HOST: Conducting data quality and control assessments are a standard and very critical part of NCHS' data review process to make sure that the data we collect produce statistics that are accurate and of high quality. These data quality and control assessments are routinely performed before the release of any data, whether it be data from vital records or data from the many health surveys conducted by NCHS. Quality assessments are particularly important for data from a unique survey such as the National Health and Nutrition Examination Survey – or NHANES – which looks at numerous measures ranging from infectious disease to chronic disease to the dietary habits and body measurements of Americans of all ages.

NHANES also studies the oral health of Americans, and this week an in-depth data quality and control assessment report on the subject of dental fluorosis is being published.

Dental fluorosis is a condition in which small, opaque areas are scattered across the tooth's enamel. Fluorosis is caused by fluoride exposure from any source during the period of tooth development. By age 8, experts say there is no future risk of dental fluorosis, except for permanent third molars, because by that age the enamel of the permanent teeth is fully mineralized.

In the United States, fluorosis is generally considered a cosmetic effect with no negative functional effect. The severe form of fluorosis, however, may have adverse dental effects because the pitting can compromise the protective function of the enamel and the affected area can break away, resulting in excessive wearing of the teeth. However, severe fluorosis is very rare in the U.S.

NCHS has been collecting oral health data for 60 years, since 1959. The NHANES survey is unique in that it conducts physical examinations among participants in addition to interviews. The exams take place in Mobile Examination Centers or "MECs." From 1999-2004 and 2011-2016, dentists conducted fluorosis assessments on participants ages 6–19. Teeth were scored using one of the most commonly used tools for assessing fluorosis in the US, called the Dean's Fluorosis Index. Based on the assessment, participants are categorized as "unaffected, questionable, very mild, mild, moderate, or severe."

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Dr. Eleanor Fleming is the dental epidemiologist with NHANES, and one of the contributors on the new report on dental fluorosis clinical assessment data. She discussed the objectives behind the new report and what they found

EF: For this report, our objectives were three-fold: First, we wanted to describe the fluorosis data collection and quality assurance and control procedures. Second, we wanted to evaluate the data quality by examining rater variability and reliability. Third, we wanted to evaluate the biologic plausibility of the prevalence estimates for children.

This report is a good example of the quality assurance and quality control procedures – the QA/QC - that NCHS typically performs on NHANES data, in general and specifically with data collected by examiners on the MEC. During the oral health examination, as the dentist is assessing a participant's tooth, data are recorded directly onto a computerized data collection system by a dental recorder. The system is integrated centrally and allows NCHS to regularly monitor the collected data for logical inconsistencies and examiner error.

NCHS also periodically conducts field observations to ensure that established exam procedures and protocols are being followed. The dentists are further evaluated about twice a year by having a certain number of their exams repeated by a second dentist, known as the reference examiner. Data from these repeat exams are used to determine how consistently the dentist and reference rated the extent of fluorosis. For a few years, we also had repeat exams on the same participant by the same examiner at two different time periods.

Evaluation of these inter-examiner data, that is, those comparing the dentist and reference examiner – found moderate to almost perfect agreement for the 9 dentists who performed dental fluorosis clinical exams. However, the total number of exams for which a gold standard exam was conducted was only about 2-4%, which could be considered low given the subjective scoring nature of the Dean's Fluorosis Index. The intra-examiner data, those comparing 2 repeat exams by the same dentist on the same participant also showed moderate to substantial agreement. However, the difference in fluorosis severity level for the same person assessed in the same way days apart demonstrates that it may be difficult to assess fluorosis the same way consistently.

We also evaluated whether the prevalence estimates computed with these data for children were biologically plausible. Too much fluoride ingestion before tooth eruption is the only known cause of fluorosis. Therefore, we would not expect a change in fluorosis prevalence among erupted permanent teeth of the same tooth type among children as they age over time. For this analysis, we created a synthetic cohort that included participants who were ages 6–9 in 2001–2004 and ages 16–19 in 2011–2014. In other words, two points in time focusing on participants who were born around the same period, although measurements were not taken on the same group of participants at each time period.

Based on these analysis, we found that there was a significant increase in the prevalence of mild or greater fluorosis in permanent first molars. The prevalence increased from about 10% in children ages 6–9 in 2001–2004 to 46.9% in children ages 16–19 in 2011–2014. This increase between surveys is unexpected, since the prevalence of fluorosis in the first permanent molar should not change over time. We concluded therefore that this increase was biologically implausible.

So, although the inter and intra examiner reliability statistics showed at least moderate agreement between the dentist and reference examiners, the observed increase in dental fluorosis prevalence with age based on the cohort analysis is not biologically plausible. While it is not possible to determine what accounts for this apparent increase over time, the results are consistent with changes in how both the dental examiner and the reference examiner evaluated the level of fluorosis.

We strongly encourage that the quality assessment findings in this report be considered when determining whether these data are appropriate for the user's analytic objectives, including studies of prevalence and trends.