C stands for context (oral health prevention in pregnant women), and O refers to outcome (knowledge, attitudes, and practices of the study population).

2.2 | Eligibility criteria

Inclusion criteria included cross-sectional studies published in English within the last 5 years (2018–2022) that assessed the knowledge, attitudes, and practices of PCP towards oral health in pregnancy. Exclusion criteria comprised articles that were not directly related to research questions, exclusively qualitative studies, and studies involving medical students or other medical professionals.

The searches were conducted using PubMed, Web of Science, Lilacs, Scopus, and Embase databases. The line-by-line search strategies for each of the different bibliographic databases used is described in Table 1. The search was carried out in May 24, 2022 and the results obtained were exported to EndNote.

2.3 | Study selection

The studies were independently selected by three reviewers (BHA, MJA, and MLP). Articles were first excluded based only on their title and abstract; then, finally, on their full-text. Any divergence was discussed to reach a consensus between the three reviewers.

2.4 | Data extraction

Data were standardly extracted by the three reviewers from the selected articles. The following variables were extracted: authors, year of publication, country, target population, sample size, age, sex, years of professional experience, methods, main findings, and overall assessment of the results of the study according to the authors of the study.

2.5 | Quality assessment

The risk of bias and the quality of each study was individually assessed, based on the Modified Newcastle-Ottawa scale.¹⁸ This assessment was carried out by three examiners (BHA, MJA, and MLP) separately, and was based on the information provided in each study. The applied scale focuses on three domains: selection (sample representativeness, sample size, non-respondents, and exposure verification), comparability, and results (evaluation of the results and statistical analysis). Based on the items within each domain and subdomain, each study received a final score, with a maximum of 10 points. No study was excluded based on the assessment of its quality.

TABLE 1 Databases used and search strategy.

Database	Search strategy
Pubmed	(gynecolog* OR gynecology[MeSH terms] OR obstetric* OR obstetrics[MeSH terms] OR midwi* OR midwifery[MeSH terms] OR nurse* OR nurses[MeSH terms] OR "general practitioners" OR general practitioners[MeSH terms] OR "prenatal care practitioners" OR "physician" OR physician[MeSH terms] OR "health care") AND ("oral health" OR oral health[MeSH terms] OR "oral disease" OR "oral hygiene" OR "periodontal diseases" OR gingiv* OR "caries") AND (know* OR knowledge[MeSH terms] OR educat* OR education[MeSH terms] OR attitude* OR behavior* OR opinion* OR perception* OR belie* OR counsel* OR refer* OR intervention* OR "practice") AND (pregnan* OR gestat* OR pregnancy[MeSH terms] OR prenatal OR antenatal)
Web of Science	(gynecolog* OR obstetric* OR midwi* OR nurse* OR "general practitioners" OR "prenatal care practitioners" OR "physician" OR "health care") AND ("oral health" OR "oral disease" OR "oral hygiene" OR "periodontal diseases" OR gingiv* OR "caries") AND (know* OR educat* OR attitude* OR behavior* OR opinion* OR perception* OR belie* OR counsel* OR refer* OR intervention* OR "practice") AND (pregnan* OR gestat* OR prenatal OR antenatal)
Lilacs	(gynecolog* OR obstetric* OR midwi* OR nurse* OR "general practitioners" OR "prenatal care practitioners" OR "physician" OR "health care") AND ("oral health" OR "oral disease" OR "oral hygiene" OR "periodontal diseases" OR gingiv* OR "caries") AND (know* OR educat* OR attitude* OR behavior* OR opinion* OR perception* OR belie* OR counsel* OR refer* OR intervention* OR "practice") AND (pregnan* OR gestat* OR prenatal OR antenatal)
Scopus	(gynecolog* OR obstetric* OR midwi* OR nurse* OR "general practitioners" OR "prenatal care practitioners" OR "physician" OR "health care") AND ("oral health" OR "oral disease" OR "oral hygiene" OR "periodontal diseases" OR gingiv* OR "caries") AND (know* OR educat* OR attitude* OR behavior* OR opinion* OR perception* OR belie* OR counsel* OR refer* OR intervention* OR "practice") AND (pregnan* OR gestat* OR prenatal OR antenatal)
Embase	(gynecolog* OR obstetric* OR midwi* OR nurse* OR "general practitioners" OR "prenatal care practitioners" OR "physician" OR "health care") AND ("oral health" OR "oral disease" OR "oral hygiene" OR "periodontal diseases" OR gingiv* OR "caries") AND (know* OR educat* OR attitude* OR behavior* OR opinion* OR perception* OR belie* OR counsel* OR refer* OR intervention* OR "practice") AND (pregnan* OR gestat* OR prenatal OR antenatal)

3 | RESULTS

A total of 996 articles were retrieved from the five databases. The study selection process is described in [Figure 1](#). The final sample comprised 24 articles.^{19–42}

All studies used questionnaires to characterize the knowledge, attitudes, and practices of PCP. The questionnaires implemented in the different studies varied in the number of questions (ranged from 15^{21,36} to 82 questions⁴⁰), and the authors resorted to "Yes/No" questions,^{19,20,23,25,27,32,33,36,37,41,43} multiple-choice,^{22,31} and Likert scales.^{21,24,26,28–30,34,37,38,40,42} All questionnaires were self-answered, 10 of which were carried out online.^{23,26–28,30,31,36,39,41} The content of the questionnaires applied is summarized in [Table 2](#).

In each of the included studies, the study population was mostly gynecologists/obstetricians ($n = 16$),^{19,20,22–25,27,28,32–34,36–39,41} but there were also studies including and/or focused on midwives ($n = 9$),^{26,30,31,34–36,39,40,42} general or family physicians/practitioners ($n = 5$),^{25,26,29,36,39} and nurses ($n = 4$).^{21,26,35,42}

The level of knowledge of PCP was adequate in 14 out of 24 studies, with the subgroup of gynecologists/obstetricians presenting adequate knowledge in 65.0% of the studies (10 out of 16 studies; [Table S1](#)), followed by general and family physicians (60.0%; 3 out of 5 studies; [Table S2](#)), midwives (33.0%; 3 out of 9 studies; [Table S3](#)), and nurses (25.0%; 1 out of 4 studies; [Table S4](#))^{19,20,23–26,29,30,32,33,36,37,40,41}

Among the questions used to characterize the knowledge of oral health of these professionals, the most addressed topic was periodontology, with 21.6%²⁰ to 86.3%⁴¹ of gynecologists/obstetricians associating periodontal diseases with the best known adverse pregnancy outcomes, such as preterm delivery, infants with low weight at birth, and pre-eclampsia.^{20,22–25,28,32,37,41} In fact, in this subgroup of PCP, more than 50.0% of the professionals knew about this association in the majority of studies.^{22–24,28,32,37,41} On the other hand, around 13.7%²⁶ to 58.0%²⁵ of general physicians and 7.8%³¹ to 59.6%⁴⁰ of midwives and nurses believed in this association.^{25,26,31,40}

There were still professionals, namely gynecologists (74.6%),²³ general physicians (29.0%),²⁹ and gynecologists and midwives (28.8%),³⁴ who believed that calcium is removed from the mother's teeth by the developing fetus. Regarding the safety of dental procedures during pregnancy, 43.1%–73.0% of gynecologists considered that the use of anesthesia with a vasoconstrictor was not safe during pregnancy,^{20,23,32} while only 6.4% of midwives/midwifery students believed so.⁴⁰ About 20.0%–60.0% of gynecologists considered radiographing pregnant women safe,^{20,22,27,28,32,33} whereas 76.6% of midwives/midwifery students considered dental radiographs safe.⁴⁰ The second trimester was named the safest during which to perform dental procedures by 46.0%–74.0% of gynecologists/obstetricians.^{20,24,27,32,37}

Concerning their attitudes,^{19,23,24,29,31–34,40} gynecologists and obstetricians presented an adequate attitude in 60.0% of the studies

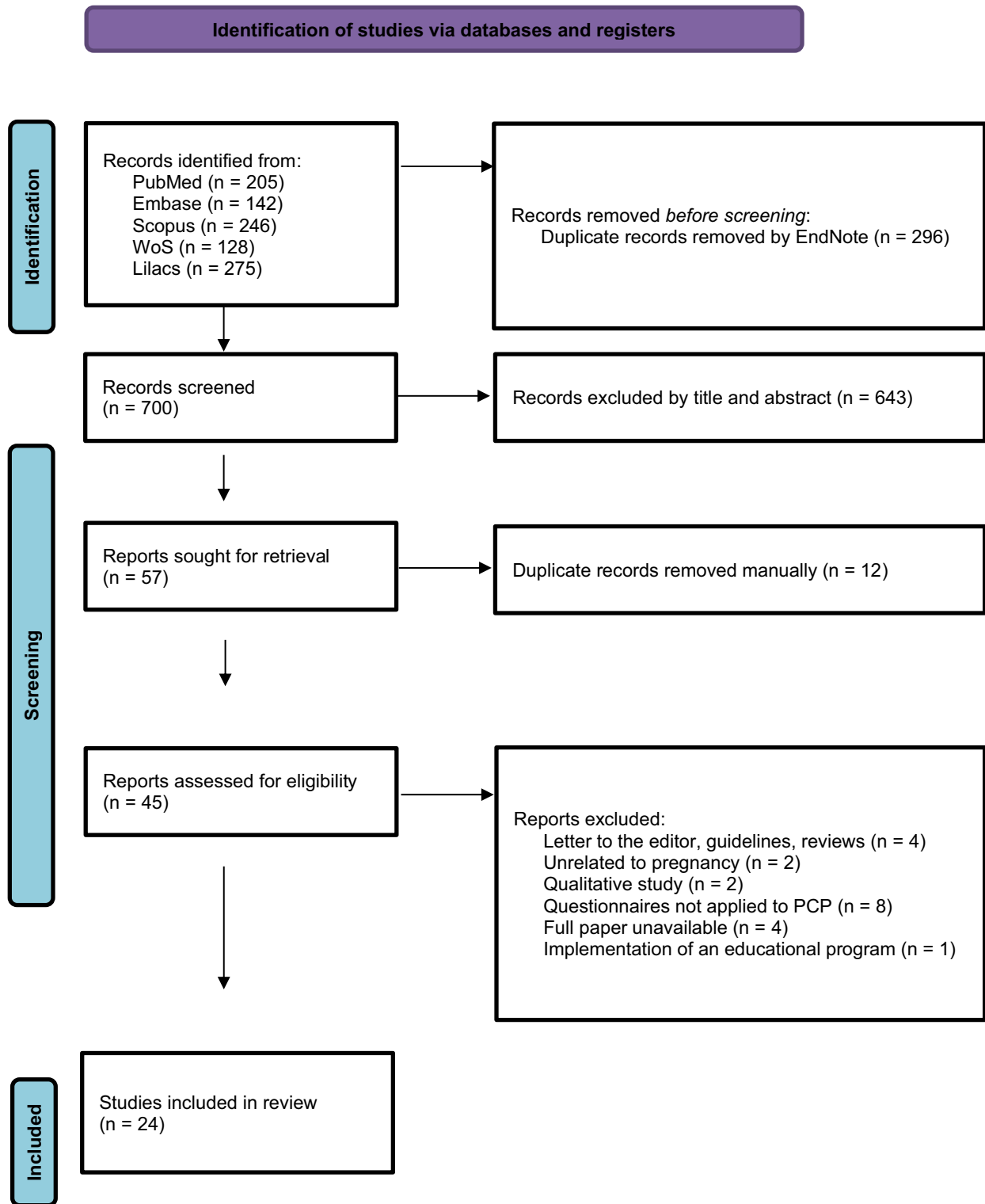


FIGURE 1 Workflow for the selection of studies, according to PRISMA guidelines.

(6 out of 10 studies; Table S1),^{19,23-25,28,32-34,37,38} contrasting with midwives (43.0%; 3 out of 7 studies; Table S3),^{26,30,31,34,35,40,42} general physicians (0.0%; 0 out of 2 studies; Table S2),^{25,26} and nurses (0.0%; 0 out of 4 studies; Table S4).^{21,26,35,42} Regarding practices, these were only adequate in 25.0% of the studies evaluating gynecologists and obstetricians (2 out of 8 studies; Table S1),^{19,24,25,28,32-34,37}

17.0% of the studies evaluating midwives (1 out of 6 studies; Table S3),^{26,30,31,34-36,39,40,42} 33.0% of studies evaluating general practitioners (1 out of 3 studies; Table S2),^{25,26,29} and 0.0% of the studies evaluating nurses (0 of 4 studies; Table S4).^{21,26,35,42} Although the majority of PCP acknowledged the importance of oral health care during pregnancy, most professionals did not interview

TABLE 2 Content of each survey of the included studies.

	Acharya et al. ¹⁹	Ahmad et al. ²⁰	Ahmed et al. ²¹	Almutairi et al. ²³	Al-Qahtani et al. ²²	Bakhshi et al. ²⁴	Govindasamy, et al. ²⁵	Hoerler et al. ²⁶	Kobylinska et al. ²⁷	Lyu J., et al. ²⁸	Maniam et al. ²⁹	Naavaal et al. ³⁰	Nguyen et al. ³¹	Paneer et al. ³²	Popli et al. ³³	Rashidi-Maybodi et al. ³⁴	Sahin & Kaya ³⁵	Senyuva et al. ³⁶	Sinha et al. ³⁷	Smadi et al. ³⁸	Suwardjani et al. ³⁹	Tourifo et al. ⁴⁰	Ustaoglu et al. ⁴¹	Uwambaye et al. ⁴²	
Knowledge																									
Periodontal disease and/or adverse pregnancy effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dental caries and/or risk factors in the pregnant women and/or child	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Malocclusions and/or risk factors in children									✓																
Myths associated with oral health during pregnancy			✓					✓	✓																
Indication, efficiency and safety of dental treatments during pregnancy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Safety of radiography, medication, and/or use of anesthesia with/without vasoconstrictor during pregnancy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Attitudes/practices																									
Referral to the dentist	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Recommendations regarding oral health care during pregnancy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Recommendations regarding oral health care of the child			✓																						
Oral examination	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Oral health anamnesis						✓																			

pregnant women on their oral health status and the reasons presented were lack of oral health training, the subject not being a priority, or because asking about oral health care was considered outside the scope and responsibility of PCP.^{21,29,38,42} Moreover, 20% (gynecologists and midwives)³⁴ to 90.0% (midwives)³¹ of PCP did not routinely observe the oral cavity of their patients, with 20.0%³⁴ to 93.0%³¹ of midwives and 70.0% of gynecologists³³ admitting never doing it.^{26,31,33,34,40,42} There were only a few cases of PCP performing oral examinations after the diagnosis of pregnancy (5.3% of gynecologists)²⁴ and periodically or routinely in appointments (37.6% of PCP including midwives, nurses, general physicians, and residents).²⁶ When considering referral to oral health care, 15.0%²⁴ to 80.0%²⁷ of gynecologists recommended their patients to go to the dentist, rates that were similar to those of midwives (17.2%³⁵ to 79.3%³⁰).^{24,26,27,29,30,32,35,37,38} Regarding referral during the pre-conception period, 28% (gynecologists) to 55.0% (gynecologists and midwives) of the professionals reported doing it,^{34,37} whereas in one study only 21.9% (midwives and midwifery students) never referred.⁴⁰ The main results of each study are presented in [Table 3](#).

Additionally, the majority of studies (62.5%; 5 out of 8 studies) described a positive correlation between years of experience of the PCP and knowledge/attitudes towards oral health.^{22,24,28,29,31,36,40,42} Regarding knowledge, four studies found a positive correlation between years of experience of midwives,^{40,42} nurses,⁴² gynecologists,²² and physicians²⁹ and oral health knowledge. One study found a correlation between years of experience, caries knowledge, and referral to the dentist in PCP (including obstetricians/gynecologists, family physicians, and midwives).³⁶

The results of the risk of bias analysis and quality assessment of the included studies are displayed in [Table 4](#). The scores varied between 3 and 9 in the 24 studies, with none of the included studies meeting all the criteria and the majority presenting a high and medium risk of bias.

4 | DISCUSSION

In this systematic review, we aimed to evaluate whether PCP were aware of the importance of oral health in pregnancy and if these professionals apply this knowledge in their daily work. Regarding the overall knowledge of PCP about oral health, the findings illustrate that the importance of oral health during pregnancy is acknowledged particularly by gynecologists/obstetricians and general/family physicians, who presented adequate knowledge in the majority of the studies. On the other hand, and although the attitudes of gynecologists/obstetricians were adequate in most studies,^{19,30-32,39,40} the practices of healthcare professionals towards oral health are still insufficient. Moreover, it was also possible to observe that the years of experience seem to be associated with a higher knowledge about oral health in pregnancy.

From all the PCP evaluated, both gynecologists/obstetricians and general/family physicians presented an adequate knowledge of oral health, whereas nurses and midwives still present

inadequate knowledge in the majority of studies. The most frequently inquired subject was the association between periodontal disease and adverse pregnancy outcomes, namely preterm delivery, pre-eclampsia, and low weight at birth.^{20,22-25,28,32,37,41} Overall, gynecologists/obstetricians demonstrated a good level of knowledge regarding this association, while general physicians, midwives, and nurses scored lower. Several works already addressed this association,^{4,44} but recently a meta-analysis of observational studies reported that women with periodontal disease have a 1.57-fold and 2.43-fold higher risk of delivering preterm or a low-birth-weight newborn, respectively.³ Therefore, it is important to reinforce among PCP, in particular midwives, nurses, and general practitioners, the potential impact of periodontal disease on pregnancy and the importance of advising pregnant women to seek oral healthcare professionals.

Regarding the myths that still exist about pregnancy, three articles addressed the removal of calcium from the mother's teeth by the developing fetus and there are professionals who believe in this statement, namely gynecologists, general physicians, and midwives.^{23,29,34} However, there is no evidence that the calcium from the mother's teeth is removed, as this mineral is in a stable crystalline form.⁴⁵ This myth may be associated with a possible increase of dental caries during pregnancy, but this phenomenon is associated with changes in dietary and oral health hygiene habits.⁴⁶ Therefore, PCP should encourage pregnant women to maintain good oral hygiene to prevent the development of dental caries.

In general, PCP acknowledged the second trimester as the safest to perform dental treatments. Indeed, the second trimester is known to be the safest to perform medical and dental procedures on pregnant women because there is greater emotional stability and, therefore, less stress and anxiety.^{6-8,47} In terms of knowledge about the safety of radiographs, we found that the majority of the PCP considered radiographs to be safe during pregnancy. Although radiographs are safe, they should be avoided and, when necessary, lead vests should be used.⁶ A large proportion of gynecologists believed that the use of anesthesia with a vasoconstrictor was not safe, whereas only 6.4% of midwives/midwifery students believed so.^{20,23,32,40} However, evidence demonstrates that the use of local anesthesia with vasoconstrictor is safe during pregnancy.⁴⁸ In fact, a prospective observational study that followed 210 pregnancies exposed to dental local anesthetics versus 794 pregnancies not exposed to them reported no differences between groups in the rate of miscarriages, gestational age at delivery, or birth weight.⁴⁹ Given that the small concentration of the vasoconstrictors in the anesthetic solution, they do not represent a risk to the fetus or the pregnancy.⁵⁰ In sum, many pregnant women are still afraid of the adverse effects that these treatments may have on the fetus's health and it is also up to PCP to reassure them in this regard and encourage them to seek medical and dental care. Despite the overall adequate knowledge level of some subgroups of PCP, this systematic review highlighted an evident gap between knowledge, attitudes, and practice regarding oral health promotion. Overall, only a small proportion of PCP frequently ask about the oral health of

TABLE 3 Characteristics and main findings of the included studies.

Reference	Country	Population	Age, years	Sex	Professional experience	Type of study	K	A	P	Main findings	Overall assessment of the authors
Acharya et al. ¹⁹	India	21 GYN	40–50 years: 57.14%	♀ 66.7%	>10 years: 52.4%	CS	✓	✓	✓	A total of 61% of the GYN did not know periodontal disease may lead to preterm low-birth-weight neonates. A positive correlation between knowledge/attitude and knowledge/practice was observed, but attitude/practice had a negative correlation. All of the GYN stated that dental reference is important for their patients and 62% of them referred pregnant women to dentists	Adequate knowledge, attitudes and practices about oral health of expectant mothers and infants
Ahmad et al. ²⁰	Pakistan	450 GYN	$\bar{x} \pm SD$ 44.76 ± 9.34 years	—	>10 years: 55.5%	CS	✓	—	—	More than 80% of GYN believed that plaque control decreased gingivitis and 75% considered pregnancy as a cause of gingivitis. Almost 60% of GYN considered dental procedures are safe during second trimester and 56.9% knew that adrenaline and lidocaine were allowed during pregnancy	Adequate knowledge about oral health of pregnant women
Ahmed et al. ²¹	India	170N	$\bar{x} \pm SD$ 30.6 ± 6.9 years	♀ = 100%	$\bar{x} \pm SD$ 6.6 ± 5.7 years	CS	✓	✓	✓	Nurses were aware of the importance of oral health; however, their knowledge in some details was lacking. About 69% of the nurses did not recommend dental visits for pregnant women and 73% did not ask them about their oral health	Inadequate knowledge, attitudes and practices about oral health of pregnant women
Almutairi et al. ²³	Kuwait	118 GYN	<30 years: 36.1%	♀ = 61.9%	\bar{x} 10.8 years	CS	✓	✓	—	Around 73.7% of the participants advised pregnant women to visit a dentist while only 40.7% suggested delaying the dental visit until after delivery. About 50.8% of GYN believed that pregnant women can be safely given local anesthetic agents containing vasoconstrictors and 68.6% acknowledged a possible connection between periodontal health and pregnancy, with 50.8% believing that the inflammation of the periodontal tissues can have a negative impact on the pregnancy outcome. More than 30.0% thought periodontal disease is a predisposing factor for preterm and/or low birth weight. However, 74.6% of GYN believed that the fetus draws calcium from the mother's teeth	Adequate knowledge and attitudes towards oral health
Al-Qahtani et al. ²²	Saudi Arabia	203 GYN	≤50 years: 65.8%	♀ = 84.7%	—	CS	✓	—	—	Around 53.0% of the GYN agreed that periodontal disease is a risk factor for preterm low-birth-weight neonates. Participants older than 50 years had greater knowledge regarding the association between periodontal health and female sex hormones	Inadequate knowledge about the association between periodontal diseases and adverse pregnancy outcomes
Bakhshi et al. ²⁴	Iran	308 GYN	\bar{x} = 45.7 years	—	>10 years: 76.4%	CS	✓	✓	✓	About 75.0% of the GYN were aware that pregnancy could cause gingivitis and bleeding and knew that gingival diseases could cause preterm delivery and low birth weight. More than 60.0% of the GYN knew dental treatments are permitted and safe in the second trimester and 62% evaluated their patient's oral health at the beginning of the pregnancy. More than 70.0% of GYN recommends oral check-ups in the beginning of pregnancy and referred their patients to dentists	Adequate knowledge, attitudes and practice towards oral health during pregnancy
Gowindasamy et al. ²⁵	India	50 GYN 50 GPs	\bar{x} = 32.6 years	—	—	CS	✓	✓	✓	About 64.0% and 68.0% of GPs and GYN, respectively, were aware of the association between periodontal disease and adverse pregnancy outcomes. About 92.0% of GYN and GPs believed that dental treatment during pregnancy improved pregnancy outcomes. The majority of the participants acknowledged the importance of assessing and maintaining oral health during pregnancy	Adequate knowledge, but inadequate attitudes and practices towards oral health during pregnancy
Hoerler et al. ²⁶	USA	13 M 5 N 40 PYS 11 R	—	♀: 78.0%	>5 years: 33.3%	CS	✓	✓	✓	The majority agreed that pregnancy increases the tendency of gingival inflammation and strongly disagreed regarding advising pregnant mothers to stop brushing or flossing if their gingival tissues bleed. Most agreed that gingival problems can be treated safely during pregnancy. A total of 61.0% said that gingival problems could result in low-birth-weight neonates and in preterm birth (71.0%). M and N had higher knowledge scores as compared to PYS and R. The majority (84.0%) never advised a patient to delay their dental visits until after pregnancy	Adequate knowledge, but inadequate attitudes and practices towards oral health in pregnancy

(Continues)

TABLE 3 (Continued)

Reference	Country	Population	Age, years	Sex	Professional experience	Type of study	K	A	P	Main findings	Overall assessment of the authors
Kobylinska et al. ²⁷	Poland	485 D 185 OBS/ GYN	<30 years: 25.8%	♀: 77.3%	>10 years: 47.6%	CS	✓	–	–	Only 23.2% of OBS/GYN were aware of the relationship between poor maternal periodontal health and the risk of pre-eclampsia. Similar observations were made for low birth weight (40.0%) and periodontal health of the child (30.3%). 92.4% of OBS/GYN were convinced that dental treatment may be implemented in any trimester; however, 54.1% of OBS/GYN considered the second trimester to be the safest period for treatment. About 62.2% of OBS/GYN considered radiographies safe in pregnancy. The proportion of professionals referring their pregnant patients to the dentist was about 80.0%	Inadequate knowledge regarding oral health in pregnancy
Lyu et al. ²⁸	China	259 D 146 OBS/ GYN	–	♀ D: 66.4% ♀ OBS/ GYN: 91.7%	D: ≥10 years: 32.4% OBS/GYN: ≥10 years: 44.5%	CS	✓	✓	✓	OBS/GYN and D demonstrated a good understanding of the bidirectional relationship between oral and general health, the risk of periodontal disease in pregnancy and the impact of dietary changes in the increased risk of caries. The overall knowledge level of OBS/GYN and D regarding the safety of dental treatment for pregnant women was low. Almost all D (99.2%) and OBS/GYN (98.6%) believed it is important to undergo oral health care consultations for pregnant women. Only 16.8% of OBS/GYN stated that they had provided oral examinations	Inadequate knowledge, attitudes and practices towards oral health in pregnancy
Maniam et al. ²⁹	Malaysia	138 PYS	\bar{x} = 34 years	♀ = 87.0%	\bar{x} = 4 years	CS	✓	–	✓	The practices of advising patients to see dentists during pregnancy (69.6%), referring patients to dentists for dental check-up (64.6%), and advising patients not to delay dental visits until after pregnancy (85.5%) were reported by PYS. However, only 23.9% reported asking patients if they have oral health issues and only 18.9% performed oral health assessment. Most respondents knew the symptoms of gingivitis and that it is associated with dental plaque and smoking. Only 29.0% of the PYS knew that calcium is not drawn out of the mothers' teeth by the fetus. Only a small percentage (9.4%) agreed that it is the PYS responsibility to examine a patient's mouth to detect oral health problems	Adequate knowledge and practices towards oral health during pregnancy
Naavaal et al. ³⁰	USA	30 M	\bar{x} = 51.9 years	♀ 100%	>10 years: 58.6%	CS	✓	✓	–	The statement with the lowest percentage of correct response addressed the relationship between maternal oral health and the child's oral health (86.2%), followed by the statement that addressed changes in salivary pH during pregnancy. Although 79.3% reported providing oral health referrals for pregnant women, the majority of participants reported discussing oral health but not conducting oral health screenings. When asked about oral health-related evidence-based guidelines for pregnant women, more than half of the midwives were not aware of the guidelines	Adequate knowledge, but inadequate attitudes towards oral health in pregnancy
Nguyen et al. ³¹	Australia	100 M	\bar{x} = 67.5 years	♀ 100% of M	≥10 years: 27.0%	CS	✓	✓	✓	A total of 63.0% of the participants correctly knew that periodontal disease is an inflammatory condition involving bacterial infection and that it can lead to adverse pregnancy outcomes and that those can be prevented during pregnancy (98.0%), with 80.0% of the respondents agreeing that treatment of periodontal disease during pregnancy positively affects pregnancy outcomes. A total of 49.0% routinely referred patients to their dentist for check-ups. Most participants (81.0%) responded that conducting an oral examination is outside the routine practices of a M	Inadequate knowledge but adequate attitudes and practices towards oral health during pregnancy

TABLE 3 (Continued)

Reference	Country	Population	Age, years	Sex	Professional experience	Type of study	K	A	P	Main findings	Overall assessment of the authors
Paneer et al. ³²	India	200 GYN	—	—	—	CS	✓	✓	—	A total of 64% of GYN agreed that pregnancy increases the likelihood of gingival inflammation. Moreover, 67.0% believed that gingival/periodontal inflammation can affect the outcome of pregnancy and 63.0% agreed that periodontal disease can lead to preterm labor and low birth weight. About 74.0% considered second trimester to be the safest time for dental procedures. Around 67.0% of GYN advised their patients to visit a dentist during pregnancy	Adequate knowledge and attitudes about oral health in pregnancy
Popli et al. ³³	India	60 GYN	30–35 years (41.6%)	♀ 98.3%	>10 years: 20.1%	CS	✓	✓	✓	Although 76.7% of GYN were aware of the adverse effects of periodontal disease, only 20% said that dental radiographies are safe during pregnancy. Two-thirds of the GYN did not refer patients to dentist, 70.0% did not examine their oral cavity and 83.0% did not advise the use of fluoride toothpaste	Adequate knowledge, attitudes, but inadequate practices about oral health in pregnancy
Rashidi-Maybodi et al. ³⁴	Iran	40 GYN 40 M	\bar{x} = 47 years	♀ 100.0%	—	CS	✓	✓	✓	Gingivitis was defined by 70.0% of the participants as reversible gingival inflammation and 43.8% of them considered dental plaque as the main cause of periodontal diseases. About 35% of the PCP regularly give their patients nutritional and health advice to improve their oral health. On the other hand, 36.3% rarely allocated a special time for oral examinations of their patients and 20.0% never allocated any time for this purpose. 55.0% referred their patients to a dentist as a routine before pregnancy	Inadequate knowledge and practices, but adequate attitudes towards oral health during pregnancy
Sahin & Kaya ³⁵	Turkey	138 N 206 M 18 MN 16 HO	\bar{x} = 32.9 years	♀ 97.9%	—	CS	✓	✓	✓	PCP thought that tooth treatment should be part of prenatal care (86.8%), and that it affects both the health of the pregnant woman (89.9%) and the fetus (77.0%). PCP responded that dental examinations (96.3%) and routine tooth cleaning (81.2%) could be performed during pregnancy, but the treatment of periodontal diseases (72.5%) and filling/coating (74.1%) could not be performed. A total of 78% of PCP reported that no information on oral health is given to pregnant women. About 82.8% of PCP reported that they did not refer pregnant women to dentists in routine pregnancy follow ups and 82.3% did not give suggestions to pregnant women about gingival care	Inadequate knowledge, attitudes and practices towards oral health in pregnancy
Şenyuva et al. ³⁶	Turkey	29 OBS/ GYN 67 D 14 Family PYS 71 M	—	—	\bar{x} = 15.1 years	CS	✓	—	—	Family PYS and M had the lowest knowledge level on the effect of periodontal diseases on systemic diseases and adverse pregnancy outcomes	Adequate knowledge of OBS/ GYN towards oral health and pregnancy. Inadequate knowledge of family PYS and M
Sinha et al. ³⁷	India	50 GYN	\bar{x} = 39.2 years	—	—	CS	✓	✓	✓	The association between periodontal disease and adverse pregnancy outcomes was acknowledged by 76.0% of the PCP. The vast majority (96.0%) believed that treating gingival problems was safe during pregnancy. From these, 48.0% and 46.0% felt that first and second trimester were safe to treat dental diseases, respectively. About 82.0% thought that treating periodontal diseases during pregnancy would improve the pregnancy outcomes. Only 28.0% of the PCP referred their pregnant patients to a dentist for a dental check-up as a part of antenatal care, although 96.0% of them agreed that dental check-up is necessary for pregnant patients and 70.0% of them considered a dental check-up necessary as part of the routine pregnancy check-up	Adequate knowledge, but inadequate attitudes and practices towards oral health in pregnancy

(Continues)

TABLE 3 (Continued)

Reference	Country	Population	Age, years	Sex	Professional experience	Type of study	K	A	P	Main findings	Overall assessment of the authors
Smadi et al. ³⁸	Jordan	721 OBS	\bar{x} = 45.3 years	\bar{q} = 69.0%	—	CS	✓	✓	—	Overall knowledge scores were 3.5 out of 8 points. About 37.0% of OBS considered dental health care a priority during pregnancy. Only 23.0% of the OBS agreed that the treatment of dental diseases during pregnancy might affect the pregnancy outcome and considered referring their patients to dentists	Inadequate knowledge and attitudes about oral health during pregnancy
Suwardjani et al. ³⁹	Indonesia	95 D 24 GPs 52 GYN 16 HPO 4 M	—	—	—	CS	✓	—	—	A total of 77.0% of five types of health workers stated that they have knowledge in terms of the minimum number of visits of pregnant women to health services during their pregnancy. Prenatal examination treatment packages for pregnant women were known by 72.4% of the respondents. Moreover, 84.9% of health workers knew that they should advise pregnant women to have oral health examinations. However, 9 out of 13 knowledge items regarding oral health care for pregnant women were evaluated as poor	Inadequate knowledge about oral health during pregnancy
Tourino et al. ⁴⁰	Spain	24 Midwifery students 61 M	<40 years: 66.0%	\bar{q} = 95.7%	≥10 years: 36.2%	CS	✓	✓	✓	The average oral knowledge score was 6.5 which reflects a regular level of knowledge about oral health during pregnancy. Participants had a positive attitude towards activities promoting oral health during pregnancy. The most negative attitudes were observed when they were asked if conducting a dental assessment in pregnant women was within the routine practices of midwives and less than 3.0% of participants reported conducting an oral health assessment on pregnant women during prenatal visits	Adequate knowledge and attitudes, but inadequate practices towards oral health in pregnancy
Ustaoglu et al. ⁴¹	Turkey	80 OBS	<45 years: 25.0%	\bar{q} = 62.5%	>10 years: 67.5%	CS	✓	—	—	Around 53.8% of the OBS did not register the oral health history of their patients. Conversely, 96.3% of the OBS reported that pregnancy aggravated gingival inflammation and 86.3% were aware that periodontal disease influenced pregnancy outcomes. The majority of OBS considered periodontal disease as a risk factor for premature birth, low birth weight and pre-eclampsia. OBS believed that treatment of periodontal disease in pregnancy could reduce the risk of premature births. Regarding the dental treatments, 76.3% of OBS thought that dental plaque scaling and root planning were possible during pregnancy	Adequate knowledge about oral health in pregnancy
Uwambaye et al. ⁴²	Rwanda	52 M 27 N	\bar{x} = 33.6 years	—	\bar{x} = 7.6 years	CS	✓	✓	✓	More than half (54.4%) of participants had never heard of periodontal diseases, while 73.4% did not know if periodontal diseases affect the fetus before delivery. No significant difference in knowledge of periodontal diseases between N and M. Overall, 83.5% never checked for oral diseases during antenatal care and 84.8% did not give any basic oral care. A total of 50.7% thought that they do not need to refer pregnant women to dental services if there was no pain and 75.6% thought that it was not their responsibility to look into the oral cavity of their patients	Inadequate knowledge, attitudes and practices towards oral health during pregnancy

Abbreviations: A, attitudes; CS, cross-sectional studies; D, dentists; GPs, general practitioners; GYN, gynecologists; HO, health officials; HPO, health promotion officers; K, knowledge; M, midwives; MN, midwife-nurses; N, nurses; OBS, obstetricians; P, practices; PCP, prenatal care practitioners; PYS, physicians; R, residents; ✓, Studies that assessed the K, A, or P.

TABLE 4 Analysis of the quality and risk of bias for each individual included study (Modified Newcastle-Ottawa Scale¹⁸).

Reference	Selection				Comparability	Results		Total (maximum)	Risk of bias
	Q1	Q2	Q3	Q4		Q5	Q6		
Acharya et al. ¹⁹	*	*	—	*	—	*	*	5 (10)	Medium
Ahmad et al. ²⁰	—	—	—	*	*	*	*	4 (10)	High
Ahmed et al. ²¹	—	—	—	*	*	*	*	4 (10)	High
Almutairi et al. ²³	*	*	—	—	*	*	—	4 (10)	High
Al-Qahtani et al. ²²	*	*	—	**	*	*	*	7 (10)	Medium
Bakhshi et al. ²⁴	*	—	—	**	*	*	*	6 (10)	Medium
Govindasamy et al. ²⁵	—	*	*	**	*	*	*	7 (10)	Medium
Hoerler et al. ²⁶	—	*	—	**	*	*	*	6 (10)	Medium
Kobylnska et al. ²⁷	*	—	—	*	*	*	*	5 (10)	Medium
Lyu et al. ²⁸	*	—	*	*	**	—	*	6 (10)	Medium
Maniam et al. ²⁹	*	*	—	**	*	*	*	7 (10)	Medium
Naavaal et al. ³⁰	*	—	—	**	*	*	*	6 (10)	Medium
Nguyen et al. ³¹	—	—	—	**	—	—	*	3 (10)	High
Paneer et al. ³²	*	—	*	*	—	*	*	5 (10)	Medium
Popli et al. ³³	—	—	—	*	*	*	—	3 (10)	High
Rashidi-Maybodi et al. ³⁴	—	—	*	**	*	*	*	6 (10)	Medium
Sahin & Kaya ³⁵	*	—	*	*	*	—	—	4 (10)	High
Şenyuva et al. ³⁶	*	*	—	*	*	*	*	6 (10)	Medium
Sinha et al. ³⁷	—	*	*	**	—	*	*	6 (10)	Medium
Smadi et al. ³⁸	*	—	—	*	*	*	—	4 (10)	High
Suwardiani et al. ³⁹	*	*	*	—	**	—	—	5 (10)	Medium
Tourino et al. ⁴⁰	*	*	*	*	**	—	*	7 (10)	Medium
Ustaoglu et al. ⁴¹	—	—	—	**	*	*	—	4 (10)	High
Uwambaye et al. ⁴²	*	*	*	**	**	*	*	9 (10)	Low

Note: Q1: Representativeness of the sample; Q2: Sample size; Q3: Participants who did not respond; Q4: Exposure verification; Q5: Comparability; Q6: Evaluation of results; Q7: Statistical analysis. Scores, 0–4: high risk of bias; 5–7: medium risk of bias; 8–10: low risk of bias.

their patients and perform oral health screenings. This finding is in line with a systematic review by George et al.,¹⁵ which reported that PCP had adequate knowledge of oral health, but seldom applied it in their clinical practice. Some barriers to this translational process have been identified in previous studies and include lack of time, lack of training, and not seeing this subject as a priority or a responsibility.^{51,52} During pregnancy, women are more prone to certain oral pathologies, directly or indirectly related to the physiologic changes that result from this period of life. However, most pregnant women are unaware of the implications that poor oral health can have on their well-being, on pregnancy outcomes, and on the oral and general health of their offspring, and they do not seek dental care during pregnancy.^{14,53,54} Pregnant women are regularly monitored throughout pregnancy and puerperium by their PCP and they develop an unconditional trust relationship with them.⁵⁴ In light of our results, a considerable percentage of pregnant women may not demystify their beliefs nor receive dental assistance due to the insufficient attention given to oral health during prenatal appointments. Addressing oral health care during pregnancy is fundamental even in patients with good oral health, as it allows their maintenance and

counseling regarding certain aspects, such as the oral health of their future child. Therefore, PCP can play an important role in raising awareness towards the oral health of pregnant women by discussing their importance, fostering correct oral hygiene habits, and promoting regular visits to the dentist.⁵³ For this reason, institutions such as the American College of Obstetricians and Gynecologists and the “Oral Health Care During Pregnancy Expert Workgroup” published a series of recommendations to help and incentivize PCP to actively improve oral health provision to pregnant women.^{7,55} Additionally, several qualitative studies that approached PCP through semi-structured interviews reported that these professionals would value the inclusion of oral healthcare providers as part of the prenatal team and the creation of referral pathways.^{47,56}

Regarding the limitations of this study, the discrepancies observed throughout the methods and results of the studies reflect the lack of standardized validated questionnaires on this topic. Consequently, there are several studies with a high risk of bias. In addition, most studies were carried out in convenience samples in specific cities and developing countries, as this topic is particularly important due to the high infant mortality and difficult access to

health care by the general population. Due to these methodologic heterogeneities, it is difficult to draw conclusions that can be extrapolated to other populations. Finally, as the questionnaires were self-administered, they may not effectively reflect the practices of professionals.

To conclude, with this systematic review, we observed that PCP and, in particular, gynecologists/obstetricians, have adequate knowledge of oral health, but do not seem to apply it in their clinical practice. There is a clear need to invest in continuous education and training of PCP at pre- and post-graduate levels, to keep their knowledge of oral health updated and to reinforce the importance of translating their knowledge into daily clinical practice.

AUTHOR CONTRIBUTIONS

BHA and MLP designed the research questions and methods. BHA, MJA, and MLP conducted data extraction and analysis. BHA and MJA prepared the manuscript. All authors provided feedback on the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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