The information filter: how dentists use diet diary information to

give patients clear and simple advice

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***Running title: How dentists use diet diaries to advise patients***

# Abstract:

Objectives: Diet diaries are recommended for dentists to monitor children’s sugar consumption. Diaries provide multifaceted dietary information, but patients respond better to simpler advice. We explore how dentists integrate information from diet diaries to deliver useable advice to patients.

Methods: As part of a questionnaire study of general dental practitioners (GDPs) in Northwest England, we asked dentists to specify the advice they would give a hypothetical patient based upon a diet diary case vignette. A sequential-mixed method approach was used for data analysis: An initial inductive content analysis (ICA) to develop coding system to capture the complexity of dietary assessment and delivered advice. Using these codes, a quantitative analysis was conducted to examine correspondences between identified dietary problems and advice given. From these correspondences, we inferred how dentists reduced problems to give simple advice.

Results: 229 dentists’ responses were analysed. ICA on 40 questionnaires identified two distinctive approaches of developing diet advice: a summative (summary of issues into an all-encompassing message) and a selective approach (selection of a main message approach). In the quantitative analysis of all responses, raw frequencies indicated that dentists saw more problems than they advised on, and provided highly specific advice on a restricted number of problems (e.g., not eating sugars before bedtime 50.7% or harmful items 42.4%, rather than simply reducing the amount of sugar 9.2%). Binary logistic regression models indicate that dentists provided specific advice that was tailored to the key problems that they identified.

***Conclusion:*** Dentists provided specific recommendations to address what they felt were key problems, whilst not intervening to address other problems that they may have felt less pressing.

**BACKGROUND**

The aetiology of dental caries involves a complex interplay of social, biological, environmental, and behavioural factors 1. Recently, the role of free sugar as a modifiable dietary and behavioural risk factor for dental caries has been reemphasised 2. Systematic review evidence concludes that the contribution of free sugars to total daily energy should be reduced to less than 5 % in order to reduce the incidence of dental caries 3. However, frequency, timing of consumption and duration in the mouth all impact the cariogenic potential of sugar consumed 4. In addition, the dynamic nature of the mineralisation/demineralisation process involved in the development of dental caries makes advice much more complex than simply emphasise the overall amount of sugar 5.

Dental practitioners are encouraged to provide dietary advice that is ‘systematic, comprehensive, and tailored to patients’ needs’ in order to support behaviour change in patients at high risk of dental caries 6. A careful assessment of patients’ dietary habits is indicated in order to understand dietary practices and to allow a tailoring and optimising of advice 7. Current guidance recommends diet diaries as good practice for diet assessment in dental practice 8. Patients are typically asked to keep the diary for three consecutive days including at least one weekend day. They are asked to record type, amount and timing of dietary intakes as well as timing of bedtime. 9. This information provides a contemporaneous account of dietary intakes, as a basis for discussions between dentists and patient and the identification of appropriate behaviour change goals 7.

However, information provided by diet diaries is nuanced and multifaceted, yet behavioural change is most likely to be affected by simple, focussed and easily implemented advice 10. It is unclear how dentists handle the task of reducing this information to simple messages. Current literature provides little insight into this problem. Using complex information to best inform decision making is an issue that is common to many areas of clinical practice 11 12, but few studies have investigated how dentists process diagnostic information in order to provide clinical advice 13 14. This study therefore aimed to explore how dentists navigate the problem of integrating complex information from diet diaries to deliver useable dietary advice to patients.

**METHODS**

Ethics (reference 14/LO/1204) and research governance approvals were obtained before commencing this study.

This study used a case vignette comprising a 2-day diet diary of a child with dental caries 15 16. Multiple problem behaviours were specified; eating immediately before bedtime, snacking, sticky and hidden sugars, amount and frequency of intake and alternate sequence of sugar intake with protective food as well as varies general eating behaviours. Dentists were asked, in separate items with free-text responses, to specify what they thought were the problematic entries in terms of caries risk in the vignette, and to state advice that they would give to the patient.

Dentists were presented with a single case vignette (supplemental file1). Contextual dental and medical history was given, and the diary was identified as being from an 11-year-old, NHS dental patient at high risk of developing dental caries, who presented to the dentist with mild dental toothache due to dentine caries. She had a clear medical history while dental history showed multiple extractions and regular dental visits in the last year. A 2-day diet diary was structured to allow a record which included multifaceted and varied information related to type, amount and time of dietary intakes and time the patient went to the bed. For example on day1 the vignette included information on finishing the meal with cheese after yoghurt, whereas in day 2 cheese was in the middle of the meal which is finished by hidden sugar in Actimel. Also, on day 1 two milkshakes were taken 1 hour apart and near bedtime and on day 2 cake and milkshake were consumed together though near bedtime. The vignette was followed by four open-ended questions with sufficient space to provide a detailed open text response to each. Dentists were asked to:

1. Indicate up to 6 behaviours, on the 2-day diet-diary, which represented dental health issues
2. Indicate any aspects of the diet diary that child/or the parents would be asked to give more information about
3. State the first dietary issue that the child/ parents would be advised about
4. Specify any other areas of advice (if any)

The diet diary case vignette was included in a wider postal questionnaire about dietary advice to general dental practitioners (GDPs) in Northwest England. The methodology of the questionnaire is described in detail elsewhere 17. In summary, the questionnaire was sent to 972 GDPs between September 2014 and January 2015. A two-stage cluster sampling method was used to stratify areas according to practice location in areas of low, medium and high caries prevalence. A total of 229 questionnaires with completed vignettes responses were received.

***Data analysis***

To the best of our knowledge, there is no pre-existing research on how dentists use diet diary information to formulate diet advice. Thus, a sequential approach, comprising qualitative and quantitative analyses, was used. An inductive content analysis (ICA) was initially carried out in a subsample of questionnaires, to understand how dentists used diet diary information to formulate their advice for patients and to develop a coding system for dentists’ interpretations of the dietary information given in the diet-diary. The coding framework was then applied to the wider sample in a quantitative phase of the analysis.

***Inductive Content Analysis:***

ICA was carried out in a subsample of 40 cases (questionnaires) with completed open text responses. These were purposefully selected for their completeness and variability of the responses. All cases were anonymised using serial numbers and letters indicating the area’s caries level (L=Low, M=Moderate, H=High) and practice type (N=NHS, P= private). Open text responses for all selected cases were transcribed verbatim and coded using a qualitative analysis software package, the NVIVO 9.2 (QSR International). A constant comparison method was used, where data were coded and concurrently compared for the occurrence and interrelation between codes across different cases 18. The process of cases selection and coding was iterative until data saturation was reached 19. Data saturation was observed after 35 cases. A further five cases were analysed to validate the coding and ascertain the saturation.

ICA commenced with repeated readings through the data to gain thorough understanding and to make sense of the data. Data were then analysed inductively at the level of words, sentences and phrases. A coding system was generated and continually refined as an ongoing process during the course of the analysis, leading to the identification of emerging themes and sub-themes regarding what did dentists viewed as important information in the diet diary (identified problems) which was identified from responses to vignette’s questions 1&2; and what dentists included in their diet advice, which was identified from responses to vignette’s questions 3&4 (Fig 1). By investigating what dentists recognised as issues from the diet diary information; and what they suggested as solutions in the diet advice they would give, we made assumptions on how dentists approached formulating dietary advice from diet diary information presented to them.

***Quantitative analysis***

The coding scheme generated from qualitative analysis (Tables 1 & 2) was applied to all questionnaires with completed open text responses (n=229). The variables were coded as 1= the identified problem or advice was indicated by the dentist or 0=not indicated. The coding process was carried out by a single investigator and verified by an independent assessor for the first 20 questionnaires. Absolute agreements of 90% -100% were reached.

Data were analysed using statistical software SPSS Version 22.0. (Armonk, NY: IBM Corp.). Counts and proportions were used to describe the frequency of each code for what dentists identified as problems and what they included in their suggested dietary advice to the patient. Binary logistic regression models were used to explore associations between identified problems and advice. A multivariate model regressed each binary outcome (advice) variable (yes/no), onto the predictor (identified problem) variables. The regression model was adjusted for the dentists’ demographic and professional characteristics (gender, years in service and role in practice) as well as characteristics of their dental practice (area’s caries level, Index of Multiple Deprivation quintiles and the proportion of practice case mix reported to be NHS or private).

**RESULTS:**

The results are outlined to reflect the order of methods and analysis used, with the findings of ICA presented first, followed by results of the quantitative analysis.

**Results of qualitative analysis:**

***The coding framework: important dietary issues & advice topics***

ICA themes and subthemes with their conceptual definitions and supporting data are given in Tables 1 & 2. Many dentists approached their analysis of the diary by identifying items that they considered as harmful to oral health by the virtue of their cariogenic and erosive potential. The GDPs, also, addressed such items in their suggested dietary advice.

 *“Apple juice, both sugary and acidic”*

 *MN33: (Response to Q1- identified problem)*

In many cases, dentists identified the ways in which sugar was consumed as problematic. Information which identified by GDPs as important included the amount, frequency, timing and duration of exposures to items with cariogenic potential, as well as the hidden sugars and sequencing of sugar with alkaline intakes. For example:

 *“Frequent eating and snacking of sugar leads to too frequent* *acid attacks”*

 *HN20: (Response to Q1- identified problem)*

Environmental factors and patient’s behaviours that were not strictly dietary but might act to modify either the intake or the effect of harmful items (such as oral hygiene practices, parental attitude and motivation) were identified as important information and also would have been discussed by GDPs when giving advice. For example, the GDPs, in their responses to question (3), indicated that they would ask the child/ parents about oral hygiene habits and how the child access sugary snacks.

 *“Who buys the chocolate + drinks?”*

 *MN212 (Response to Q3- advice)*

General dietary issues were also reported as important diet diary information and in the advice topics.

 *“Choice of evening meal contains a lot of fat. Lack of fibre in diet”*

 *HP8: (Response to Q1- identified problem)*

***Approaches to formulating dietary advice:***

From correspondences between problem and advice codes, we identified two approaches of formulating advice from identified problems. These were a) a summative approach, and b) a selective approach.

1. ***A summative approach: (Figure 1)***

Some GDPs made an effort to sum up the complex register of important dietary issues and deliver this in an all-encompassing set of advice (Figure 1). This appeared to be a reflection of GDPs’ interpretation of what constitutes a common factor among the issues they had identified. These GDPs recognised many different items and dietary behaviours in the diet diary as important (e.g. amount, frequency, hidden sugars and between meals and near bedtime intake of sugars), but did not focus on any particular issue. Some gave general advice, addressing a common aspect among various issues (usually sugar consumption). For example, the dentist may deliver an all-purpose statement with a core message to restrict all forms of harmful intakes (e.g. *reduce the intake of sugary foods and drinks* or*. reduce the amount and frequency of sugar intakes/ reduce sugar intake to minimum).*

1. ***A selective approach: (Figure 2)***

In this approach, some GDPs gave their advice by picking up one or two from many issues from the diet diary which they considered as important. In doing so, they addressed specific dietary problems; possibly what they considered the most important (Figure 2). Put more simply, these GDPs highlighted in their response to vignette’s question (1) a range of important issues (e.g. frequency, amount, near bedtime and sequence of sugary items intake), but when it comes to delivering advice (vignette’s questions 3 & 4), they took a very specific approach and select one or two particular topics to address (e.g. avoid near bedtime intake of sugars or reduce the frequency of sugar intake to less than 4 times a day).

**Results of quantitative analysis:**

***Sample profile***

Table 3 shows characteristics of the 229 participants who completed the vignette section of the questionnaire. These respondents had a mean 20 (±12) years of service since qualification, most of them undertook some NHS work (97%, 219) and the majority worked in practices located in first and second quintile IMD areas (most deprived). There was a relatively even distribution of respondents by their gender and by caries prevalence (high, medium and low), of areas in which their practices were located.

***Frequencies of important dietary issues and diet advice topics:***

Generally, the number of diet advice topics addressed (advice) were fewer than the number of identified problems (Table 4). The most frequently identified problems were near bedtime (180, 79%) and frequency (59, 26%) of consumption of sugar as well as general dietary habits (54, 25%), whereas sequence and prolonged intake of sugars were the least frequently recognised dietary issue. On the other hand, most frequently observed advice were near bedtime consumption of sugars (116, 51%), harmful items (97, 42%) and frequent sugar intakes (89, 39%). The amount of sugar intake was among the least common advice topics (21, 9%). Sequence of intake and prolonged contact time were absent in dietary advice.

***Predictors of diet advice topics:***

Summaries of binary logistic regression models are presented in Table 5. These show a high level of specificity in the correspondence between advice and identified problems for nearly all analyses, the odds ratio (OR) of each item of advice being given were uniquely and significantly (p < 0.05) higher if the corresponding problem was identified. Further, the advice given was generally the only significant predictor. The only exception for this was giving advice about harmful items which was not predictable from its identification as a problem (identifying harmful items as problem). Instead this was predicted from general diet and frequency and near bedtime consumption of sugars being noted in the identified problems (Table 4). We did observe very few associations between background variables and whether specific advice topics were given. Dentists from quintile 3 were more likely to give advice related to between meals, whereas those from quintile 5 to give advice related to between meals and near bed time intake of sugars, (p < 0.05).

**DISCUSSION:**

The qualitative and quantitative components of this study showed that, when interpreting a child’s diet diary and giving advice, dentists chose fewer issues on which to provide advice than the number of problems that they identified in the diary. The logistic regression analyses showed that the advice provided was highly specific to the problems that they had identified. Thus, we suggest that dentists filtered information in such a way that they focussed on what they saw as key areas at the time.

We interpret dentists’ behaviour as an intelligent adaptation to a key practice dilemma; how to provide the best evidence-based advice to patients whose understandings of preventive dental health, attention to detail, and their motivations and opportunities to change their behaviour may be sub-optimal. Thus, we argue that dentists reduced the amount of advice given to provide a coherent and easily implemented recommendation, whilst prioritising the key problems that would otherwise have an appreciable impact on dental health. In particular, dentists preferred to address specific and contextualised problems, such as frequency and timing of sugar consumption that they identified. For instance, the majority of dentists focused on near bedtime intake of sugars which, whether it is high or not, can increase caries risk because it is associated with reduced salivary flow during sleep and consequently lower protective effects of saliva 20 21. They did not often give general advice such reduce the amount of sugar consumed.

In filtering information, dentists make it both more comprehensible and easier to implement for patients. Their efforts are supported by theory. For example, fuzzy trace theory demonstrates that a simple and coherent message is more likely to be remembered, retrieved and implemented than a more detailed message 22. The latter may be more comprehensive and accurate, but these advantages are lost because they are complex and difficult to remember and use in decision-making 22. Thus, dentists’ filtering of information can be seen in much the same way; they presented a simplified message rather than a more comprehensive message that is less likely to have an influence. The specific principles that dentists use to prioritise and select information are currently unclear and require further research.

However, we emphasise that we describe a process whereby dentists provide simplified advice, but did not directly ask dentists why they simplified this advice. Thus, our claim that they do this to improve patients’ adherence is yet untested inference. Other explanations for this may exist; dentists may provide simpler advice in response to pressures on their time 17 or because they do not wish to preserve good relationships with patients by being overly critical of them.

Whilst dentists’ choices of what advice to give appear to be logical, they run partially counter to current guidance that emphasises only the amount and frequency of sugar consumption and bedtime consumption 7. This may be attributable to dentists more specific focus on dental health rather than more general health problems such as weight control. Although very recent evidence indicates that amount may be more important than frequency of sugar intake for controlling dental caries 23, Sugar amount has been shown to be a poor indicator of food’s cariogenic potential compared to a more specific focus on the frequency, timing and context in which it is consumed 24. Another possibility may be that dentists are aware that their patients find it easier to visualise frequency and timing of sugar intake than amount, and that reducing the frequency of sugar intake is more practical than reducing amount 6.

To the authors’ best of knowledge, this is the first study to investigate how dentists interpret and use diet diaries for dietary advice. This study used a case vignette in a survey of dentists which combines the internal validity of the vignette as an experiment with the external validity of the survey 15. Although it might be argued that there are inherent differences between vignette’s responses and actions in real life 25, this was not an issue in this study because the focus was on how dentists process the information rather than what they actually do in real world. The latter is preferably assessed by observations and interviews 26.

**CONCLUSION:**

At a broader level, this research contributes to a small but growing literature that examines the cognitive strategies that dentists use to make clinical decisions 13 14. Here we demonstrate that, faced with the constraints of providing information that is both simple and easy to implement, dentists rely upon a strategy of intelligent selection to filter out dietary information. Challenged with a large field of information, they select what they see as a subset of either the most useful or the easiest information to understand and implement. Contrary to the current focus in dental literature, dentist pay a relatively little attention to amount of sugar in diet and instead deal with a wide range of sugar consumption related aspects. Further research is needed to understand the specific principles behind these choices.

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| **Table 1. Dietary information regarded as important by GDPs**  |
| **Theme** | **Conceptual definition**  | **Supporting Quotation(s)** |
| **Harmful items** | Items which have cariogenic or erosive potential represent risk to oral health | *MN33: “Apple juice, both sugary and acidic”**HN 215: “The type of food consumed. acidic/cariogenic”* |
| **Consumption patterns** | The way in which a harmful item consumed raises the risk of caries/erosion.  |
| **Subtheme** | Frequency | A high number of intakes per day  | *LN116“High frequency of sugar throughout the day”* |
| Amount | A large amount of sugar/ acid  | *MN201“How much sugar is in the milkshake she has?”* |
| In-between meals | Sugar consumption between meals  | *MP6“Milkshake high in sugar+ taken before bed”* |
| Near bedtime | Sugar consumption close to bedtime | *HN6“milkshakes last thing at night”* |
| Prolonged exposure | Consumption manners and food form that extend the duration of sugar exposure | *LN31“Caramel is sticky and chocolate is high in sugar”**HN6“Are milkshakes consumed quickly in one go or lots of sips?”* |
| Sequence | The order of items intake within the meal/snack | *HN31“7:45 am, day 2, is milk last thing after coco pops /pear?”* |
| Hidden sugars | Patient’s unawareness of sugar content in the diet  | *HN6“Are they aware of hidden sugars in food?”*  |
| **Personal oral health care**  | Oral hygiene practices and use of fluoridated toothpaste may modify the effect of harmful items | *HN6“Does she brush her teeth before bedtime?”**LN311“Brushing habits (before or after breakfast) 2 x days”*  |
| **Environmental influences** | Patients’ ways of living, values and routine behaviours may influence the consumption of sugary/acidic items |  *HN31“Does the child take a packed lunch or have a school dinner?”**MN212“Who buy the chocolate + drinks?”* |
| **General dietary issues** | Unbalanced diet of poor nutritional value and irregular eating habits affect the general heath | *MN212“Absence of guideline ‘5–A-Day’ healthy fruit and veg foods concern over some possible sequelae for general health”* |
| **Table 2. Topics to be covered by GDPs giving dietary advice** |
| **Theme** | **Conceptual definition**  | **Supporting Quotation(s)** |
| **Harmful items** | A recommendation to reduce the intake of cariogenic/erosive items  | MN35“Reduce sugary, acidic drinks to a minimum”*HN 215: “reduce overall sugar consumption*” |
| **Consumption patterns** | Reduce or avoid ways of consumption that raise the risk of caries/erosion.  |
| ***Subtheme*** | Frequency | Reduce the number of intakes per day | *LN113“Sugar frequency should be limited to 4 a day or less”* |
| Amount | Reduce amount of sugar in diet | *HN6 “Reduce the amount and frequency of consumption of sugar”* |
| In-between meals | Avoid sugar consumption between meals  | *MP6“Milkshake high in sugar+ taken before bed”* |
| Near bedtime | Avoid sugar consumption close to bedtime | *LN306“Only have water or plain milk between meals”* |
| Hidden sugars | Raise patient’s awareness of unseen sugars in diet | *MN256“Go through foods which contain hidden sugars, e.g. tomato sauce in beans “* |
| **Personal oral health care**  | Maintenance of good oral hygiene and fluoride use | *HN6“Tooth brushing /oral hygiene/ fluoride use advice”* |
| **Environmental influences** | Provide advice to child carers including those outside home | *HN13“Awareness of same advice to grandparents as well”**LN 316“Involve parents and other members of family”* |
| **General dietary issues** | General diet, nutrition and eating habits recommendations | *HP8“Choice of evening meal contains a lot of fat. Lack of fibre in diet”* *MN212“Balanced diet - more vegetables etc.”* |

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| **Table3: Characteristics of the study sample (n=229)** |
| **Variables** |  **Summary Statistic** |
|  N (%) |
| ***Sex*** | Men | 126 | (55) |
|  | Women | 103 | (45) |
| ***Role*** | Practice Owner | 96 | (41.9) |
| Associate/other | 133 | (58.1) |
| ***Caries Incidence***  | Low | 84 | (36.7) |
|  | Moderate | 67 | (29.3) |
|  | High | 78 | (34.1) |
| ***Index of******Multiple******Deprivation quintiles*** | Quintile 1(Most deprived) | 69 | (30.1) |
| Quintile 2 | 76 | (33.2) |
| Quintile 3 | 30 | (13.1) |
| Quintile 4 | 36 | (15.7) |
| Quintile 5 (Least deprived) | 18 | (7.9) |
| ***Practice sector*** | NHS | 219 | (96.6) |
| Private | 10 | (3.4) |
| ***Years in service***  |  Mean  | (SD) |
|  20.9 (12.0) |

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| Table 4: Frequencies of important dietary issues and diet advice topics: (N=229) |
|  | **Important issues** | **Advice topics** |
| Harmful items | 142 (62) | 97 (42.4) |
| Frequency | 59 (25.8) | 89 (38.9) |
| Amount  | 44 (19.2) | 21 (9.2) |
| Between-meals  | 125 (54.6) | 87 (38) |
| Near bedtime | 180 (78.6) | 116 (50.7) |
| Sequence  | 13 (5.7) | ---- |
| Hidden sugars  | 31 (13.5) | 15 (6.6) |
| Prolonged contact time | 22 (9.6) | ---- |
| General dietary issues | 54 (24.9) | 67(29.3) |
| Personal oral health care | 83 (36.2) | 47(20.5) |
| Environmental factors | 35 (15.3) | 4 (1.7) |
| Count (%) |  |  |

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| **Table 5: The association between given diet diary information and their coverage as diet advice topic**  |
| **Important issues** | **Diet advice**  |
| **Harmful items****OR (95% CI)** | **Frequency****OR (95% CI)** | **Amount****OR (95% CI)** | **Between-meals****OR (95% CI)** | **Near bedtime****OR (95% CI)** | **Hidden sugars****OR (95% CI)** | **General diet****OR (95% CI)** | **Personal oral health care** **OR (95% CI)** |
| **Harmful items** | 1.28 (0.65, 2.22) | 0.89 (0.46, 1.75) | 2.49 (0.68, 9.06) | 0.76 (0.39, 1.49) | 0.42 (0.21, 0.83) | 1.70 (0.43, 6.76) | 1.25 (0.57, 2.75) | 0.67 (0.29, 1.54) |
| **Frequency** | **0.48 (0.23, 1.00)** | **3.39 (1.39 6.82)** | 1.61 (0.53, 4.92) | 0.56 (0.27, 1.16) | 1.00 (0.49, 2.04) | 0.45 (0.08,2.45) | 0.84 (0.38, 2.81) | 2.21 (0.97, 4.05) |
| **Amount** | 0.67 (0.31, 1.46) | 1.25 (0.57, 2.75) | **2.37 (0.68, 8.33)** | 1.90 (0.87, 4.15) | 0.94 (0.43, 2.05) | 0.34 (0.04, 3.11) | 1.17 (0.50, 2.76) | 1.28 (0.51, 3.20) |
| **Between-meals** | 0.65 (0.33, 1.27) | 0.97 (0.49, 1.94) | 0.80 (0.25, 2.55) | **3.00 (1.49, 6.04)** | 1.11 (0.56, 2.21) | 1.61 (0.39, 6.67) | 1.81 (0.84, 3.91) | 0.41 (0.18, 0.97) |
| **Near bedtime** | **0.37 (0.17, 0 .87)**  | 1.05 (0.47, 2.37) | 1.61 (0.40, 6.44) | 1.64 (0.69, 3.89) | **2.40 (1.05, 5.49)** | 1.80 (0.31, 10.47) | 0.30 (0.12, 0.75) | 2.11 (0.75, 5.94) |
| **Sequence** | 1.19 (0.33, 4.24) | 1.19 (0.34, 4.20) | ---- | 0.91 (0.25, 3.30) | 3.89 (0.94,16.03) | 1.63 (0.16, 17.18) | 1.79 (0.43, 7.53) | 2.59 (0.67, 1.02) |
| **Hidden sugars** | 0.70 (0.29, 1.68) | 0.62 (0.24, 1.57) | 0.32 (0.03, 2.91) | 1.13 (0.47, 2.70) | 0.96 (0.40, 2.29) | **3.56 (0.91, 13.93)** | 1.68 (0.63, 4.51) | 0 .95 (0.29, 3.20) |
| **contact time** | 1.98 (0.74, 5.25) | 0.88 (0.31, 2.53) | ---- | 1.21 (0.44, 3.29) | 0.95 (0.34, 2.70) | 2.45 (0.54, 11.11) | 0.17 (0.03, 0.88) | 0.50 (0.12, 2.03) |
| **General diet** | **2.35 (1.15, 4.80)**  | 0.94 (0.41, 2.14) | 1.55 (0.43, 5.64) | 1.34 (0.65, 2.74) | 0.73 (0.36, 1.48) | 0.93 (0.21, 4.16) | **8.88 (4.00 ,19.71)** | **0.29 (0.11, 0.89)** |
| **Personal oral health care** | 1.68 (0.89, 3.16) | 1.03 (0.55, 1.94) | 1.39 (0.47, 4.14) | 0.74 (0.39, 1.40) | 0.92 (0.39, 2.15) | 1.79 (0.45, 7.10) | 1.11 (0.55, 2.27) | **4.07 (1.87,8.86)** |
| **Environmental factors** | 1.24 (0.54, 2.89) | 1.61 (0.75, 3.64) | 0.72 (0.18, 2.93) | 1.08 (0.47, 2.51) | 1.52 (0.81, 2.85) | 0.09 (0.37, 1.53) | 0.82 (0.32, 2.14) | 0 .90 (0.30, 2.69) |
| **Chi-square** | **0.013\*** | **0.022**\* | 0.308 | **0.012**\* | **0.001\*\*** | 0.757 | **≤ 0.001\*\*\*** | **0.006\*\*** |
| **Nagelkerke R2** | 0.192 | 0.190 | .205 | 0.149 | 0.245 | 0.169 | 0.292 | 0.248 |
| \*P < 0.05, \*\*P < 0.01, \*\*\*P < 0.001. **Bold: significant p value** **P < 0.05** |

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| **Figure 1: A summative approach to delivering diet advice based on dietary assessment**  |
| **Identified problems** | **Suggested advice**  |
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| **Figure 2: A selective approach to delivering diet advice based on dietary assessment** |
| **Identified problems** | **Suggested advice**  |
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