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Patient perceptions of healthy weight promotion in dental settings

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ABSTRACT

Introduction: Excess weight is a risk factor for systemic and oral diseases. Since dental professionals are already involved in imparting overall health messages when certain conditions impact oral health, it should make sense that they also deliver related health messages such as promoting the maintenance of healthy weight for patients. **Objectives:** This study evaluated the perceptions of adult patients attending private dental clinics on healthy weight promotion by dental professionals.

Methods: A cross-sectional multicenter survey was designed and set in four private dental clinics (London/Hampshire) between April and July 2015. All eligible patients (≥ 18 years) completed a questionnaire. Body Mass Index (BMI; kg/m^2) was calculated from height and weight measurements. Questionnaire content was centred on patient perceptions of 6 domains with the primary domain as to whether patients would accept healthy weight promotion by dental professionals.

Results: 213 adults (aged 20–85 years) participated in this study and 58.2% were females. Although the overwhelming majority endorsed healthy weight promotion by the dental team, the overweight/obese were significantly more sensitive (BMI screening χ^2 trend = 6.840, $p = 0.009$; healthy weight information χ^2 trend = 6.231, $p = 0.013$). Awareness of risk of periodontitis, carcinoma and overall adverse health outcomes associated with overweight or obesity was low.

Conclusion: The study cohort was well primed for healthy weight advice. Routine healthy weight promotion and BMI screening should be considered in the private dental clinic settings.

Clinical significance: This is an opportunity to collaborate with other health care professionals to support overall health monitoring/advice; a common risk factor strategy as recommended by the WHO. Future research is merited for this new initiative particularly perceptions of: dental teams' on healthy weight management, longitudinal interventions, NHS, children/parents and separate obese groups.

Introduction

Obesity has become an entrenched global epidemic very rapidly with rates continuing to soar [1–5]. In the UK alone, over half the adult population is either overweight (a BMI in excess of $24.9 \text{ kg}/\text{m}^2$) or obese (a BMI in excess of $30.0 \text{ kg}/\text{m}^2$) [6–8]. The World Health Organisation (WHO) has categorised obesity and oral diseases as non-communicable chronic diseases addressed through a common risk factor approach. Both obesity and oral diseases pose major public health concerns due to threats to an individual's overall health, quality of life and resultant spiralling healthcare expenditures [9–11].

International consensus advocates a comprehensive range of strategies to curtail excess weight gain (Fig. 1) [6,12]. The common risk factor approach endorsed by the WHO aims to target both general and

dental diseases simultaneously by tackling shared multiple (modifiable) unhealthy lifestyle risk determinants such as diet [9,13–15]. This strategy also highlights the dental professionals' role in healthy weight promotion.

It is well recognized that obesity has a substantial adverse impact on systemic health, which compromises both physical and psychological health [16–18]. Diabetes mellitus Type II (DMT2, pre-diabetes), cardiovascular disease such as stroke and myocardial infarction, hypertension, hyperlipidaemia, osteoarthritis, oesophageal, endometrial, and breast carcinomas, lung, liver or gallbladder dysfunction are a few diseases potentially influenced by obesity. It is also known that obesity, unhealthy diet and insalubrious lifestyle are associated with increased risks to oral diseases. For example, a statistically significant small to moderate magnitude correlation exists with chronic periodontitis

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Policy	Key recommendations
WHO global strategy World Health Assembly (2004).	Individual responsibility: <ul style="list-style-type: none"> • Limit fat/sugars/salt in diets. • Increase fruits/vegetables. • Nutritious choices. • Exercise. Communal/environmental support: <ul style="list-style-type: none"> • Political commitment. • Global/regional/local stakeholder collaborations. • Responsible marketing. • Affordable/available healthier choices.
WHO global action plan for NCDs (2013 - 2020).	25% mortality reductions. 2025 obesity levels to equal 2010.
United Nation General Assembly (2011).	Implement WHO guidelines.

Fig. 1. Global Policies/Guidelines to Reduce Overweight/Obesity.

(affecting disease prevalence, severity and extent) [19–23], adverse periodontal therapy outcome [24], extrinsic erosion [25] as well as xerostomia/delayed salivary habituation [26,27]. Furthermore, epidemiological studies focused on the middle aged to elderly support an inverse obesity/BMI/tooth loss relationship [27–29]. Crucially, tooth loss compromises mastication, perceived chewing ability and in turn healthy dietary choices [30–33]. The relationship with dental caries however, remains inconclusive and complex [34,35]. Obesity also complicates prosthodontic management due to limitations in physiology, clinical protocol and equipment [19,36]. Moreover, oral diseases are capable of undermining an individual's quality of life, well-being and self-esteem [9,10].

BMI (Kg/m^2) is an epidemiological tool that estimates disease related adiposity levels [4,8]. Although reliability in determining health recommendations at an individual level has been questioned, based upon epidemiological data, BMI classification remains valuable for health care professionals when discussing health aspects with potentially high risk individuals [8,19].

Excess sugary drinks intake increases the rate of dental caries as per *Moyñihan and Kelly's 2014* systematic review [37]. Carbonated beverages and fruit juice acidity also facilitate extrinsic erosion of teeth [38–44]. Equally, a large body of recent research substantiates weight gain/obesity with increased intake of sugary drinks [16,17,45–53]. Even consuming low levels of sugar sweetened beverages could result in long term weight gain [18,47].

It has been proposed that dental professionals should be proactive in increasing public awareness through not only discussing the correlations amongst obesity, oral diseases and sugary drinks with their patients but also the resultant adverse effects to overall health outcomes. Discussions on healthy beverages, highlighting their role in both dental diseases and weight management, might present dental teams with an appropriate platform to project healthy weight messages. These messages could be very helpful in raising patient awareness of the association between adverse oral health and being overweight or obese.

Dental professionals have been effectively imparting overall health messages with regard to the effect of smoking on oral health risks. Preliminary smoking research in the 1990s identified an active role for dental professionals in educating patients on the health risks of tobacco use and successful protocols were implemented subsequently. Currently, dental professionals routinely impart messages of the adverse effect smoking has on oral and general health or incorporate very brief advice (VBA) when time pressured to facilitate patient referral to specialist centres [54–57]. Research have also depicted the benefits of

diabetes screening demonstrated amongst over 45 year olds and the over 30 year olds, incidences of 40.1%–30% (HbA1c measurements $\geq 5.7\%$), respectively of early diagnosis (prediabetes state) [58,59].

Likewise, recent research cites dental settings as being well suited to address healthy weight management [60,61]; since routine visits to appropriately trained dental professionals could facilitate meaningful and efficient health monitoring or counselling by using height and weight measurements. This would thereby allow effective discussions on common dietary considerations (such as calorie, sugar and acid intake), oral disease prevention and healthy weight recommendations. The combination of these messages have the potential to result in overall health benefits.

Realistically, making an impact and changing behaviour can be challenging. To put it in context, successful interventions will also require consideration of wider behavioural and socioeconomic factors modifying oral health, such as existing oral health knowledge/habits, dental anxiety and access to care [62]. However, using a contemporary behavioural change framework (Motivational Interviewing) emphasising a collaborative dentist/patient approach based on rapport build up have succeeded in promoting BMI screening acceptance and healthy dietary choices among paediatric populations [60,61]. Despite the above, a knowledge gap still exists on adult patients' views on the role of dental professionals in this area, which this study sets out to investigate.

This study evaluated patients' perceptions of healthy weight promotion by dental professionals and preliminary information pertaining to beverage habits. It also investigated adult patients' comfort levels when provided healthy weight advice by dental professionals in private dental clinics.

Materials and methods

A cross sectional questionnaire survey was used for data collection. It was administered to adult patients attending four private dental clinics (three in London and one in Hampshire, UK) between April and June 2015. The questionnaire included 27 questions based upon validated surveys or published research. It was **first** piloted amongst dental professionals ($n = 10$) similar to those who would administer it to their patients to obtain feedback on suitability for a private practice setting as well as to confirm questions were understandable from an individual perspective as if they were a patient. The study was approved by the University College London Ethics Committee prior to commencement. Informed written consent was obtained from all participants prior to

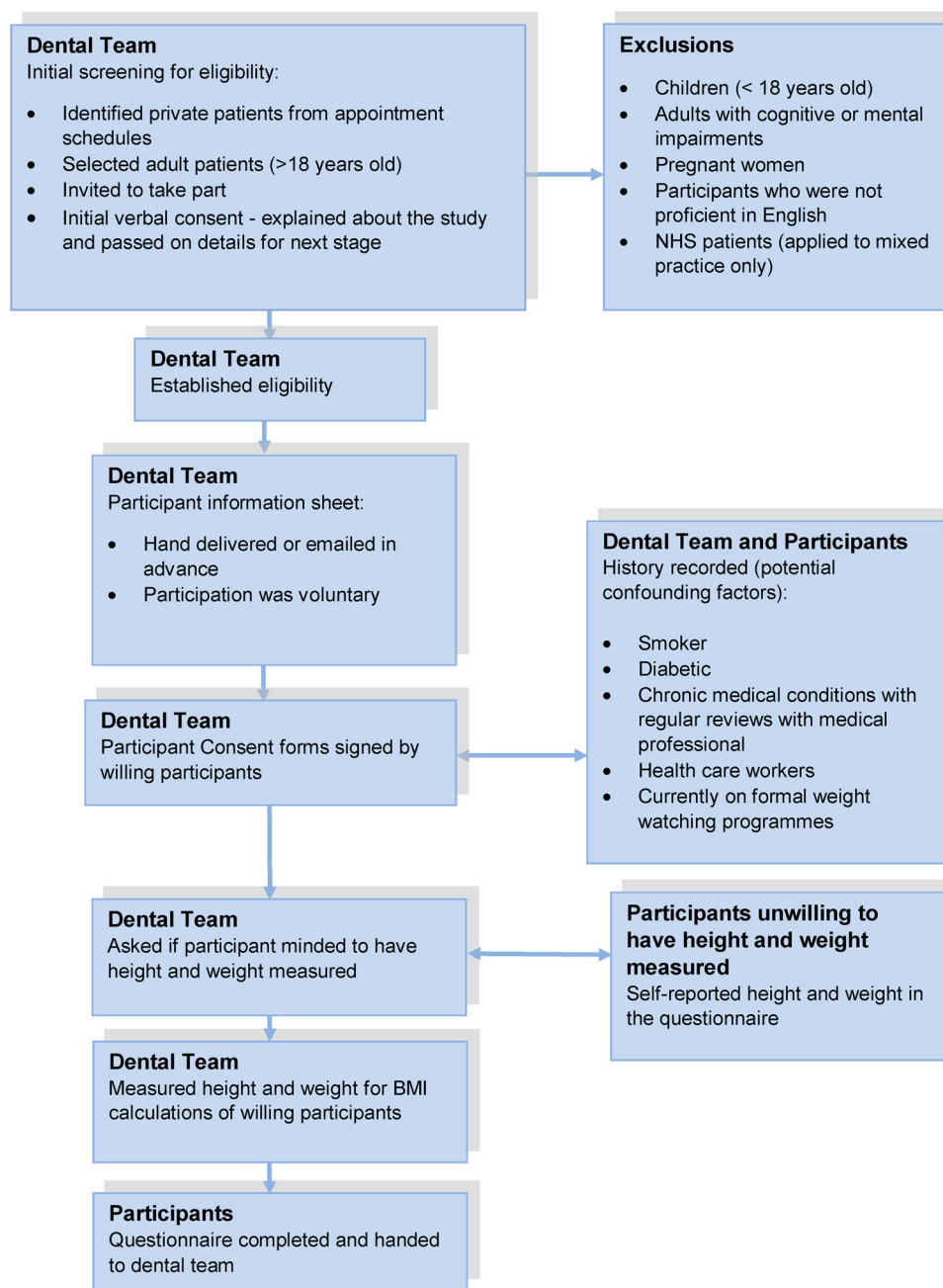


Fig. 2. Study Flow Diagram.

their participation in this study.

As demonstrated in the flow diagram (Fig. 2) dental professionals (receptionists/nurses/dentists) were trained on participant enrolment, questionnaire administration, and height/weight measures. All eligible participants were approached. In order to minimise study selection bias, the study included and reported on patients who were diabetics, smokers, health care workers, those attending regular chronic medical reviews or formal weight watching programmes.

Based on previously published material, we anticipated that 50% of participants would find advice from the dental team acceptable. In order to estimate the proportion with 95% Confidence Interval (CI) $\pm 7.5\%$, a minimum of 171 participants was calculated to be necessary [47,63,64]. The extent to which patients would endorse healthy weight advice by dental teams was evaluated against the corresponding a) body weight profile, b) lifestyle factors, c) personal BMI, d) general and oral health risk awareness related to being overweight or obese.

The cohort of anonymous mixed qualitative and quantitative data was collected and analysed. Data entry was achieved utilising Excel followed by SPSS 21. A range of descriptive statistics were used to help analyse and interpret the data.

Results

The participants included 213 individuals with an age range of 20–85 years; 58.2% were females, and 66.6% were Caucasian. The majority were nonsmokers with low health needs; for example, 16.0% self-reported diabetes status, 15.0% had more than three fillings, and 28.6% reported an unhealthy periodontal status over the previous 3 years. Most participants perceived high overall oral health values, with 83.5% who reported visiting the dentist at least once a year, 37.8% reporting low dental anxiety, and 14.1% being health workers.

Of the study sample, 40.8% were overweight or obese in accordance

Table 1
Study Sample Characteristics.

Variable (Categorical)	Overall n = 213 n (%)	Underweight/Healthy weight n = 126 (59.2 %) n (%)	Overweight/Obese n = 87 (40.8 %) n (%)	BMI Groups Test Score (P - Value) * χ^2 Test ** χ^2 trend + Exact Test
Male	89 (41.8)	47 (37.3)	42 (48.3)	*2.54 (0.11)
Caucasian	141 (66.2)	79 (62.7)	62 (71.3)	*1.67 (0.19)
Smoker	18 (8.5)	11 (8.7)	7 (8.0)	*0.36 (0.86)
Diabetes	13 (6.1)	4 (3.2)	9 (10.3)	*4.62 (0.03)
Chronic care:	22 (10.3)	11 (8.7)	11 (12.6)	*0.85 (0.36)
Health job:	30 (14.1)	18 (14.3)	12 (13.8)	*0.01 (0.92)
Weight-watching programme	7 (3.3)	3 (2.4)	4 (4.6)	*0.890 (0.37)
Self - reported:				
Dental attendance:				
6 monthly	120 (56.3)	69 (54.8)	51 (58.6)	**0.28 (0.60)
Yearly	58 (27.2)	39 (31.0)	19 (21.8)	
Occasional	15 (7)	9 (7.1)	6 (6.9)	
Only when problems	18 (8.5)	8 (6.3)	10 (11.5)	
Don't know	2 (0.9)	1 (8.0)	1 (1.1)	
Fillings (3 year history):				
> 3	32 (15)	16 (12.7)	16 (18.4)	+ 1.38 (0.72) FET
< 3	91 (42.7)	55 (43.7)	36 (41.4)	
None	82 (38.5)	50 (39.7)	32 (36.8)	
Gum disease	61 (28.6)	35 (27.8)	26 (29.9)	*0.11 (0.74)
BMI: Known	26 (12.2)	14 (11.1)	12 (13.5)	*0.35 (0.56)
Variable (Continuous)	Overall Mean (SD), Median	Underweight/ Healthy weight Mean (SD), Median	Overweight / Obese Mean (SD), Median	Test Score (P - Value) *ANOVA + Mann -Whitney
Age (years)	46.82 (15.85), 47.00	45.28 (15.81), 44.50	49.05 (15.74), 49.00	*2.934 (0.088)
BMI continuous value (Kg/m ²)	24.61(3.81), 24.26	22.13 (2.14), 22.49	28.20 (2.66), 27.24	*338.84 (0.000)
Dental anxiety level (%)	37.83 (33.43) 30.00	35.51 (33.58), 24.50	41.20 (33.12), 42.00	+ 4870.00(0.166)
Perceived overall health (%)	93.14 (9.86), 98.00	93.82 (9.39), 98.00	92.16 (10.48), 96.00	+ 5048.00(0.310)
Perceived oral health (%)	92.51(11.82), 98.00	93.54 (10.12), 50.00	91.01 (13.85), 50.00	+ 4787.00 (0.101)

with WHO statistics, BMI and dental anxiety values were normally distributed. Perceived oral and overall health values were skewed with very few reporting low perceived oral and overall health importance. Participants who were overweight or obese self-reported significantly greater BMI as well as being diabetic, and received more care for chronic medical conditions (Table 1).

Perceptions of dental professional's role in weight management

An overwhelming majority of participants endorsed receiving healthy weight information during a dental visit (63.2%–75.4%). They were very comfortable with BMI screening (57.5%–74.2%) and accepted such involvements from all healthcare professionals (64.4%–73%). However, although receptive, overweight/obese participants were significantly more sensitive to the same ideas (BMI screening χ^2 trend = 6.840, $p = 0.009$; healthy weight information χ^2 trend = 6.231; $p = 0.013$). For participants contemplating weight changes, they welcomed screening significantly (χ^2 trend = 6.231; $p = 0.013$) and readily approved receiving healthy weight information (70.8%; $n = 97$), and by dental professionals (73%; $n = 100$) (Table 2, Fig. 3).

Perceptions of health risk awareness

Only a minority of participants identified risks to periodontal disease (49.8%), carcinoma (66.2%) and the risks to both of the above to oral and general health (41.8%). Overweight or obese participants recognized these risk factors slightly more, with carcinoma ($\chi^2 = 3.566$; $p = 0.059$) and hypertension ($\chi^2 = 3.382$; $p = 0.066$) showing statistical significance (Table 3, Fig. 4).

Perceptions of body weight status

The overall majority of participants believed that they were currently at “the right weight” although they still contemplated weight loss. Most participants recognized either “upbringing and lifestyle” or “genetics and upbringing” as important contributory factors to being overweight. However, their knowledge on their individual BMI values was limited. Amongst the overweight or obese participants, 1 in 3 were in denial of their true (clinical) BMI. Weight loss attempts amongst these overweight or obese subjects were significant ($\chi^2 = 26.52$; $p = 0.000$). Self-weight profile associations were compelling ($p < 0.000$). Females were significantly more weight conscious (current weight loss attempts $\chi^2 = 5.132$, $p = 0.023$; past attempts $\chi^2 = 4.003$, $p = 0.043$) (Table 4).

Discussion

As far as the authors are aware, this study is the first in the literature investigating perceptions of adult patients on healthy weight promotion in dental settings in the UK.

An overwhelming majority of the participants endorsed the concept of healthy weight promotion by dental professionals. This is in agreement with preliminary BMI interventions among pediatric settings that supports healthy weight promotion in dental offices [60]. Overweight or obese participants in this study who were more sensitive to receiving these healthcare messages and advice, will require a knowledgeable, trained and considerate dental team approach for such advice to be most receptive by them. Some participants however, were unaware of potential benefits to personal weight management perhaps since BMI screening is a more recent initiative.

The limited self-awareness of BMI in this cohort of participants

Table 2
Perceptions of the Dentists' Role in Dispensing Health Messages by Group.

Summary Outcomes	Overall n (%)	Male n (%)	Female n (%)	Under/Healthy weight n (%)	Overweight/Obese n (%)	Status of Change n (%)
1. Diet/OH advice history:						
Yes	113 (53.1)	46 (51.7)	67 (54.0)	68 (54.0)	45 (51.7)	72 (52.6)
Can't remember	23 (10.8)	8 (9.0)	15 (12.1)	15 (11.9)	8 (9.2)	13 (9.5)
No	77 (36.2)	35 (39.3)	42 (33.9)	43 (34.1)	34 (39.1)	53 (38.0)
Test Score (P - Value)			0.37 (0.580)		0.31 (0.63)	0.23 (0.63)
χ ² Trend						
2. Weight information:						
Don't know	12 (5.6)	5 (5.6)	7 (5.6)	8 (6.3)	4 (4.6)	7 (5.1)
Not mind the least	150 (70.4)	64 (71.9)	86 (69.4)	95 (75.4)	55 (63.2)	97 (70.8)
Slight uneasy	27 (12.7)	12 (13.5)	15 (12.1)	14 (11.1)	13 (14.9)	19 (13.9)
Prefer if not offered	24 (11.3)	8 (9.0)	16 (12.9)	9 (7.1)	15 (17.2)	14 (10.2)
Test Score (P - Value)			0.39 (0.53)		6.23 (0.01)	0.01 (0.92)
χ ² Trend					Trend	Trend
3. Body mass assessment :						
Very comfortable	140 (65.7)	66 (74.2)	74 (59.7)	90 (71.4)	50 (57.5)	83 (60.6)
Don't know	12 (5.6)	0 (0.0)	12 (9.7)	7 (5.6)	5 (5.7)	7 (5.1)
Slight discomfort	50 (23.5)	21 (23.6)	29 (23.4)	27 (21.4)	23 (26.4)	38 (27.7)
Very uncomfortable	11 (5.2)	2 (2.2)	9 (7.3)	2 (1.6)	9 (10.3)	9 (6.6)
Test Score (P - Value)			3.05 (0.08)		6.84 (0.01)	5.72 (0.02)
χ ² Trend					Trend	Trend
4. BMI screening impact:						
Strongly agree	43 (20.2)	15 (16.9)	28 (22.6)	25 (19.8)	18 (20.7)	29 (21.2)
Agree	72 (33.8)	29 (32.6)	43 (34.7)	45 (35.7)	27 (31.1)	48 (35.0)
Neither	73 (34.3)	36 (40.4)	37 (29.8)	43 (34.1)	30 (34.5)	45 (32.8)
Disagree	21 (9.9)	8 (9.0)	13 (10.5)	11 (8.7)	10 (11.5)	13 (9.5)
Strongly disagree	4 (1.9)	1 (1.1)	3 (2.4)	2 (1.6)	2 (2.3)	2 (1.5)
Test Score (P - Value)			0.49 (0.49)		0.28 (0.60)	0.78 (0.38)
χ ² Trend						
5. All health professionals advice:						
Strongly agree	69 (32.4)	29 (32.6)	40 (32.3)	41 (32.5)	28 (32.2)	49 (35.8)
Agree	79 (37.1)	32 (36.0)	47 (37.9)	51 (40.5)	28 (32.2)	51 (37.2)
Neither/don't know	46 (21.5)	21 (23.5)	25 (20.1)	25 (19.9)	21 (24.1)	23 (16.8)
Disagree	17 (8.0)	0 (0.0)	2 (1.6)	1 (0.8)	1 (1.1)	12 (8.8)
Strongly disagree	2 (0.9)	7 (7.9)	10 (8.1)	8 (6.3)	9 (10.3)	2 (1.5)
Test Score (P - Value)			0.00 (0.96)		1.21 (0.27)	0.69 (0.41)
χ ² Trend						

conflicted however, with a long-term epidemiological survey that identified greater BMI awareness. In the same survey, Johnson and co-workers identified three quarters of the population to have “heard of” BMI, although substantial self under estimation existed between the true BMI measured clinically, and the perceived normalised BMI for the very overweight or obese participants, and is in line with other studies [65]. The majority of participants’ awareness of overweight related health risks of periodontitis, carcinoma and overall diseases, was low. This highlights the importance of the provision of additional public health education to improve patients’ understanding of oral and general health risks in respect of BMI thresholds.

A majority of the participating cohort also displayed generally high awareness of personal body weight profiles, contemplated changing current weight status and appreciated lifestyle factors contributing to weight gain. These findings indicate the presence of the right attitude necessary to affect positive healthy lifestyle changes. Contrastingly, other research reported low lifestyle factor recognition particularly with carcinoma [66]. Other leading diseases such as cardiovascular disease and diabetes, have benefited from wide media exposure and similar media scrutiny geared towards overweight or obese individuals. This will also benefit the wider public by elevating their awareness of the consequences of unhealthy diet or lifestyle.

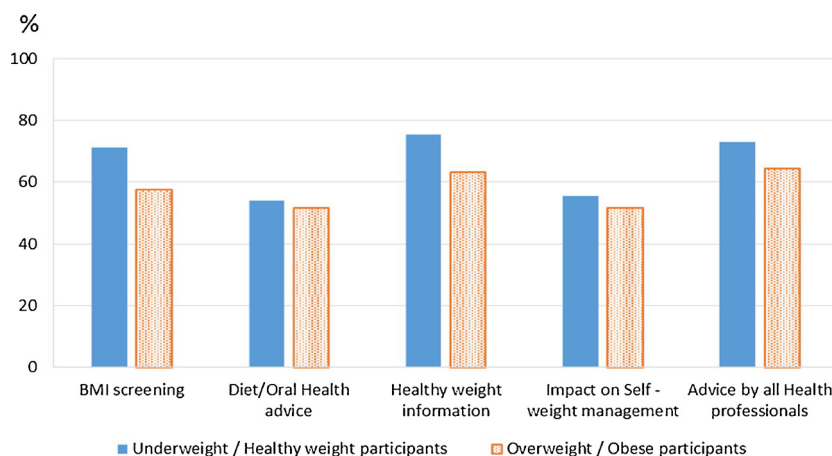


Fig. 3. Under/Healthy Weight vs. Overweight/Obese Positive Perceptions of Dentists' Role in Dispensing Health Messages.

Table 3
Perceptions of Overweight/Obese Related Health Risks.

Risks	Overall Yes n (%)	Under/Healthy Weight Yes n (%)	Overweight/Obese Yes n (%)	BMI Groups Test Score (P - Value) * χ^2 Test + Exact Test
Diabetes	198 (93.95)	116 (92.1)	82 (94.3)	*0.377 (0.60)
Hypertension	194 (91.08)	111 (88.1)	83 (95.4)	*3.382 (0.07)
Cardiovascular	190 (89.20)	110 (87.3)	80 (92.0)	*1.157 (0.28)
Periodontitis	106 (49.77)	60 (47.6)	46 (52.9)	*0.582 (0.45)
Carcinoma	141 (66.20)	77 (61.1)	64 (73.6)	*3.566 (0.06)
All	89 (41.78)	49 (38.9)	40 (46.0)	*1.063 (0.30)
Don't know	7 (3.3)	3 (2.4)	4 (4.6)	+ FET (0.45)

In addition, this study cohort portrayed healthy patient – dental team rapport since the majority of them displayed high perceived importance of overall and oral health values, a history of dental dietary advice, frequent attendance and low dental anxiety. Congruent dental team and patient relations are beneficial when sensitive topics such as body weight are presented. Any expansion of overlapping dietary preventative roles between oral health and excess weight (for example sugars, acids, healthy alternatives), can facilitate patient understanding and positively influence healthy lifestyle choices. Sugar sweetened beverage discussions is another potential avenue to harness when attempting to engage patients and make them realise the relevance of an active dental professional role, although it is beyond the scope of this study.

The concept of dental screening of medical conditions is not novel, and has been shown to be effective in smoking counselling, oral carcinoma, cardiovascular disease and dysglycaemia screenings to name but a few. Prior to rolling out screening programmes in dental clinics, smokers were similarly significantly unaware of the oral health effects of passive smoking, resisting behaviour change versus status-of-change individuals [55]. A recent impetus for diabetes screening has identified patients with high-risk of moderate to severe periodontitis [58,67]. Integration with health care professionals can optimise overall disease prevention, accelerate diagnosis and limit pathogenesis [59]. Interdisciplinary collaborations also enhance a consistent team approach that benefits long-term behavioural or lifestyle changes that are necessary for healthy weight management to succeed. However, in one study dental professionals perceived significant discomfort in measuring BMI [68]. Other barriers such as current knowledge, training, client resistance and time, are also relevant factors to be considered when introducing healthy weight promotion in a dental environment [69]. As with the development of tobacco use cessation advice suitable for various dental settings, the cost-effectiveness of different approaches pertaining to advice on other lifestyle factors including

healthy weight management is merited as interventions are developed and efficacy has been demonstrated.

Limitations to this study might be that the results do not fully reflect the public since the overweight or obese population in the study cohort was lower than the national average of 61%. Participants also attended private clinics which only constitutes 27% of the general population [6,10]. Sample dental visits were also more regular when compared with available public figures (83.5% bi-annual or annual attendance versus 71% among the population) [35]. It is clear that regular dental visits created opportunities to build up patient rapport as well as to monitor or to give advice on BMI status. The health values among the study cohort were greater than the general population (81% general health and 70% oral health) and dental anxiety relatively low. Similarly, sample population levels of extreme anxiety were low (10%). Overweight or obese individuals however, were anxious and frequented less. Literature also connects obesity with dental anxiety and avoidance but together with low perceived general health values [27,29].

Furthermore, this study did not consider the perceptions of obese participants as a single entity. The participant mean BMI was overweight rather than obese and overweight and obese results were combined into a single category during data analysis. The sixteen participants who declined BMI screening and instead chose to self-report BMI, might have affected study results. Considering the substantially greater health needs of the population, greater obesity incidence, lower body weight profiles/lifestyle factor awareness and slightly lower health values, might render the public less health conscious and more resistant when being approached by dental practitioners [10,70,71]. Future research is indicated to understand these aspects. Interpretation of the study results might have been impacted by the cross-sectional design, potential response bias with more favourable responses to please participant dental teams and self-reporting of medical and dental histories. This study did not consider perception changes that might occur over time and the duration of the patient - dentist relationship.

Conclusions

Patients with low health needs, high health values, regular dental visits, healthy dental team rapport and appreciation of lifestyle contributors, were most receptive to healthy weight advice. Irrespective of their current health needs, being aware of and receptive to evidence based health advice would be beneficial to the general health and the continuing well-being of the individuals. However, even amongst the above cohort, general awareness of oral and overall disease risks related to excess weight (defined by BMI thresholds), was lacking. There is room for improvement in this aspect of public health delivery. Healthy weight messages have been shown to be practicable in private dental settings and dental professionals should consider becoming actively involved in routine healthy weight promotion, including BMI screening

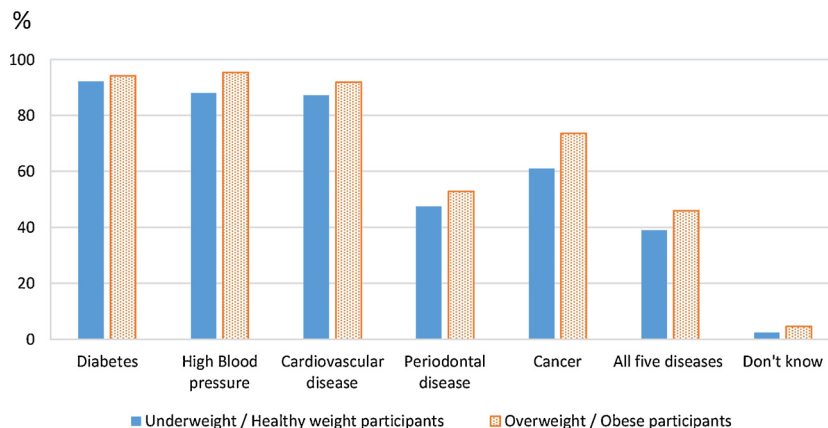


Fig. 4. Comparative Awareness of Diseases Associated with Excess Weight.

Table 4
Self Perceptions of Weight.

Summary Outcomes	Overall n (%)	Under/ Healthy weight n (%)	Overweight /Obese n (%)	BMI Groups Test Score (P-Value) * χ^2 Test ** χ^2 Trend	Male n (%)	Female n (%)
1. Considering height/weight height/weight you are:						
Don't know	4(1.9)	2 (1.6)	2 (2.3)	**41.77	1 (1.1)	3 (2.4)
Too light	15 (7.0)	14 (11.1)	1 (1.1)	(0.000)	8 (9.0)	7 (5.6)
About right weight	119 (55.9)	92 (73.0)	27 (31.0)	Trend	53 (59.6)	66 (53.2)
Too heavy	75 (35.2)	14 (11.1)	57 (65.5)		27 (30.3)	48 (38.7)
2. Current attempts:						
Don't know	5 (2.3)	4 (3.2)	1 (1.1)	**21.67	2 (2.2)	3 (2.4)
Lose weight	110 (51.6)	46 (36.5)	64 (73.6)	(0.000)	39 (43.8)	71 (57.3)
Not change	89(41.8)	67 (53.2)	22 (25.3)	Trend	43 (48.3)	46 (37.1)
Gain weight	9 (4.2)	9 (7.1)	0 (0.0)		5 (5.6)	4 (3.2)
3. Self – weight description:						
Don't know	1 (0.5)	0 (0.0)	1 (1.1)	**20.85	1 (1.1)	0 (0.0)
Attempting to lose	91 (42.7)	37 (29.4)	59 (62.1)	(0.000)	29 (32.6)	62 (50.0)
Not affected	23 (10.8)	17 (13.5)	6 (6.9)	Trend	10 (11.2)	13 (10.5)
Maintaining	86 (40.4)	63 (50.0)	23 (26.4)		43 (48.3)	43 (34.7)
None of these	12 (5.6)	9 (7.1)	3 (3.4)		6 (6.7)	6 (4.8)
4. Past weight loss attempts:						
No	86 (40.4)	69 (54.8)	17 (19.5)	*26.52	43 (48.3)	43 (43.7)
Yes	127(59.6)	57 (45.2)	70 (80.5)	(0.000)	46 (51.7)	81 (65.3)
				Significant		
5. Overweight contributors:						
Don't know	11 (5.2)	7 (5.6)	4 (4.6)	**0.02	5 (5.6)	6 (4.8)
All genetic	0 (0.0)	0 (0.0)	0 (0.0)	(0.90)	0 (0.0)	0 (0.0)
Mostly genetic	6 (2.8)	3 (2.4)	3 (3.4)		1 (1.1)	5 (4.0)
Equal Genes/upbringing	85 (39.9)	46 (36.5)	39 (44.8)		33 (37.1)	52 (41.9)
Most upbringing/lifestyle	97 (45.5)	64 (50.8)	33 (37.9)		41 (46.1)	56 (45.2)
All upbringing/lifestyle	14 (6.6)	6 (4.8)	8 (9.2)		9 (10.1)	5 (4.0)
Pure chance	0 (0.0)	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)

to maximize the benefits to the population at large.

Dental settings present an excellent opportunity for dental professional to collaborate with other health care professionals and act as part of a global health initiative - to better support overall health monitoring and advice; a common risk factor strategy endorsed by the WHO, to extract maximum overall health benefits to the population at large.

Conflicts of interest

There was no conflict of interest at any stage during the study associated with any of the authors.

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References

- [1] W.O. Federation, Number of Overweight and Obese Individuals in Selected European Countries, (2014).
- [2] OECD, Overweight and Obesity Europe 2012, (2012).
- [3] W.H. Organisation, WHO Obesity Maps, (2014).
- [4] W.H. Organisation, WHO Global Observatory Data; Obesity Situation and Trends, (2015).
- [5] Y.C. Wang, K. McPherson, T. Marsh, S.L. Gortmaker, M. Brown, Health and economic burden of the projected obesity trends in the USA and the UK, *Lancet* 378 (9793) (2011) 815–825.
- [6] D.o. Health, Healthy Lives Healthy People, (2011).
- [7] H.o. Commons, Research Briefings Parliament, (2011).
- [8] NICE, Obesity Overview NICE Pathways, (2015).
- [9] A. Sheiham, Oral health, general health and quality of life, *Bull. World Health Organ.* 83 (9) (2005) 644.
- [10] D.o. Health, Adult Dental Health Survey, (2011).
- [11] G.O.f. Science, Tackling Obesities Future Choices, (2007).
- [12] W.H. Organisation, Obesity Fact Sheet, (2015).
- [13] P.E. Petersen, D. Bourgeois, H. Ogawa, S. Estupinan-Day, C. Ndiaye, The global burden of oral diseases and risks to oral health, *Bull. World Health Organ.* 83 (9) (2005) 661–669.
- [14] W.H. Organisation, Oral Health Fact Sheet, (2012).
- [15] P.E. Petersen, World Health Organization global policy for improvement of oral health—World Health Assembly 2007, *Int. Dent. J.* 58 (3) (2008) 115–121.
- [16] F.B. Hu, V.S. Malik, Sugar-sweetened beverages and risk of obesity and type 2 diabetes: epidemiologic evidence, *Physiol. Behav.* 100 (1) (2010) 47–54.
- [17] V.S. Malik, B.M. Popkin, G.A. Bray, J.P. Despres, F.B. Hu, Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk, *Circulation* 121 (11) (2010) 1356–1364.
- [18] V.S. Malik, M.B. Schulze, F.B. Hu, Intake of sugar-sweetened beverages and weight gain: a systematic review, *Am. J. Clin. Nutr.* 84 (2) (2006) 274–288.
- [19] R. Levine, Obesity and oral disease—a challenge for dentistry, *Br. Dent. J.* 213 (9) (2012) 453–456.
- [20] J. Suvan, F. D'Aiuto, D.R. Moles, A. Petrie, N. Donos, Association between overweight/obesity and periodontitis in adults. A systematic review, *Obes. Rev* 12 (5) (2011) e381–e404.
- [21] B.W. Chaffee, S.J. Weston, Association between chronic periodontal disease and obesity: a systematic review and meta-analysis, *J. Periodontol.* 81 (12) (2010) 1708–1724.
- [22] Y.S. Khader, H.A. Bawadi, T.F. Haroun, M. Alomari, R.F. Tayyem, The association between periodontal disease and obesity among adults in Jordan, *J. Clin. Periodontol.* 36 (1) (2009) 18–24.
- [23] L. Nibali, N. Tatarakis, I. Needleman, Y.K. Tu, F. D'Aiuto, M. Rizzo, N. Donos, Clinical review: association between metabolic syndrome and periodontitis: a systematic review and meta-analysis, *J. Clin. Endocrinol. Metab.* 98 (3) (2013) 913–920.
- [24] J. Suvan, A. Petrie, D.R. Moles, L. Nibali, K. Patel, U. Darbar, N. Donos, M. Tonetti, F. D'Aiuto, Body mass index as a predictive factor of periodontal therapy outcomes, *J. Dent. Res.* 93 (1) (2014) 49–54.
- [25] H.J. Tong, M.C. Rudolf, T. Muyombwe, M.S. Duggal, R. Balmer, An investigation into the dental health of children with obesity: an analysis of dental erosion and caries status, *Eur. Arch. Paediatr. Dent.* 15 (3) (2014) 203–210.
- [26] D.S. Bond, H.A. Raynor, S. Vithianathan, H.C. Sax, D. Pohl, G.D. Roye, B.A. Ryder,

- R.R. Wing, Differences in salivary habituation to a taste stimulus in bariatric surgery candidates and normal-weight controls, *Obes. Surg.* 19 (7) (2009) 873–878.
- [27] A.L. Ostberg, C. Bengtsson, L. Lissner, M. Hakeberg, Oral health and obesity indicators, *BMC Oral Health* 12 (2012) 50.
- [28] T. Osterberg, D.K. Dey, V. Sundh, G.E. Carlsson, J.O. Jansson, D. Mellstrom, Edentulism associated with obesity: a study of four national surveys of 16 416 Swedes aged 55–84 years, *Acta Odontol. Scand.* 68 (6) (2010) 360–367.
- [29] H.B. Forslund, A.K. Lindroos, K. Blomkvist, M. Hakeberg, U. Berggren, M. Jontell, J.S. Torgerson, Number of teeth, body mass index, and dental anxiety in middle-aged Swedish women, *Acta Odontol. Scand.* 60 (6) (2002) 346–352.
- [30] A. Sheiham, J.G. Steele, W. Marcenes, S. Finch, A.W. Walls, The relationship between oral health status and body mass index among older people: a national survey of older people in Great Britain, *Br. Dent. J.* 192 (12) (2002) 703–706.
- [31] R.B. Ervin, B.A. Dye, The effect of functional dentition on healthy eating index scores and nutrient intakes in a nationally representative sample of older adults, *J. Public Health Dent.* 69 (4) (2009) 207–216.
- [32] R.E. Nowjack-Raymer, A. Sheiham, Numbers of natural teeth, diet, and nutritional status in US adults, *J. Dent. Res.* 86 (12) (2007) 1171–1175.
- [33] G. Tsakos, K. Herrick, A. Sheiham, R.G. Watt, Edentulism and fruit and vegetable intake in low-income adults, *J. Dent. Res.* 89 (5) (2010) 462–467.
- [34] M. Hooley, H. Skouteris, C. Bogani, J. Satur, N. Kilpatrick, Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011, *Syst. Rev.* 1 (2012) 57.
- [35] K.R. Kantovitz, F.M. Pascon, R.M. Rontani, M.B. Gaviao, Obesity and dental caries—a systematic review, *Oral Health Prev. Dent.* 4 (2) (2006) 137–144.
- [36] J.C. Yuan, F.S. Afshari, D.J. Lee, C. Sukotjo, The impact of obesity on prosthodontic treatment, *Gen. Dent.* 60 (6) (2012) 526–533.
- [37] P.J. Moynihan, S.A. Kelly, Effect on caries of restricting sugars intake: systematic review to inform WHO guidelines, *J. Dent. Res.* 93 (1) (2014) 8–18.
- [38] D.W. Bartlett, P. Shah, A critical review of non-carious cervical (wear) lesions and the role of abfraction, erosion, and abrasion, *J. Dent. Res.* 85 (4) (2006) 306–312.
- [39] J.D. Eccles, Tooth surface loss from abrasion, attrition and erosion, *Dent. Update* 9 (7) (1982) 373–378 380.
- [40] J.O. Grippo, M. Simring, T.A. Coleman, Abfraction, abrasion, biocorrosion, and the enigma of noncarious cervical lesions: a 20-year perspective, *J. Esthet. Restor. Dent.* 24 (1) (2012) 10–23.
- [41] A.K. Johansson, P. Lingstrom, T. Imfeld, D. Birkhed, Influence of drinking method on tooth-surface pH in relation to dental erosion, *Eur. J. Oral Sci.* 112 (6) (2004) 484–489.
- [42] M. Kelleher, K. Bishop, Tooth surface loss: an overview, *Br. Dent. J.* 186 (2) (1999) 61–66.
- [43] S.B. Mehta, S. Banerji, B.J. Millar, J.M. Suarez-Feito, Current concepts on the management of tooth wear: part 1. Assessment, treatment planning and strategies for the prevention and the passive management of tooth wear, *Br. Dent. J.* 212 (1) (2012) 17–27.
- [44] J.S. Rees, The role of drinks in tooth surface loss, *Dent. Update* 31 (6) (2004) 318–324 326.
- [45] A.S. Anderson, Sugars and health—risk assessment to risk management, *Public Health Nutr.* 17 (10) (2014) 2148–2150.
- [46] G.A. Bray, S.J. Nielsen, B.M. Popkin, Consumption of high-fructose corn syrup in beverages may play a role in the epidemic of obesity, *Am. J. Clin. Nutr.* 79 (4) (2004) 537–543.
- [47] V.S. Malik, A. Pan, W.C. Willett, F.B. Hu, Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis, *Am. J. Clin. Nutr.* 98 (4) (2013) 1084–1102.
- [48] M.L. Te, S. Mallard, J. Mann, Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies, *BMJ* 346 (2012) e7492.
- [49] A. Avery, L. Bostock, F. McCullough, A systematic review investigating interventions that can help reduce consumption of sugar-sweetened beverages in children leading to changes in body fatness, *J. Hum. Nutr. Diet.* 28 (Suppl 1) (2015) 52–64.
- [50] I. Darton-Hill, Reducing Consumption of Sugar Sweetened Beverages to Reduce Risk of Unhealthy Weight Gain Commentary, (2014).
- [51] J.C. de Ruyter, M.R. Olthof, J.C. Seidell, M.B. Katan, A trial of sugar-free or sugar-sweetened beverages and body weight in children, *N. Engl. J. Med.* 367 (15) (2012) 1397–1406.
- [52] C.B. Ebbeling, H.A. Feldman, V.R. Chomitz, T.A. Antonelli, S.L. Gortmaker, S.K. Osganian, D.S. Ludwig, A randomized trial of sugar-sweetened beverages and adolescent body weight, *N. Engl. J. Med.* 367 (15) (2012) 1407–1416.
- [53] J. James, P. Thomas, D. Kerr, Preventing childhood obesity: two year follow-up results from the Christchurch obesity prevention programme in schools (CHOPPS), *BMJ* 335 (7623) (2007) 762.
- [54] R.G. Watt, N.W. Johnson, K.A. Warnakulasuriya, Action on smoking—opportunities for the dental team, *Br. Dent. J.* 189 (7) (2000) 357–360.
- [55] G. Rikard-Bell, N. Donnelly, J. Ward, Preventive dentistry: what do Australian patients endorse and recall of smoking cessation advice by their dentists? *Br. Dent. J.* 194 (3) (2003) 159–164.
- [56] M. Terrades, W.A. Coulter, H. Clarke, B.H. Mullally, M. Stevenson, Patients' knowledge and views about the effects of smoking on their mouths and the involvement of their dentists in smoking cessation activities, *Br. Dent. J.* 207 (11) (2009) E22–E23.
- [57] C.A. Ramseier, J.E. Suvan, Behaviour change counselling for tobacco use cessation and promotion of healthy lifestyles: a systematic review, *J. Clin. Periodontol.* 42 (Suppl 16) (2015) S47–58.
- [58] R.J. Genco, R.E. Schifferle, R.G. Dunford, K.L. Falkner, W.C. Hsu, J. Balukjian, Screening for diabetes mellitus in dental practices: a field trial, *J. Am. Dent. Assoc.* 145 (1) (2014) 57–64.
- [59] W.H. Herman, G.W. Taylor, J.J. Jacobson, R. Burke, M.B. Brown, Screening for prediabetes and type 2 diabetes in dental offices, *J. Public Health Dent.* 75 (3) (2015) 175–182.
- [60] M. Tavares, V. Chomitz, A healthy weight intervention for children in a dental setting: a pilot study, *J. Am. Dent. Assoc.* 140 (3) (2009) 313–316.
- [61] R. Tseng, W.F. Vann Jr, E.M. Perrin, Addressing childhood overweight and obesity in the dental office: rationale and practical guidelines, *Pediatr. Dent.* 32 (5) (2010) 417–423.
- [62] S. Martino, Oral health behavioral and social intervention research concepts and methods, *J. Public Health Dent.* 71 (Suppl 1) (2011) S2–S6.
- [63] EpiTools, 2018. <http://epitools.ausvet.com.au/content.php?page=1Proportion&Proportion=0.5&Precision=0.075&Conf=0.95&Population>. (Accessed 04/04 2019).
- [64] A. Pan, V.S. Malik, T. Hao, W.C. Willett, D. Mozaffarian, F.B. Hu, Changes in water and beverage intake and long-term weight changes: results from three prospective cohort studies, *Int. J. Obes. (Lond.)* 37 (10) (2013) 1378–1385.
- [65] F. Johnson, R.J. Beeken, H. Croker, J. Wardle, Do weight perceptions among obese adults in Great Britain match clinical definitions? Analysis of cross-sectional surveys from 2007 and 2012, *BMJ Open* 4 (11) (2014) e005561.
- [66] S.C. Sanderson, J. Waller, M.J. Jarvis, S.E. Humphries, J. Wardle, Awareness of lifestyle risk factors for cancer and heart disease among adults in the UK, *Patient Educ. Couns.* 74 (2) (2009) 221–227.
- [67] S.M. Strauss, J. Tuthill, G. Singh, D. Rindskopf, J.A. Maggiore, R. Schoor, A. Brodsky, A. Einhorn, A. Hochstein, S. Russell, M. Rosedale, A novel intraoral diabetes screening approach in periodontal patients: results of a pilot study, *J. Periodontol.* 83 (6) (2012) 699–706.
- [68] B.L. Greenberg, M. Glick, J. Frantsve-Hawley, M.L. Kantor, Dentists' attitudes toward chairside screening for medical conditions, *J. Am. Dent. Assoc.* 141 (1) (2010) 52–62.
- [69] T. Esmeili, J. Ellison, M.M. Walsh, Dentists' attitudes and practices related to diabetes in the dental setting, *J. Public Health Dent.* 70 (2) (2010) 108–114.
- [70] P.H. England, Improving Oral Health, (2014).
- [71] P.H. England, Sugar Reduction - Responding to Challenges, (2014).