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Exploring medical and dental practitioner perspectives and developing a knowledge attitude and practice (KAP) evaluation tool for the common risk factor approach in managing non-communicable and periodontal diseases

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Abstract

Background The Common Risk Factor Approach (CRFA) is one of the methods to achieve medical-dental integration. CRFA addresses shared risk factors among major Non-communicable Diseases (NCDs). This study aimed to explore the perspectives of dental and medical practitioners concerning CRFA for managing NCDs and periodontal diseases and to create and validate a tool to evaluate the Knowledge, Attitude, and Practice (KAP) of medical and dental practitioners in relation to utilization of CRFA for management of NCDs and Periodontal diseases.

Methods This research employed a concurrent mixed-method model and was carried out from January 2021 to February 2022, focusing on medical and dental practitioners in South India. In the qualitative phase, online interviews were conducted with dental and medical practitioners, recorded, and transcribed. Thematic analysis was applied after achieving data saturation. In the quantitative phase, a KAP questionnaire was developed. The sample size was determined by using the G power statistical power analysis program. A sample size of 220 in each group (dentists and medical practitioners) was estimated. Systematic random sampling was used to recruit the potential participants. The data obtained through the online dissemination of KAP tool was analysed and scores were standardized to categorize the KAP.

Results Qualitative thematic analysis identified four major themes: understanding of common risk factors, risk factor reduction and disease burden, integrating CRFA into clinical practice, and barriers to CRFA. In addition, thematic analysis revealed seventeen subthemes. For the quantitative phase, standardization was applied to a 14-item KAP questionnaire for medical practitioners and a 19-item KAP questionnaire for dental practitioners. The total KAP score

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for medical practitioners in the study was 21.84 ± 2.87, while dental practitioners scored 22.82 ± 3.21, which indicated a high level of KAP regarding CRFA. Meta integration of qualitative and quantitative data identified eight overarching themes: four were concordant, three were discordant, and one theme provided the explanatory component.

Conclusion The study's structured, validated questionnaire showed that both medical and dental professionals had a high knowledge of CRFA. However, they were not appreciably aware of the risk factors that are shared between NCDs and periodontal disease. Both groups were interested in the idea of using CRFA in integrated medical and dental care.

Keywords Healthcare coalitions, Health Services Research, Medical-dental integration, Non-communicable diseases, Periodontal diseases, Risk factors

Introduction

Non-communicable diseases (NCDs) account for more than 41 million deaths globally each year [1]. These diseases are influenced by both non-modifiable and modifiable risk factors [2]. Periodontal disease, another multifactorial non-communicable ailment, shares several risk factors with NCDs. Individuals with periodontal diseases, particularly periodontitis, face a heightened risk of losing multiple teeth, leading to compromised masticatory function and altered dietary habits [3]. This not only affects the quality of life and self-esteem of affected individuals but also imposes significant socio-economic burdens and healthcare costs [4]. Despite the evident connections between periodontal disease and NCDs [5, 6], there persists a historical divide between oral and general healthcare [7], further reinforced by the establishment of medical insurance [8]. This separation has contributed to out-of-pocket expenditures (OOPE) on dental care, accounting for approximately 14% of OOPE in Organisation for Economic Co-operation and Development (OECD) countries. [9] A recent study in South India revealed that 15.4% of sanitary workers experienced Catastrophic Dental Health Expenditure (CDHE) [10]. Additionally, a global study involving 41 low- and middle-income countries found that 7% of households faced CDHE [11].

The integration of dental and medical care would bring substantial benefits to the general population. Oral health has a significant impact on general health. Simple, non-invasive periodontal therapy was found to result in a remarkable (40–70%) reduction in medical costs and hospitalizations for individuals with conditions such as diabetes, coronary artery disease, or during pregnancy [12]. This underscores the potential advantages of addressing oral health within the broader spectrum of healthcare, leading to improved overall health outcomes and reduced healthcare costs.

Several methods of integrating medical and dental care have been explored, [13–15] and one such strategy is risk reduction for disease prevention. Common risk factors such as smoking, obesity, poor nutrition, low socio-economic status, stress, and inadequate oral hygiene are shared by both periodontitis and NCDs [5]. Traditional health promotion tends to focus on specific diseases, potentially contributing to the separation of oral health from general health. An alternative approach, the Common Risk Factor Approach (CRFA), addresses shared risk factors among major NCDs, including oral diseases. CRFA emphasizes managing contributing elements to enhance overall population health.

The approaches within CRFA aim to mitigate the impact of common chronic diseases [13] and include integrated action against shared risk factors and altering one risk factor that may influence others, leading to a cascade effect. For instance, changing smoking behavior could impact related behaviors like alcohol consumption and diet. Collaborative efforts across sectors, concentrating upstream on basic etiological factors, can lead to progress in oral health improvement and decreased oral health inequalities [16]. Given the clustering of both modifiable and non-modifiable risk factors in patients with NCDs and periodontal diseases, CRFA emerges as a cost-effective and rational approach [13]. Of these risk factors, modifiable risk factors can be controlled or changed. The control or modification of a few key risk factors can have a substantial impact on managing numerous chronic conditions.

The World Health Organization (WHO) advocates a global strategy for enhancing oral health alongside overall health, emphasizing shared risk factors [17]. Implementing CRFA for overall health, including oral health, presents opportunities to integrate oral health promotion into broader health policies, such as those related to food [15]. However, successful implementation requires appropriate evidence, guidelines, and policies due to perceived challenges in applying CRFA for oral health promotion [15].

To comprehensively assess the potential initiation of the CRFA for NCDs, including periodontal disease, it is crucial to understand the knowledge, attitudes, and practices of medical and dental practitioners regarding shared risk factors. While previous studies have explored knowledge about periodontitis risk factors among medical practitioners and the general population, [18, 19] there is a notable gap in understanding the KAP of both medical and dental practitioners regarding shared risk factors

between NCDs and periodontitis and the integration of CRFA into medical and dental practices.

Capacity-building measures are essential for implementing CRFA-based programs [15], and assessing the baseline KAP of the target population will bridge the evidence gap for integrations. Despite the pivotal role of CRFA in addressing health issues, there is currently no standardized instrument tailored to assess practitioners' KAP in this context. Questionnaires are commonly used for KAP assessment [20], and a structured, validated questionnaire is essential for obtaining clear information on practitioners' understanding and application of CRFA in managing NCDs and periodontal diseases.

The objectives of this mixed-method study are to address these gaps by understanding practitioners' opinions on CRFA and developing a validated structured instrument to assess the Knowledge, Attitude, and Practice of medical and dental practitioners toward the use of CRFA for managing NCDs and periodontal diseases. The study will employ both quantitative and qualitative methods, utilizing a structured questionnaire to capture practitioners' perspectives and incorporating open-ended communication to gain insights into the reasons behind their opinions, support, and potential hurdles in implementing CRFA in the Indian context.

Methods

The mixed-method study received ethical approval from the institutional ethics committee and institutional review board, and informed consent was obtained from the participants during the conduct of the study.

Research design

The study employed a concurrent mixed-methods model, incorporating both qualitative and quantitative arms, to holistically investigate the research questions. This approach combines the advantages of qualitative and quantitative data, allowing for a comprehensive exploration of the CRFA. The qualitative arm provides in-depth insights into the complex phenomena associated with CRFA, offering a contextual richness that complements the quantitative results. The lists of potential participants were obtained from the list of dentists and medical practitioners of Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, and Goa available through the regional Indian Dental Association (IDA), Indian Medical Association (IMA), and directories of medical and dental practitioners. Based on the data obtained from the directories, a state-wise distribution of samples was done. Systematic random sampling was used to select the possible participants for the study from January 2021 to February 2022.

Qualitative arm

Study context and population

The qualitative segment of the study sought to delve into the viewpoints of experts in medicine and general dental practice, particularly those possessing relevant expertise related to the CRFA. Participants were selected from specialties such as endocrinology, gynaecology, otorhinolaryngology, periodontology, general medicine, and general dentistry, based on their relevance to the shared risk factors between periodontal disease and various medical conditions. Purposive sampling was employed to recruit a diverse group of medical and dental practitioners, and the sampling units were identified from the directories of professional associations like the Indian Dental Association (IDA) and the Indian Medical Association (IMA). Participation in the online interviews using the 'Zoom Meetings' online platform was voluntary. After obtaining their consent, the link for the Zoom meeting was shared with the participants. Participants received acknowledgment certificates as an incentive. No explicit exclusion criteria were set, ensuring a broad representation of perspectives across the selected fields.

In-depth interviews

The qualitative phase of the study utilized in-depth interview guides that covered similar topics for both dental and medical practitioners. These guides included components related to the understanding of common risk factors, risk factor reduction, and disease burden, suggested methods for integrating CRFA into clinical practice, and barriers to CRFA. The semi-structured questions were developed a priori, drawing from existing literature. The interviews were conducted with consent, and a note-keeper recorded the proceedings, while in-depth interviews were recorded for transcription. The recordings were transformed into verbatim transcripts at the end of each day.

The number of participants for in-depth interviews was determined based on achieving data saturation, ensuring that the sample size was sufficient to capture a diverse range of perspectives until no new information or themes emerged. Data saturation enhances the credibility and trustworthiness of study findings, signifying theoretical sufficiency. The analysis methodology involved progressive analysis throughout the study, allowing for the incremental identification and incorporation of themes and sub-themes after each interview. This iterative process facilitated the continual refinement of emerging data patterns.

The decision to conclude interviews was guided by the observation of the ceased emergence of new themes, indicating data saturation. Close monitoring of interview data helped identify a point where further sessions yielded no novel insights or themes. After achieving data

saturation, a comprehensive final thematic analysis was conducted following guidelines by Braun and Clark [21] and reiterated by Kiger et al [22]. This analysis involved data review, coding, categorization, and synthesis to derive conclusive themes and sub-themes. Each transcript underwent review by two researchers, and emerging themes were developed, involving a third author in cases of disagreement. Consensus on codes, categories, and themes was reached through regular discussions. The data was organized and managed using computer-assisted qualitative research software, QDA Miner Lite (Version 2.0.7; Provalis Research).

Quantitative arm

The quantitative segment of the mixed-method study focused on developing and validating a KAP questionnaire on the CRFA for the integration of medical and dental care. Distinct questionnaires were created for medical and dental practitioners. The development of the questionnaire occurred in two stages.

In the first stage, item and domain development took place, involving a deductive approach to form initial questions, followed by content validation and test-retest reliability. The second stage involved the validation of the questionnaire through item response theory, exploratory factor analysis, and internal consistency reliability assessment. This two-stage process ensured the robustness and appropriateness of the questionnaire for assessing the KAP of medical and dental practitioners regarding CRFA in the context of managing NCDs and Periodontal diseases.

Study population

The study included both medical practitioners and dental practitioners, encompassing those with and without a postgraduate degree or specialization. This diverse inclusion aimed to capture perspectives from practitioners with varying levels of education and expertise, providing a comprehensive understanding of the knowledge, attitudes, and practices related to the CRFA among professionals in both fields.

Sample size

The sample size was determined by using the G power statistical power analysis program. Based on the findings from a previous study [23] a sample size of 220 dentists and medical practitioners was estimated. This was done by taking into account the Chi-square test's effect size of 0.30, the study's power of 0.95, and the number of groups of medical and dental practitioners that could be used to compare mean knowledge, attitude, and practice scores.

Data collection

The study utilized a systematic approach for sampling dental and medical practitioners from Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, and Goa. The directories of the regional Indian Dental Association (IDA) and Indian Medical Association (IMA) were consulted to compile a list of practitioners (both specialists and general practitioners). To ensure a representative sample, the distribution of participants was organized by state (Table 1).

Systematic random sampling was employed to select potential participants, minimizing bias in participant selection. Contact details were then used to send a web-based questionnaire via Google Forms, accompanied by an invitation to participate. Anticipating a 50% non-response rate, the questionnaires were distributed to twice the required number of participants. The final

Table 1 Calculation of state wise distribution of number of medical and dental practitioners included in the quantitative arm

S.No.	State	No. of dentists in the directory	Proportion of total	No. to be included in the study (out of 220)
1	Karnataka	3098	19%	42
2	Kerala	6238	38%	84
3	Tamil Nadu	4814	29%	64
4	Telangana	922	5%	11
5	Andhra Pradesh	1162	7%	15
6	Goa	250	2%	4
	Total	16,484		220
S.No.	**State**	**No. of medical practitioners in the directory**	**Proportion of total**	**No. to be included in the study (out of 220)**
1	Karnataka	14,528	37%	82
2	Kerala	3457	8%	19
3	Tamil Nadu	8125	21%	46
4	Telangana	4438	11%	25
5	Andhra Pradesh	7774	20%	44
6	Goa	803	2%	4
	Total	39,125		220

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analysis included responses from 225 medical practitioners and 307 dental practitioners across South India.

Questionnaire development

The development and validation of the KAP questionnaire occurred in two distinct stages. In the first stage, item and domain development were undertaken through a three-step process: (i) Deductive approach, (ii) Content validation, (iii) Test-retest reliability. The second stage involved the validation of the questionnaire using: (i) Item response theory, (ii) Exploratory factor analysis, (iii) Internal consistency reliability assessment. Subsequently, scores were standardized to categorize the KAP of the population into low, medium, and high categories. This multi-stage process ensured the reliability and validity of the questionnaire for assessing participants' knowledge, attitude, and practice regarding the CRFA.

Stage one: item and domain development

The deductive approach was employed to develop items for the questionnaire based on existing literature related to the CRFA in the management of periodontal disease and NCDs. Eight referenced articles contributed to the conceptual definition of knowledge, attitude, and practice regarding CRFA [23–30]. The definition of CRFA emphasized its role in creating cross-disciplinary health promotion programs that address common risk factors for diseases. Knowledge, attitude, and practice were defined in terms of awareness, thoughts, behaviors, and understanding of shared risk factors and etiology related to periodontal disease and NCDs, as well as CRFA.

The initial questionnaire, developed in English, consisted of 28 items for the dental questionnaire and 24 items for the medical questionnaire, distributed across four domains: (1) Demography of participants; (2) Knowledge towards CRFA for NCDs and oral health; (3) Attitude towards CRFA for NCDs and oral health; and (4) Practice towards implementing CRFA for NCDs and oral health. To ensure content validity, the initial questionnaire underwent review by an expert panel comprising dental and medical practitioners. The test-retest reliability of the questionnaire was assessed by administering it twice to 30 participants within a one-month timeframe.

Stage two: questionnaire validation

The study included responses from 225 medical practitioners and 307 dental practitioners across six states in South India to evaluate the additional psychometric properties of the questionnaire. Data analysis was conducted using JMETRIK software.

Item response theory (IRT)

In the knowledge domain, a two-parameter logistic item response theory (2-PL IRT) analysis was conducted using responses categorized as either correct or incorrect. The analysis was performed in JMETRIK (version 4.0.0, Charlottesville, Virginia, USA) using the RASCH (log odds ratio) limited package. The analysis considered the range of difficulty (-4 to +4) and discrimination (0.20 to infinity) as the cut-off values for evaluating psychometric properties. Item fit was assessed using chi-square goodness-of-fit per item, and p values were reported. The modified parallel analysis was employed to evaluate one-dimensionality.

Exploratory factor analysis

The adequacy of sampling was assessed using the Kaiser–Meyer–Olkin measure (KMO) and Bartlett's test of sphericity [20]. A KMO value above 0.5 and a significant result in Bartlett's test ($p < 0.001$) were considered indicative of a sufficient sample.

Internal consistency reliability

The internal consistency (IC) of the items was calculated using the coefficient of Cronbach's alpha [31] and correlation between items.

Standardization of scores

The responses to the questions in the Knowledge, Attitude, and Practice groups were coded, and scores were calculated for each group. The scores were then split into percentiles for standardization. The total KAP score was also calculated and interpreted as low KAP (0 to 24th percentile), medium KAP (25th to 75th percentile), and high KAP (76th to 100th percentile) based on the percentile scores [32].

Results

Qualitative arm

In-depth interviews involved five medical practitioners specializing in endocrinology, gynaecology, otorhinolaryngology, and general medicine, along with five general dental practitioners and five periodontists. The qualitative thematic analysis identified four major themes: understanding of common risk factors, risk factor reduction and disease burden, integrating CRFA into clinical practice, and barriers to CRFA. Subsequently, seventeen subthemes emerged, encompassing topics such as enumerating risk factors, transitioning from disease-specific to risk factor approaches, diagnosing systemic NCDs through identifying risk factors and oral signs, controlling risk factors and NCD burden, the impact of periodontal therapy on NCD burden, the influence of medical practitioners over periodontists, measures for integrating CRFA, barriers to integration, and more.

Themes

Theme 1: understanding shared common risk factors The study revealed that medical and dental practitioners, including periodontists, demonstrated awareness of the association between diabetes and periodontal disease, as well as the shared risk factor of smoking. However, their knowledge regarding risk factors common to other major NCDs and periodontal disease was limited. Many practitioners were unable to identify shared risk factors such as obesity, the presence of oral pathogens, and nutritional deficiency [5]. This knowledge gap may be attributed to the prevailing practice of treating patients based on specific diseases rather than targeting shared risk factors. Although there is a gradual shift toward a risk factor-based approach in certain specialties, there remains a general scepticism about patient compliance with long-term risk factor reduction strategies. The subthemes that emerged under this major theme are: *(i) Enumeration of the risk factors (ii) Transition from disease specific to risk factor approach (iii) Diagnosis of a systemic NCD through identification of presence of risk factors and oral signs.*

'There are many risk factors, ranging from smoking to genetics. Very common ones are smoking, alcohol, lifestyle. Each and every factor has a specific role. Genetics has a significant role. If a parent is diabetic by his or her 50s then the next generation will become diabetic by 30s'. (MP1)

There was a consensus regarding the need for a change from a disease specific approach to a risk factor approach.

MP1 had supported CRFA. 'This is a very good approach. Common risk factors are present for many diseases. So, if we can create an awareness regarding smoking, alcohol, and sedentary lifestyle, it can significantly reduce the development of many diseases.'

The identification of clustering of risk factors for periodontal disease and NCDs in patients, in addition to the occurrence of oral signs, can sometimes lead to the diagnosis of systemic diseases.

PR5 'In diabetes we have noticed. They come with multiple abscesses, then we advise them to check the blood glucose level and they are diagnosed with diabetes. They are not aware of the condition before. So, once we treat the patient and with the consultation with the diabetologist, we have noticed an improvement in the status.'

Theme 2: risk factor reduction and disease burden All practitioners concurred on the potential positive impact of early identification of risk factors, counselling, and reducing risk factors to mitigate disease burden. Nevertheless, medical practitioners acknowledged that a significant portion of them tend to overlook oral health, possibly due to a lack of awareness regarding its association with systemic conditions. The thematic analysis revealed subthemes such as (i) Control of Risk Factors and Impact on NCD Burden (ii) The Role of Periodontal Therapy in Alleviating the NCD Burden (iii) Reciprocal Impact of Other NCD Therapies on Periodontal Disease Burden (iv) Influence of Medical Practitioners in Shaping Patient Decisions Over Periodontists. These subthemes underscored the interconnectedness of risk factors, diverse therapies, and the collaborative role of medical and dental practitioners in addressing both oral and systemic health.

PR1 stated that 'Lifestyle modification…I have been following the periodontal patients in my clinic. There are patients whom I have been following for last 6 to 7 years. Patients who have been motivated to maintain the oral hygiene, their rate of progression (of periodontal disease) and diabetic control is much better than patients who are not maintaining their oral hygiene properly.'

The dental practitioners have observed that periodontal therapy can result in improving the NCD status and that a better compliance is observed when the advice is given by a medical practitioner.

'Yes, after periodontal treatment, sugar level often reduces as noticed in diabetes. Diabetics with uncontrolled sugar levels, fluctuating sugar levels, after periodontal therapy usually have better controlled sugar levels', GP1 said.

PR3 said, 'Yes definitely, when a physician refers the patient to us, they are more willing to listen to us and adapt to whatever changes we say.'

Theme 3: methods suggested for integrating CRFA into clinical practice Various approaches have been proposed to integrate the CRFA into clinical practice. These strategies encompass capacity building initiatives to promote medical-dental integration, such as establishing NCD clinics; raising awareness among the medical community regarding the interconnectedness of medical and dental health; advocating for policies that underscore the significance of CRFA integration in clinical settings; developing effective healthcare referral systems and cross-disciplinary health promotion strategies, including oral health care; and encouraging patient education and motivation. The subthemes within this overarching theme are: (i) Capacity Building (ii) Advocacy and Policy Implications (iii) Healthcare Partnerships Involving Referrals and Cross-Disciplinary Health Promotion Strategies (iv) Patient Education and Motivation.

The interviews highlighted diverse strategies for capacity building, including the implementation of regular check-ups and screening camps as integral components of healthcare services. Furthermore, suggestions encompassed the use of awareness posters and videos, adoption of evidence-based practices, and the establishment of NCD clinicsx [33]. NCD clinics, as proposed, would serve as essential hubs for screening, diagnosing, and

managing NCDs. These clinics would offer comprehensive examinations, including diet counselling, lifestyle management, and home-based care. Patients could be referred to these clinics by other healthcare centres, health workers, or they could directly report to the clinic, enabling the identification and management of complications or advanced stages of NCDs. MP1 stated, 'In government clinics, there are NCD clinic. Along with the NCD clinic, if a dental clinic can be set up, a lot of cases with oral manifestations will be diagnosed. So integrated clinics with NCD and dental will be very useful.'

Advocacy enables stakeholders and government decision-makers to have discussions and bring out suggestions and recommendations to a prevailing policy that is of interest to them.

MP1 Suggested that 'Even for a job opportunity, basic examination is physical examination and evaluation for systemic diseases. Oral examination may be included in the basic fitness requirement for the job.'

Interdisciplinary collaboration is also essential for medical dental integration as stated by MP3, 'There should be a rapport between the medical and dental practitioner so that there is communication regarding the cases and there is a follow-up of the cases.'

Communication through mass media and other visual aids, generating social and cultural awareness for patient education, and motivation for holistic health care have also been suggested to facilitate the implementation of integrated care delivery.

PR2 has mentioned, 'When this gets published, apart from journals, this should reach the common population also. The common population rarely see the journal articles. So, it should be brought forth in mass media so that it reaches the population.'

Theme 4: barriers for implementation of CRFA CRFA is considered a relatively novel approach, as the comprehensive exploration of shared risk factors and risk reduction strategies for common NCDs and periodontal disease is a recent development. The lack of awareness regarding this concept has been identified as a significant barrier to its implementation, coupled with challenges such as time constraints, concerns about the sustainability of long-term risk reduction strategies, and the need for extended resources. Moreover, the existing strict specialization within healthcare disciplines and the lack of interdisciplinary coordination pose additional obstacles to the effective execution of CRFA. The subthemes encompass: (i) Lack of awareness (ii) Time constraints (iii) Sustainability (iv) Long-term outcomes or no outcomes (v) Lack of resources (vi) Lack of interdisciplinary coordination and strict specialization.MP2 said 'One is that among us practitioners, we do not give due significance to the link between oral health and systemic health. There are no awareness programs as far as I know. The emphasis is less'.

GP5 said, 'They (medical practitioners) don't have time to peep into the oral cavity to say you have caries, go to a dentist or say you have diabetes and there is a chance to develop periodontal disease. Such opportunities are less.'

The results of following the risk reduction strategies may take a long time to manifest, and sometimes the outcomes are not as significant as what the patient would have expected. This results in a spiralling of the patient's attitude and a failure of further follow-up.

'In long term, the patients may become uncooperative, and patients will not be willing for a follow-up, they will go for things that have cost-benefit'MP1.

The lack of resources, manpower and facilities to deliver the care act as significant barriers to implementation of CRFA.

MP3 has stated, 'Cost is a problem, social acceptance is a problem, policy makers and political involvement are a problem, lack of communication between communities… In the western countries, like UK, they have NHS care, we don't have that in India and patients hence don't go for any care if they feel it is unnecessary'.

Quantitative arm
Questionnaire development
Stage one: item and domain development
i) Content validation

The total number of questions included in the dental and medical questionnaires using the deductive approach was 28 and 24 respectively. After discussion, one question was eliminated from both the medical and dental questionnaires as it had a similar connotation to a previous question. Content validation of each scale was performed by five experts to ensure content relevance, representativeness, and technical quality. The KAP questionnaire was reduced to 26 questions for dental practitioners after content validation. Item reduction was performed to 22 for the questionnaire for medical practitioners after eliminating 1 question. A few questions were rephrased based on the suggestions given by the expert panel prior to administering the questionnaire for test-retest reliability assessment. The details of content validation are given in Table 2.

ii) Test-re test reliability

The scoring of items was done, and the data was utilized to assess the reliability of the questionnaire. 21 questions in dental and medical questionnaires were subjected to test-retest reliability assessment. Five questions in the dental questionnaire were option questions, leading questions, or open-ended questions (Eg: Are you a periodontist) and one question in the medical questionnaire was open ended, hence they were not subjected to test-retest reliability. The unweighted Kappa coefficient

Table 2 Content validation

	Medical KAP questionnaire	Dental KAP questionnaire
Scale level Content Validity Index/Average (S-CVI/Ave)	0.84	0.91
Scale level Content Validity Index/Universal Agreement (S-CVI/UA)	0.45	0.64
Free marginal Kappa	0.64	0.79
Fixed marginal Kappa	0.14	0.08
Percentage agreement	73.18%	84.29%

was used to assess the reliability of the items with binary responses (Table 3). The intraclass correlation coefficient (ICC) was used for assessing the questions in the attitude category with categorical variables (Table 3). Based on the test-retest reliability assessment, three questions from the dental questionnaire and two questions from the medical questionnaire were eliminated.

iii)Psychometric evaluation of questionnaire

The 20-item medical and 23-item dental KAP questionnaires (including the open-ended and leading questions) were administered to 450 medical and dental practitioners, and responses were obtained from 225 samples in the medical stream and 307 in the dental stream.

In the medical KAP questionnaire, four items from the knowledge domain and one item each from the attitude and practice domain were eliminated owing to the high difficulty statistic. One item each from the knowledge and practice domain was retained considering the importance of the items, even though they had a higher difficulty range. After item reduction using item response theory, 14 items (including the open-ended question) remained in the final questionnaire for medical practitioners. The KMO sampling adequacy and test of sphericity for the domains of knowledge, attitude, and practice were found to be in an acceptable range. Internal consistency measured using Cronbach's alpha improved from 0.471 to 0.658 for the attitude domain after item deletion. For knowledge and practice, the Cronbach's alpha after item deletion was reported to be 0.553 and 0.727, respectively.

The 23-item questionnaire was reduced to 19 items with the elimination of 3 items from THE knowledge domain and single item from attitude domain. Two items with poor scores of difficulty were deemed to be important in the questionnaire and were not eliminated. After item reduction, a total of 14 items remained in the final questionnaire in addition to the five leading/option questions. The KMO sampling adequacy and test of sphericity for the domains of knowledge, attitude, and practice were found to be in acceptable range. Internal consistency measured using Cronbach's alpha was found to be slightly reliable in case of the attitude domain (0.459). While for knowledge and practice domain internal consistency was within the acceptable range (Knowledge 0.634, Practice 0.513) after item deletion.

Multivariate logistic regression was attempted between the parameters such as age, gender, qualification, experience, type of service, location, and number of patients seen per day and the knowledge, attitude, and practice regarding CRFA for both medical and dental practitioners, and no significant results were obtained for both medical and dental practitioners. (The details of the psychometric evaluation of the questionnaire and the characteristics of the study population are given in supplementary file 1)

iv) standardization of scores

For the south Indian population, the 14 item questionnaire scores were standardized (Table 4).

The validated questionnaires for medical and dental practitioners are given in supplementary file 2. For the medical KAP questionnaire, scores below 14 indicated low KAP, scores between 15 and 18 indicated medium, and scores greater than 18 indicated good knowledge, attitude, and practice of CRFA. For dental practitioners, scores less than 16 were reported to be low KAP; scores 16 to 19 indicated medium level; and scores greater than 20 indicated a good level of knowledge, attitude, and practice regarding CRFA.

Total KAP amongst the medical practitioners who participated in the present study was 21.84±2.87 and that of dental practitioners was 22.82±3.21. Both values indicated a high level of KAP amongst the participants regarding CRFA.

Meta-integration

Eight overarching themes emerged in the meta integration of the qualitative and quantitative data (Fig. 1). The themes that had a confirmatory fit as assessed from both the quantitative and qualitative aspects of the study include (i) awareness of common risk factors for NCDs including periodontal diseases, (ii) neglect of dental status while assessing general health, (iii) awareness of effect of systemic diseases on oral health, (iv) awareness of risk factor reduction and improvement of NCD status. Contradictory observations from the quantitative and qualitative arms of the study resulted in a discordant fit in the following themes: (i) regular follow-up of periodontal health of patients with NCDs (ii) awareness regarding need for referral for periodontal examination and management in patients with NCDs (iii) awareness of perio-systemic interlink. The qualitative arm of the study explained the theme 'Reasons for lack of referral to dental practitioners by medical practitioners' and provided

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Table 3 Test-re-test reliability

Unweighted Kappa Coefficient for items with binary responses

Item	Dental KAP questionnaire		Medical KAP questionnaire	
	Kappa	Interpretation	Kappa	Interpretation
K1	-0.053	No agreement	1	Almost Perfect Agreement
K2	1	Almost Perfect Agreement	1	Almost Perfect Agreement
K3	0.524	Moderate Agreement	0.80	Substantial Agreement
K4	0.839	Almost Perfect Agreement	1	Almost Perfect Agreement
K5	1	Almost Perfect Agreement	1	Almost Perfect Agreement
K6	0.524	Moderate Agreement	1	Almost Perfect Agreement
K7	0.651	Substantial Agreement	1	Almost Perfect Agreement
K8	0.609	Substantial Agreement	0.040	Slight Agreement
K9	0.609	Substantial Agreement	0.710	Substantial Agreement
K10	0.651	Substantial Agreement	0.440	Moderate Agreement
K11	0.609	Substantial Agreement	0.550	Substantial Agreement
K12	0.379	Fair Agreement	0.484	Moderate Agreement
P1	0.464	Moderate Agreement	1	Almost Perfect Agreement
P2	0.510	Moderate Agreement	0.710	Substantial Agreement
P3	0.510	Moderate Agreement	0.80	Substantial Agreement
P4	0.118	Slight Agreement	0.80	Substantial Agreement

Intraclass correlation for categorical variable-Medical KAP questionnaire

Sl No	Dimension	ICC	Lower Bound	Upper Bound
1	Attitude Overall	0.735	0.349	0.894
2	A1	0.327	-0.788	0.739
3	A2	0.638	0.071	0.857
4	A3	0.593	-0.026	0.839
5	A4	0.925	0.812	0.970
6	A5	0.558	-0.052	0.821

Intraclass correlation for categorical variable-Dental KAP questionnaire

Sl No	Dimension	ICC	Lower Bound	Upper Bound
1	Attitude Overall	0.711	0.582	0.829
2	A1	0.781	0.545	0.895
3	A2	0.239	-0.630	0.641
4	A3	0.623	0.199	0.822
5	A4	0.822	0.631	0.915
6	A5	0.812	0.602	0.911

Table 4 Standardisation of scores

Standardisation of Medical KAP questionnaire score

Scores	Interpretation
Less than 14	Low
15–18	Medium
More than 18	High
KAP of the population	21.84 ± 2.87

Standardisation of Dental KAP questionnaire score

Scores	Interpretation
Scores	*Interpretation*
Less than 16	Low
16–19	Medium
More than 20	High
Population	22.82 ± 3.21

reasons such a reduced emphasis on oral health with a lack of awareness regarding the same amongst the practitioners, resource and time constraints that prevent the medical practitioners from looking into the overall health of the patient apart from the presenting complaint, over-specialization of the medical field with focus only on the specific field of specialization, to state a few.

Discussion

NCDs and periodontal disease pose substantial societal burdens in terms of economic costs and years lost to ill-health, disability, or premature death [34]. Various factors, including social, demographic, environmental, behavioural, and personal elements, predispose individuals to major NCDs and oral diseases [5]. The CRFA addresses these shared risk factors, allowing the regulation of a few risk factors to exert a significant impact on controlling multiple chronic conditions [5]. This study has successfully developed and validated a questionnaire with satisfactory content validity and reliability to assess the knowledge, attitude, and behavior regarding CRFA for managing NCDs and periodontal disease.

To the best of our knowledge, this is the first study to create a suitable questionnaire for this purpose, incorporating a qualitative component to comprehend potential pathways and barriers to CRFA implementation. All retained questionnaire items demonstrated discrimination and difficulty parameters within acceptable ranges [20]. The KAP questionnaire exhibited acceptable internal consistency, validating its effectiveness for assessing CRFA-related KAP.

A crucial finding is the lack of understanding among medical and dental practitioners regarding common risk factors for NCDs and periodontal disease, hindering the implementation of CRFA. Literature that demonstrates the presence of shared risk factors between periodontal disease and other non-communicable diseases has, perchance, not been extensively explored by the health-care community. Almeida et al., in their systematic review,
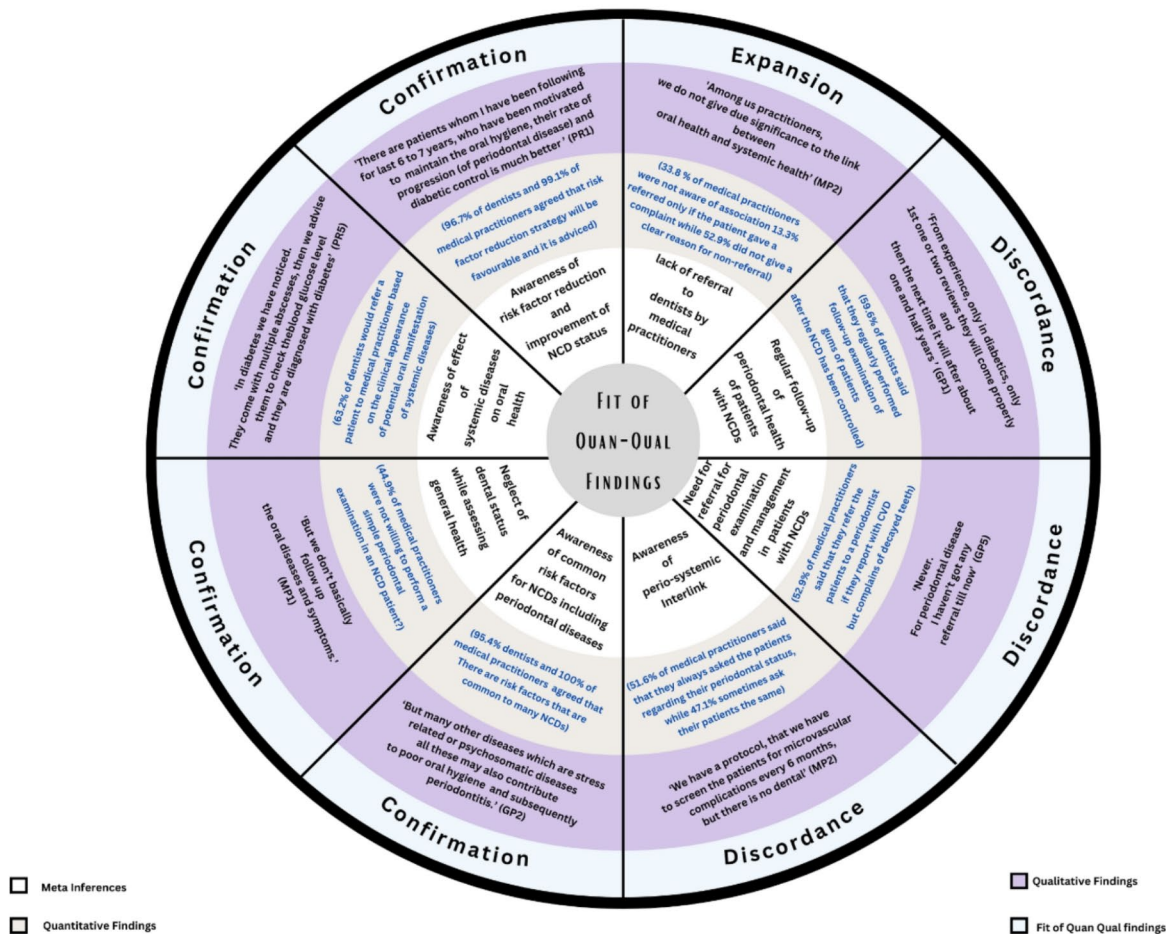
Fig. 1 Awareness of common risk factors for NCDs including periodontal diseases

showed that the inflammatory mediators CRP and IL-6 had a significant association with both periodontitis and atherosclerosis [35]. A study by Arregoces et al. [36] showed an increase in ultrasensitive CRP (usCRP) in acute myocardial infarction (AMI), diabetes and periodontal disease. abdominal obesity [37] and insulin resistance [38] are proven to be contributing risk factors for metabolic syndrome and periodontal disease. The risk for CVD and periodontal disease is related to poor glycemic control, dyslipidemia, and chronic inflammatory state [39–41]. Smoking has been proven as a risk factor for periodontal disease, hypertension, diabetes, and metabolic syndrome through several studies [42–45]. Holmlund et al. have demonstrated the association between immunoglobulin G levels against P gingivalis and the risk for AMI and periodontal disease [46]. The presence of Aggregatibacter actinomycetemcomitans (Aa) is shown to be a risk factor for Coronary Artery Disease (CAD) and periodontal diseasecx [47]. The role of stress and

depression as risk factors for CVD and periodontal disease has been investigated and recognized [48].

Apart from the lack of sufficient knowledge regarding the shared risk factors between periodontal disease and NCDs, there are additional barriers to the implementation of CRFA for the management of periodontal disease and NCDs. Barriers include time and resource constraints, oral health neglect in general health assessments, insufficient recognition of the need for oral health care referral for NCD patients, and limited acknowledgment of the perio-systemic interlink. However, the integration of medical and dental care is not impossible, and efforts such as creating awareness, education programs, mass media campaigns, and efficient referral systems are advocated by healthcare professionals.

The Health Resources and Services Administration (HRSA) has explained initiatives for incorporating oral health into primary medical care practice and training primary health care professionals in oral health assessment and clinical competencies [49]. The combination

of preventive dental care with general health care practice can help reduce duplication of care modalities and expenses incurred. Six levels of integration, with the evolution of the key elements involved in the integration, from communication to physical proximity to practice change, have been described [50]. Communication is the key element in the first and second levels of integration in which there is minimal collaboration and basic collaboration at a distance respectively. Basic collaboration onsite and close collaboration onsite with some system integration form the third and fourth levels of integration, in which physical proximity is the key element. The fifth and sixth levels of integration include practice change, in which there is close collaboration with an integrated practice and full collaboration with a merged, integrated practice [50].

This research indicates that while the presence of shared risk factors among NCDs is acknowledged, medical practitioners often overlook the link between oral health and systemic health. Addressing this gap in healthcare practice involves providing basic oral health care training as an integral part of general health education.

In India, the checklist for early detection of NCDs, which is used in community based NCD surveillance, takes into consideration risk factors such as age of patient, smoking, alcohol consumption, measurement of waist, physical activities, and family history of NCDs [51]. These risk factors are similar to the risk factors for periodontal disease [13]. Thus, the risk factor surveillance may be extended to include periodontal disease as well. The primary healthcare teams can be trained in strategies to reduce or modify the risk factors associated with systemic diseases and oral diseases. The methods to assess the efficiency of the integrated practice in the primary health care setting include the calculation of the percentage of patients assessed using the surveillance tool, to the percentage of staff satisfied with the referral process [52]. Research conducted in Saudi Arabia showed that the availability of an appropriate source of oral health knowledge was significantly associated with increased odds of inter-disciplinary practice [53]. Regular patient reviews and examinations, along with the reinforcement of risk reduction strategies, can be achieved through the application of knowledge regarding shared risk factors, facilitating the efficient integration of medical and dental care.

This combined mixed-methods study has the limitation that the quantitative aspect was primarily conducted through online Google Forms, which were sent only to the medical and dental practitioners who are registered in the databases that were utilized in the study, and hence the representativeness of the sample may be compromised. However, given the study's design, which provides insights into the perspectives of healthcare professionals in various fields, the results offer a valuable reflection of the KAP regarding CRFA among medical and dental practitioners.

Conclusion

The questionnaire derived from the quantitative segment of this study stands as a straightforward and effective tool for evaluating KAP related to the CRFA concerning both oral and general health. In alignment with the ongoing global efforts to enhance oral health strategies, CRFA emerges as a promising approach for seamlessly integrating medical and dental care. The qualitative aspect of this study showed that to foster this integration, key recommendations include raising awareness about the interconnectedness of oral and systemic conditions, addressing constraints related to time and resources, and establishing robust referral systems between medical and dental practitioners. These measures collectively aim to establish a unified and integrated medical-dental care system.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-024-04772-y.

Supplementary Material 1

Supplementary Material 2

Data availability
The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.The mixed-method study received ethical approvals from the Institutional Review Board of Amrita Institute of Medical Sciences, Kochi, with the reference IRB-AIMS-2020-165, and the Kasturba Medical College and Kasturba Hospital Institutional Ethics Committee, under the reference IEC-664/2020 and informed consent was obtained from the participants.

Declarations

Ethics approval and consent to participate
The mixed-method study received ethical approvals from the Institutional Review Board of Amrita Institute of Medical Sciences, Kochi, with the reference IRB-AIMS-2020-165, and the Kasturba Medical College and Kasturba Hospital

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Institutional Ethics Committee, under the reference IEC-664/2020 and informed consent was obtained from the participants.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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