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Comparison of ranking dental status using the Significant Caries Index and the Significant Filled and Sound-Teeth Index

N. Namal[1] and A. Sheiham[2]

[1]*Istanbul University, Cerrahpasa, Faculty of Medicine, Department of Public Health, Istanbul, Turkey;* [2]*Dept of Epidemiology and Public Health, University College London, London, England*

Objective The objective was to test whether the ranking of countries was different using the SFS-T (Significant Filled Sound-Teeth Index) or the Significant Caries Index (SiC). ***Method*** This study compared the country rankings using the SiC and the SFS-T indices in 12 year olds in a range of countries. The SFS-T is the one-third of the population with the lowest filled or sound teeth and is a measure of functional status. We used the SiC and DMFT data from the WHO database for 12 year olds. SFS-T index values were estimated for the 12 year olds for 16 countries. ***Results*** The ranking by SiC index scores was lower for developed countries than for developing countries. ***Conclusions*** These findings suggest that it may be more useful to use the SFS-T index than the SiC index in studies comparing dental status between countries.

Key words: dental, indices, SiC, FS-T, dental status, SFS-T

Introduction

The Significant Caries Index (SiC index) was introduced to draw the attention of policy makers to those children with the highest caries scores in each population (Bratthall, 2000). It was developed to sort children by their DMFT and to calculate the mean score of the one third of children with the highest caries scores and to assess the frequency distribution of caries in a population (Bratthall, 2000; Nishi *et al,* 2002). That was done to direct attention to the high caries group in a population because the frequency distribution of caries in many countries have a skewed frequency distribution and therefore using the conventional mean DMFT may mask inequalities.

The assumption, in the DMFT, and therefore the SiC, is that the dental status of populations is the sum of decayed (D), missing (M) and filled (F), teeth (T). The DMFT index has several limitations (Sheiham *et al*, 1987; Burt, 1997; Benigeri *et al*, 1998). The DMFT index mixes disease and treatment (filled teeth) and does not give any weight to sound teeth. One of the fundamental shortcomings of the DMFT index is that it gives equal weight, a score of 1 to a missing tooth as well as to a filled tooth or decayed tooth and no weight to a sound tooth (Marcenes & Sheiham, 1993). Because the DMFT is insufficiently sensitive to detect differences in oral health between population groups, measures that selectively weight components of the DMFT may be better dental indicators (Sheiham, Maizels and Maizels 1987; Namal, Vehid and Sheiham 2005).

Sheiham *et al* (1987) suggested a functional measure that weights filled and sound teeth equally, because functionally they are very similar, and a tissue health measure that differentially weights decayed, filled, and sound teeth. A sound tooth has the highest score. The measure is called FS-T (Sheiham *et al*, 1987). It is apparent that the FS-T and DMFT measure different aspects of oral health. The DMFT is an index of caries experience, not of dental status. So, while DMFT represents disease and its consequences, FS-T measures dental health and function. The number of functioning teeth and the number of sound-equivalent teeth indices are more sensitive to the influence of social and behavioural factors, such as those investigated here, than is the traditional DMFT index. Both FS-T and DMFT indices can be easily calculated from the same components (Namal, Vehid and Sheiham, 2005).

Studies agree that FS-T index is a more accurate dental heath status measure than the DMFT index (Marcenes and Sheiham, 1993; Benigeri, Payette and Brodeur, 1998; Namal *et al,* (2005)). Namal *et al,* (2005) showed that FS-T conveys a more positive dental picture than DMFT. For example, when the DMFT and FS-T indices were used in an international comparison, the DMFT values were higher in developed than in developing countries. That contrasted with the findings for FS-T values in the same countries. The FS-T showed that the status was better in the developed than in developing countries. Oral health status was indeed better in developed countries and not worse than in developing countries as suggested by DMFT Namal *et al,* (2005). Thus it is apparent that these two measures give different views of dental status. Nevertheless, DMFT is generally used in many international comparisons and SiC that uses the DMFT is now being recommended (Bratthall, 2000). For example, the WHO dental data bank records DMFT and SiC (WHO 2005).

Correspondence to: Dr Necmi Namal, Istanbul University, Cerrahpasa, Faculty of Medicine, Department of Public Health, Ataköy 9 – 10, Kisim D-20 C – D.21, 34750 Istanbul, Turkey. E-mail: necminamal@yahoo.com

The SiC, like the DMFT, is important to indicate tooth decay and its consequences. However, as shown by Morgan *et al* (2005), the rank order of caries status by geographical area is influenced by the definitions of the chosen index, and that has implications for policy planning. The question therefore that needs addressing is, do the shortcomings of DMFT compared to the FS-T as an indicator of dental health as shown by Namal *et al* (2005), apply to the SiC index, a derivative of DMFT? To test that a new index, the Significant Filled, Sound Teeth Index) (SFS-T) based on the FS-T and which calculates the group with the worst third on the FS-T index will be used and compared with the SiC**.** This study also assesses whether the SFS-T will give a better summary measure than SiC index. The objective was to test whether the ranking of countries was different using the SFS-T (Significant Filled Sound-Teeth Index) or the Significant Caries Index (SiC).

Material and Methods

The DMFT index is the sum of the DT, FT and MT (decayed, filled and missing teeth). The FS-T index is the sum of the number of FT (filled teeth) and ST (sound teeth). Both indices are based either on 32 teeth or 28 teeth depending on the inclusion or exclusion of third molars. The DMFT and FS-T indices are related numerically, since the total of D+M+F+S=28 or 32. For the FS-T, DT is defined as the number of teeth with primary and secondary caries; FT as the number teeth filled or crowned, MT as the number of teeth missing, and ST as the number of sound unfilled teeth. SiC data of the countries were found in WHO database. The D, M and F components, which constitute DMFT, were calculated from the WHO oral health database. They were also applied to D, M, F components which constitute SiC and then SiCD, SicM, SiCF levels were created. Some countries have SiC values in the WHO database. However, DMFT components were not reported in some reference sources, so these countries were excluded. The DMFT and SiC index values for 12 year olds of 16 countries were obtained from the WHO database (WHO, 2005). The SiC and SFS-T share the F component. 28 teeth per person was used in this study.

The principles of calculation of the SiC index are to sort individuals according to their DMFT, select the one-third of the population with the highest caries values and to calculate the mean DMFT for that subgroup (Bratthall, 2000). The SFS-T index sorts individuals according to their FS-T (Filled and Sound teeth), selects the one-third of the population with the lowest filled and sound teeth values and then calculates the mean FS-T for this subgroup. This study used the formula 28 - (SiCD+SiCM) = SFS-T (Table 1) to calculate SFS-T. The D and M components in 28 - DM formula used for the Significant FS-T index are the same as the values calculated for SiC index. That is to say, the highest values are D and M values which belong to worst one third segment of the population.

The relationship between rankings using SiC and SFS-T indices was investigated for 16 countries for 12 year olds (WHO, 2005). The countries were ranked by SiC and then SFS-T index values from the most positive to the most negative countries.

Results

Table 2 shows the DMFT and SiC values of 12 year olds from 16 countries. The ranking of countries, beginning from the most positive DMFT status according to the DMFT, differs from the ranking beginning with the lowest SiC value. For 11 of the 16 countries the DMFT and SiC rankings are the same. However some countries, such as Jamaica and Senegal improved their rank by three places, and the United Kingdom fell five places when using SiC.

Table 3 shows the SiC and SFS-T values of 12 year olds from the same 16 countries. Here, only 4 countries were ranked the same by the two methods. Many countries dropped in the ranking using SFS-T compared to SiC. For example, Senegal went down from 4th to 12th and China from 6th to 11th. On the other hand Austria improved from 5th to 1st and the United Kingdom, from 7th to 4th (Table 3).

Discussion

Namal, Vehid and Sheiham (2005) using the WHO dental database for DMFT in 18 year-olds group and the 35-44 year-age group, showed that the FST index reflects the dental status more accurately than the DMFT index. In that study, while developed countries were ranked worse according to the DMFT index, when compared to the FS-T index, they were in better rank positions.

Since the SiC index is a derivative of the DMFT, the SiC appears to have the same weaknesses as the DMFT when compared to the FS-T. In the present study, DMFT and SiC had similar rankings (Table 2). Both DMFT and its derivative SiC consists of Decay (D) and Missing (M) and Filled (F) as negative components. While in developed countries the numbers of filled teeth was relatively high, in developing countries the filled teeth component was low. In the FS-T index, the Filled (F) component is seen as a positive component because the teeth are still functional, whereas in the DMFT and SiC indices, Filled is seen as negative and given same weight as caries or missing. The question that planners may ask is it correct to consider a tooth that has had treatment as an unhealthy tooth? This is the core difference between the two indices compared here.

What is in fact the main target of the calculation of the SiC index? To determine the group has the highest caries risk? Can the SiC achieve that objective? Could not SFS-T's most negative one-third group be considered as a more realistic higher risk group? In our opinion, the answer is yes. In the new ranking, while some countries with a higher proportion of their DMFT as filled had higher ranks with SFS-T, developing countries fell to lower rank positions because they had fewer of their decayed teeth filled.

While developing countries have a lower level of oral health in terms of DMFT, their oral health level was better in terms of FS-T. Here, the key point is that F component is high in developed countries and was low in developing countries. A difference in the F component reflects dental health. Whereas in DMFT and SiC it is bad to have filled teeth, in FS-T and SFS-T it is given equal weighting as a sound tooth. As FS-T consists of

Table 1. Calculation of SFS-T components from SiC

	SiC	*SiCD*	*SiCM*	*SiCD+SiCM*
SiC (SiCD+SiCM+(SiCF)	2.4	1.2	0.1	1.3
SFS-T (28-(SiCD+SiCM)	26.7	1.2	0.1	1.3

Table 2. DMFT and SiC assessments of 12 year olds in 16 countries.

Country	*DMFT Rank*	*Mean DMFT*	*D*	*M*	*F*	*SiC Rank*	*Mean for SiC*	*SiCD*	*SiCM*	*SiCF*
Australia	1	0.80	0.40	0.04	0.40	1	2.40	1.20	0.10	1.20
U. Kingdom	2	0.89	0.39	0.07	0.43	7	3.24	1.42	0.25	1.57
Switzerland	3	0.90	0.15	0.02	0.72	2	2.50	1.42	0.60	2.00
China	4	1.03	0.91	0.01	0.11	6	3.00	2.66	0.03	0.32
Austria	5	1.04	0.11	0.01	0.92	5	2.90	0.31	0.03	2.57
Jamaica	6	1.10	0.80	0.10	0.20	3	2.80	2.00	0.30	0.50
Senegal	7	1.20	1.10	0.10	0.00	4	2.80	2.60	0.20	0.00
Sri Lanka	8	1.40	1.20	0.10	0.20	8	3.60	3.09	0.26	0.51
Italy	9	1.50	0.90	0.01	0.50	9	3.75	2.25	0.03	1.25
Portugal	10	1.50	0.90	0.10	0.60	10	3.79	2.27	0.25	1.52
Israel	11	1.66	0.91	0.03	0.72	11	4.13	2.26	0.07	1.79
Germany	12	1.70	0.40	0.03	1.30	12	4.10	0.96	0.07	3.14
France	13	1.90	0.80	0.20	1.00	13	4.70	1.98	0.49	2.47
Mexico	14	2.50	1.80	0.04	0.60	14	5.00	3.60	0.08	1.32
Nicaragua	15	2.80	2.70	0.07	0.04	15	5.70	5.50	0.14	0.08
Bolivia	16	4.70	4.20	0.20	0.30	16	8.80	7.90	0.40	0.50

Table 3. SiC and SFS-T ranks of 12 year olds in 16 countries.

Country	*SiC Rank*	*SiC (D+M+F)*	*SiC (D+M)*	*SFS-T Rank*	*SFS-T (28-(SiCD+SiCM)*
Australia	1	2.4	1.3	3	26.7
Switzerland	2	2.5	2.0	5	25.9
Jamaica	3	2.8	2.3	7	25.7
Senegal	4	2.8	2.8	12	25.2
Austria	5	2.9	0.3	1	27.7
China	6	3.0	2.7	11	25.3
U. Kingdom	7	3.2	1.7	4	26.3
Sri Lanka	8	3.6	3.4	13	24.6
Italy	9	3.7	2.3	6	25.7
Portugal	10	3.8	2.5	10	25.5
Israel	11	4.1	2.3	8	25.7
Germany	12	4.1	1.0	2	26.7
France	13	4.7	2.5	9	25.5
Mexico	14	5.0	3.7	14	24.3
Nicaragua	15	5.7	5.6	15	22.4
Bolivia	16	8.8	8.3	16	19.7

positive components, an increase in the value undoubtedly indicates a better level of dental health. The SFS-T shows the worst one third of the population in terms of dental health. As with FS-T it is not misleading to make comparisons between countries or regions with the SFS-T index. Although the FS-T index gives the number of functional teeth, the number of decayed teeth does appear in this index. Some treatable decayed teeth, when treated would be added to functional teeth so the FS-T and SFS-T can improve with treatment whereas the DMFT and SiC cannot improve for a given population.

Although this study was done using countries to test the changes in ranking using two measures of the dental status of the worst third of the population, the SFS-T method can be applied within a country or region if details of the DMFT are available for different populations.

The WHO database is considered a guideline all over the world for dental researchers. It contains only the DMFT and new SiC index values. Publishing of FS-T and SFS-T data from these countries should encourage researchers to use these indices. By using the formula 28-(SiCD+SiCM) = SFS-T, not approximate, but real evaluations will be able to be carried out. On the other hand, the SFS-T index can be easily estimated according to the number of teeth (28 teeth) accepted for SiC index. First, the SiC index must be estimated and then the SFS-T. Use of both of these indices can give a more realistic picture about dental status levels.

The present study has some limitations. Although some countries in the WHO database have SiC values, the DMFT components were not reported in some reference sources, so these countries were excluded. Only 16 countries whose data were accessible in WHO database and contained the information required for our analysis were included in the study.

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