Public Health England

Protecting and improving the nation's health

The relationship between dental caries and obesity in children: an evidence summary

Aim

This evidence summary explores whether dental caries and obesity are found in the same individuals and populations. It supports the dental public health and obesity teams, who may be asked about the relationship between these two outcomes.

Objectives

To review and summarise what is currently known about the relationship between dental caries and obesity in individuals and populations, using published literature and routine public health monitoring data.

Background

Dental caries and obesity are two of the most prevalent health conditions affecting children. In 2011-12 in England, 9.4% of five-year-old children were obese and 28% had dental caries experience.[1,2] Both conditions increase with age and the most recent data for England shows obesity prevalence rising to 19.1% of 10 to 11-year olds in 2013-14[3] and caries prevalence to 34% of 12-year olds.[4].

Obesity increases the risk of chronic disease and poor mental health outcomes[5-7] and dental caries impacts significantly on the quality of life of young children.[8,9] Tooth decay was the most common reason for hospital admissions in children aged five to nine years old in 2013-14.[10] For these reasons, both conditions are of great public health importance and hence why 'tackling obesity, particularly among children', and 'ensuring that every child has the best start in life' are two of PHE's seven priorities for 2015.[11]

PHE publications gateway number: 2015380
Published: October 2015

Consumption of free sugars* is a risk factor both for dental caries and obesity. In their recent report on carbohydrates and health, The Scientific Advisory Committee on Nutrition concluded that higher consumption of free sugars is associated with a greater risk of dental caries.[12] In addition, increasing the percentage of total dietary energy consumed as free sugars leads to increased total energy intake. For children and adolescents, the consumption of sugar-sweetened beverages was found to lead to greater weight gain and increases in body mass index.[12]

There is also a strong relationship between deprivation and both obesity and dental caries in children. Data from the National Child Measurement Programme (NCMP) shows an almost linear relationship between obesity prevalence in children and the Index of Multiple Deprivation 2010 (IMD) decile for the area where they live.[13] Similarly, data from the National Dental Epidemiology Programme for England shows that IMD scores explain 44% of the variation in the severity of tooth decay across local authorities.[2]

Given that excessive intake of free sugars and social deprivation are risk factors for dental caries and obesity, it has been hypothesised that these two outcomes may be more likely to co-exist within the same individuals or populations.[14-17] However, there are many non-shared risk factors for both conditions. Aside from free-sugars and socio-economic deprivation, obesity in children and young people is affected by many complex behavioural and societal factors, including overall calorie intake, physical activity levels, genetic factors and the media.[5] Dental caries is also affected by exposure to fluoride, overall dietary composition, oral bacteria, salivary composition and flow rates, and tooth enamel structure.[18]

Published literature

Methodology

A literature search of articles published between 2000 and 2014 investigating the relationship between dental caries and weight in children was performed. The search identified 142 potentially relevant abstracts, which were screened in duplicate for relevance. Studies were included if they were either a systematic review or a primary observational study published after the systematic review cut-off dates, and undertaken in a setting comparable to the UK, as in a ‘high income country’.

Results

Four systematic reviews published between 2006 and 2013, and eight more recent primary studies were identified. Two systematic reviews were considered directly relevant to the

*All monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and unsweetened fruit juices.

research question as they only included data on children,[9,10] and two were considered partially relevant as they also included data on adults.[19,20] The risk of bias in the systematic reviews was evaluated using the ROBIS tool.[21]

The two **directly relevant systematic reviews** in children aged 0 to 18 years were of low risk of bias, with clear inclusion and exclusion criteria, and all of the included studies used objective measures of exposure and outcome, ie, anthropometry for weight status and clinical dental examination for caries status.[22,23] A summary of the findings are provided below:

- Hayden et al (2013) carried out a systematic review and meta-analysis of one cross-sectional-longitudinal study and 13 cross-sectional studies, which found that children who were obese had higher dental caries scores compared to non-obese children (standardised mean difference: 0.104, P= 0.049)

- Hooley et al (2012) carried out a systematic review of 48 studies (36 cross-sectional, six longitudinal, one cross-sectional-longitudinal, three case-control and one retrospective case series). The authors did not pool the data but concluded that any association may be U-shaped rather than linear, with a general pattern emerging of increasing prevalence or severity of dental caries in underweight and overweight children when compared to those of a healthy weight[23]

The authors of both studies found that the association was modified by country income status, with more developed[23] or higher income[22] countries showing a stronger relationship between caries and obesity.

The two **partially relevant systematic reviews** that included data on adults and children were assessed as being at high risk of bias. Their inclusion criteria and search strategies were unclear, and some of the included studies used self-report and/or proxy measures of caries and obesity.[19,20]

- Silva et al (2013) included 28 studies (24 cross-sectional, three prospective cohort and one case control)

- Kantovitz et al (2006) included seven studies (six cross-sectional and one retrospective case control)[19,20]

These reviews found conflicting results across the studies and were unable to pool any data. As a result there was insufficient evidence to draw any conclusions about whether there is an association between dental caries and obesity in adults and children.[19,20]

A further **eight primary studies** (three prospective cohort,[24-26] one retrospective cohort[27] and four cross-sectional[28-31] studies) conducted after the search periods of the systematic reviews and conducted in a high-income country setting were also considered. These additional studies provided conflicting results with no clear consensus emerging.

Limitations in the evidence base

- the overall body of evidence included in all four systematic reviews was of low quality, with a high proportion of cross-sectional and case control, rather than prospective cohort studies

- many of the primary studies include underweight children in the "normal weight" category during the analysis. This may lead to inflated caries scores in the "normal weight" group if, as suggested by Hooley et al (2012), dental caries is associated with low weight as well as high weight[23,24,32]

- the nature and direction of the proposed relationship between caries and weight varies across the primary studies. Due to inconsistencies in the data, it is not possible to identify which variables if any should be appropriately treated as confounders

- many studies included in the systematic reviews come from low-income developing countries. This limits the generalisability of the findings to the UK context since food security, sanitation and access to healthcare all have a major impact on nutritional status[33]

Local authority level data

Methodology

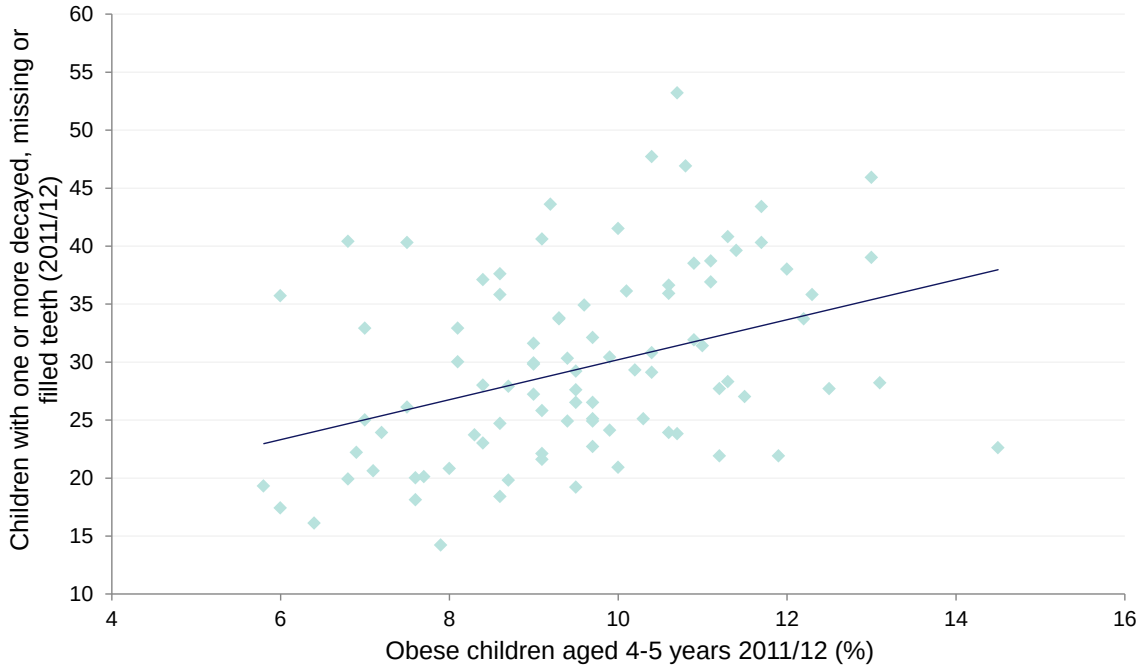
Public health outcome data routinely collected at age five provides an opportunity to examine if there is a relationship between dental caries and obesity prevalence in this age group at the local authority population level in England.[1,2] This age was specifically used in the analysis as it is the only time point where both indicators are available, although they were captured on separate occasions.

Results

There is a weak to moderate correlation (R=0.40) between increasing obesity prevalence and increasing caries prevalence (fig.1). Dental caries prevalence is moderately associated with deprivation as measured by the IMD score (R=0.58), and obesity is strongly associated with deprivation (R=0.73), which in part mediates the correlation observed between dental caries and obesity.

It should be noted that this observation is based on ecological data and therefore should not be used to comment on how much correlation there may be at the sub-population or individual level.

Fig.1. Correlation between children with one or more decayed, missing or filled teeth at age five years and children who are obese at age four to five years: upper tier local authorities in England.



Data source: National Child and Maternal Health Intelligence Network PHE

Conclusions

We found some low-quality evidence that dental caries and obesity may be more likely to occur in the same populations. This evidence comes from two systematic reviews considered to be directly relevant to the research question and at low risk of bias. They included mostly cross-sectional studies and concluded that groups of children who are overweight or obese may have higher dental caries scores, compared to groups of non-obese children. The local authority data, collected at population level and also cross-sectional, confirms that a weak to moderate correlation between dental caries and obesity prevalence can be observed at age five years; however it is not currently known whether this relationship exists in older children.

Using this type of group-level cross-sectional data it is not possible to say whether an individual who is overweight or obese is at higher risk of dental caries or vice versa. Well-designed cohort studies in populations that are comparable to the UK are required to answer this type of question and there are currently insufficient studies of this type available. Despite this, because deprivation and high intakes of free-sugars are known risk factors for dental caries and for obesity,[2,12-15] it is likely that interventions that reduce these common risk factors have the potential to impact both conditions at the population level.[34,35]

Examples of population-level interventions taking a common risk factor approach

Upstream interventions that impact upon the social determinants of health and foster supportive food environments are recommended as part of the common risk factor approach to health improvement:[34]

- examples of population-level dietary interventions include: supporting healthier catering and food procurement policies; whole-school and community engagement approaches, working with town planners and local authorities to create healthier food environments, supporting the School Food Plan and the Change4life social marketing “sugar swaps” campaign

- further details of such evidence-informed interventions can be found in ‘Commissioning better oral health’[35] and ‘Oral health: approaches for local authorities and their partners to improve the oral health of their communities’[36] and ‘Preventing obesity and helping people to manage their weight’[37]

References

1. Eastwood P. National Child Measurement Programme: England, 2010/11 school year [Internet]. 2011. Available from: http://www.hscic.gov.uk/searchcatalogue?productid=16565&q=title%3a%22national+child+measurement+programme%22&sort=Relevance&size=10&page=1#top

2. Public Health England. National Dental Epidemiology Programme for England : oral health survey of five-year-old children A report on the prevalence and severity of dental decay [Internet]. London; 2013. Available from: http://www.nwph.net/dentalhealth/Oral Health 5yr old children 2012 final report gateway approved.pdf

3. The Health and Social Care Information Centre. National Child Measurement Programme 2013-14 [Internet]. 2014. Available from: http://www.hscic.gov.uk/searchcatalogue?productid=16565&q=title:“national+child+measurement+programme”&sort=Relevance&size=10&page=1#top

4. The Health and Social Care Information Centre. Children ’ s Dental Health Survey 2013 Executive Summary. England, Wales and Northern Ireland [Internet]. 2015. Available from: http://www.hscic.gov.uk/catalogue/PUB17137/CDHS2013-Executive-Summary.pdf

5. Butland B, Jebb S, Kopelman P, McPherson K, Thomas S, Mardell J, et al. Tackling Obesities : Future Choices – Project report. 2nd ed. London: Foresight Programme of the Government Office for Science; 2007.

6. Murray CJL, Richards M a, Newton JN, Fenton K a, Anderson HR, Atkinson C, et al. UK health performance: findings of the Global Burden of Disease Study 2010. Lancet [Internet]. Elsevier Ltd; 2013 Mar 23 [cited 2014 Jul 25];381(9871):997–1020. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23668584

7. National Obesity Observatory. Obesity and mental health [Internet]. 2011. Available from: http://www.noo.org.uk/uploads/doc/vid_10266_Obesity and mental health_FINAL_070311_MG.pdf

8. Ramos-Jorge J, Alencar BM, Pordeus IA, Soares MEDC, Marques LS, Ramos-Jorge ML, et al. Impact of dental caries on quality of life among preschool children: emphasis on the type of tooth and stages of progression. Eur J Oral Sci [Internet]. 2015;123(2):88–95. Available from: http://doi.wiley.com/10.1111/eos.12166

9. Milsom KM, Tickle M, Blinkhorn A S. Dental pain and dental treatment of young children attending the general dental service. Br Dent J [Internet]. 2002 Mar 9;192(5):280–4. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11924955

10. Health and Social Care Information Centre. Hospital Episode Statistics, Admitted Patient Care, England 2013-14: Diagnosis [.xlsx]. Primary diagnosis 3: Character. 2015.

11. Public Health England. From evidence into action: opportunities to protect and improve the nation's health [Internet]. 2014. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/319696/Business_plan_11_June_pdf.pdf

12. Scientific Advisory Committee on Nutrition. Carbohydrates and Health [Internet]. London: The Stationary Office; 2015. Available from: https://www.gov.uk/government/publications/sacn-carbohydrates-and-health-report

13. Public Health England. Child obesity and socioeconomic status data factsheet [Internet]. PHE Gateway; 2014. Available from: http://www.noo.org.uk/NOO_about_obesity/inequalities

14. Moynihan PJ, Kelly SAM. Effect on Caries of Restricting Sugars Intake: Systematic Review to Inform WHO Guidelines. J Dent Res [Internet]. 2014 Jan [cited 2014 Jan 22];93(1):8–18. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24323509

15. Morenga L Te, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. BMJ Br Med J [Internet]. 2013 [cited 2014 Jan 22];7492(January):1–25. Available from: http://www.bmj.com/content/346/bmj.e7492?view=long&pmid=23321486

16. Locker D. Deprivation and oral health: a review. Community Dent Oral Epidemiol [Internet]. 2000 Jun;28(3):161–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10830642

17. Health and Social Care Information Centre. Health Survey for England 2012. Health, social care and lifestyles. Summary of key findings [Internet]. 2012. Available from: http://www.hscic.gov.uk/catalogue/PUB13218/HSE2012-Sum-bklet.pdf

18. Selwitz RH, Ismail AI, Pitts NB. Dental caries. Lancet [Internet]. 2007 Jan 6;369(9555):51–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17208642

19. Kantovitz K, Pascon FM, Rontani RMP, Gaviao MBD. Obesity and dental caries - A systematic review. Oral Heal Prev Dent [Internet]. 2006 [cited 2014 Oct 21];4:137–44. Available from: http://www.scielo.br/pdf/rsp/v47n4/0034-8910-rsp-47-04-0799.pdf

20. Silva AER, Menezes AMB, Demarco FF, Vargas-Ferreira F, Peres MA. Obesity and dental caries: systematic review. Rev Saude Publica [Internet]. 2013 Aug [cited 2014 Oct 22];47(4):799–812. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24346668

21. Whiting P, Savović J, Higgins JPT, Caldwell DM, Reeves BC, Shea B, et al. ROBIS: A new tool to assess risk of bias in systematic reviews was developed. J Clin Epidemiol [Internet]. 2015; Available from: http://linkinghub.elsevier.com/retrieve/pii/S089543561500308X

22. Hayden C, Bowler JO, Chambers S, Freeman R, Humphris G, Richards D, et al. Obesity and dental caries in children: A systematic review and meta-analysis. Community Dentistry and Oral Epidemiology. 2013. p. 289–308.

23. Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N. Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011. Syst Rev [Internet]. 2012;1:57. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3621095&tool=pmcentrez&rendertype=abstract

24. Hooley M, Skouteris H, Millar L. The relationship between childhood weight, dental caries and eating practices in children aged 4-8 years in Australia, 2004-2008. Pediatr Obes [Internet]. 2012 Dec [cited 2015 Mar 2];7(6):461–70. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22911896

25. Kay EJ, Northstone K, Ness A, Duncan K, Crean SJ. Is there a relationship between birthweight and subsequent growth on the development of dental caries at 5 years of age? A cohort study. Community Dent Oral Epidemiol [Internet]. 2010 Oct [cited 2014 Nov 10];38(5):408–14. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20545719

26. Lempert SM, Froberg K, Christensen LB, Kristensen PL, Heitmann BL. Association between body mass index and caries among children and adolescents. Community Dent Oral Epidemiol [Internet]. 2014 Feb [cited 2014 Sep 23];42(1):53–60. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23763718

27. Werner SL, Phillips C, Koroluk LD. Association between childhood obesity and dental caries. Pediatr Dent [Internet]. 2012;34(1):23–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22353452

28. Creske M, Modeste N, Hopp J, Rajaram S, Cort D. How Do Diet and Body Mass Index Impact Dental Caries in Hispanic Elementary School Children? Th J Dent Hyg. 2013;87(1).

29. Peng S-M, Wong HM, King NM, McGrath C. Is dental caries experience associated with adiposity status in preschool children? Int J Paediatr Dent [Internet]. 2014 Mar [cited 2014 Oct 24];24(2):122–30. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23711350

30. Norberg C, Hallström Stalin U, Matsson L, Thorngren-Jerneck K, Klingberg G. Body mass index (BMI) and dental caries in 5-year-old children from southern Sweden. Community Dent Oral Epidemiol [Internet]. 2012 Aug [cited 2014 Oct 24];40(4):315–22. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22469188

31. Trikaliotis A, Boka V, Kotsanos N. dmfs and BMI in pre-school Greek children. An epidemiological study. Eur Arch … [Internet]. 2011 [cited 2015 Mar 2];12(3):2008–11. Available from: http://link.springer.com/article/10.1007/BF03262802

32. Psoter W, Reid B, Katz R. Malnutrition and dental caries: a review of the literature. Caries Res [Internet]. 2005 [cited 2014 Oct 22];39(6):441–7. Available from: http://www.karger.com/Article/Abstract/88178

33. UNICEF. Causes of malnutrition. The state of the world's children [Internet]. 1998. Available from: http://www.unicef.org/sowc98/

34. Watt RG, Sheiham A. Integrating the common risk factor approach into a social determinants framework. Community Dent Oral Epidemiol [Internet]. 2012 Aug [cited 2014 Jun 14];40(4):289–96. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22429083

35. Public Health England. Local authorities improving oral health : commissioning better oral health for children and young people An evidence-informed toolkit for local authorities [Internet]. London; 2013. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/321503/CBOHMaindocumentJUNE2014.pdf

36. National Institute for Health and Care Excellence. Oral health : approaches for local authorities and their partners to improve the oral health of their communities. NICE public health guidance 55 [Internet]. 2014. Available from: http://www.nice.org.uk/guidance/ph55/resources/guidance-oral-health-approaches-for-local-authorities-and-their-partners-to-improve-the-oral-health-of-their-communities-pdf

37. National Institute for Health and Care Excellence. Preventing obesity and helping people to manage their weight [Internet]. Local Government Briefing. 2013 [cited 2015 Sep 1]. Available from: http://www.nice.org.uk/advice/lgb9/chapter/Introduction

First published: October 2015

Any enquiries regarding this publication should be sent to jenny.godson@phe.gov.uk

© Crown copyright 2015
Re-use of Crown copyright material (excluding logos) is allowed under the terms of the Open Government Licence, visit www.nationalarchives.gov.uk/doc/open-government-licence/version/2/ for terms and conditions.