

Gingival Status and Caries Experience in 12 and 15 Year Old School Children in Southern and Central Jordan

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ABSTRACT

Objective: To determine gingival status and caries experience among 12 and 15- year old school children in the middle and South regions of Jordan.

Methods: Data were collected through a clinical examination carried out by a calibrated examiner for 1,914 school children, 633 girls and 1,281 boys (943 in Southern Jordan and 971 in Central Jordan) in twenty two schools. All present teeth were examined including primary teeth. Loe and Silness gingival index was used to detect the gingival condition while dental caries experience was assessed using decayed, missing and filled teeth index.

Results: Gingivitis was detected in 31.4% of the 12 year olds compared to 52.6% of the 15 year olds. Prevalence of dental caries for 12 year olds was 89.7%, the mean decayed; missing and filled teeth 2.65 ± 1.15 and gingival score 0.47 ± 0.81 . For students aged 15 years prevalence of dental caries was 94.8%, decayed, missing and filled teeth 2.82 ± 1.36 and gingival score 0.73 ± 0.83 . For the study population, older subjects tended to have higher decayed, missing and filled teeth (2.82 ± 1.36) than younger (2.65 ± 1.15) and gingival scores were also higher in older (0.73 ± 0.83) than younger (0.47 ± 0.81) and the difference was statistically significant ($P = 0.00$). The difference in mean decayed, missing and filled teeth and gingival index between Southern and Central Jordan was statistically significant ($P = 0.00$). Boys tended to have significantly higher decayed, missing and filled teeth index and gingival scores than girls ($P = 0.00$).

Conclusion: Caries experience and gingival scores were significantly higher in boys than girls and in 15 than 12 year old school children. These scores were also worse among students in South regions of Jordan compared to those in the middle regions. A need to build a school-based oral health services is evident and both preventive and restorative approaches should be adopted for school children.

Key words: Caries, Children, Gingivitis, Jordan, Prevalence.

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Introduction

Dental caries and inflammatory periodontal diseases are among the most prevalent conditions in human population. The distribution and

severity of oral diseases vary in different parts of the world and within the same country or region. The significant role of socio-behavioural and environmental factors in oral disease and health

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is demonstrated in a large number of epidemiological surveys.⁽¹⁾

Because of its globally high prevalence, dental caries in children has been described as a 'pandemic' disease characterized by a high percentage of untreated carious cavities causing pain, discomfort and functional limitations.⁽²⁾ Untreated carious cavities have a significant impact on the general health of children and on the social and economic wellbeing of communities⁽³⁾ and are more common in developing, than developed countries.⁽⁴⁾ Globally, most children have signs of gingivitis⁽⁵⁾ and about 2% of youth have Juvenile or early-onset aggressive periodontitis, a severe periodontal condition affecting individuals during puberty and leads to premature tooth loss.⁽⁶⁾

Jordan has experienced a significant increase of its population, with children less than 15-years of age forming a large fraction (around 37.3%) of its total population.⁽⁷⁾ National epidemiological studies in 1984 and in 1990 showed that dental caries experience, as measured by decayed, missing and filled teeth index (DMFT), for the 12 to 16 year-old age group⁽⁸⁻¹⁰⁾ were found to be high. However, a study of oral health trends in Jordanian children⁽¹¹⁾ concluded that oral hygiene, gingival conditions and dental caries have improved since the early 1990s. Other studies on school children in Northern Jordan showed that dental plaque, calculus, and dental caries were reported higher than destructive periodontal disease,⁽¹⁰⁾ and the incidence of gingivitis and dental caries in Northern Jordan school children found to be higher than that of school children in developed countries.⁽¹²⁾ Assessment of the prevalence and severity of periodontal disease indicated that gingival rather than periodontal disease is common in Jordanian adolescents⁽⁹⁾ and the mean gingival index for children aged 12-14 in Northern Jordan is 1.90.⁽¹³⁾

Epidemiological data on oral health are very important in order to plan for future oral health care provision. Younger populations were the target for many epidemiological studies in Jordan⁽¹⁰⁾ and most of these studies were carried out in schools located in Northern^(10,14) and Central Jordan.⁽¹⁵⁾ Only one study included students in Southern Jordan where Moller and

Mirza⁽¹⁶⁾ conducted a survey of 300 children with DMFT value of 3.15.

This study is conducted with the following objectives: to determine and compare between 12 and 15 year old school children in Southern and Central Jordan in terms of gingival status and caries experience, to compare findings to previous studies in Jordan and in other countries.

Methods

The subjects comprising the population of this study were students from schools that follow the Military Directorate of Culture and Education (MDCE) of Jordan Armed Forces (JAF), in Central and Southern Jordan. According to geographic location, schools in Central Jordan were located in two sections: Amman, and Zarqa. Two schools (one for boys and the other for girls) were in Amman, and four schools in Zarqa (two for girls, one for boys and one for both genders) to comprise a sample of six. Total number of schools in Southern Jordan was sixteen schools (thirteen for boys and three for girls). Selection of schools was non-random. Twenty two schools of MDCE in Central and Southern Jordan were included. All school children in the 6th grade cohort (12-years-old) and 9th grade cohort (15-years-old) attending these schools were examined. All students were included except students who for a variety of reasons did not attend school at the day of the examination.

Demographic profile of the study population was as follows. A total of 1,914 students were examined in this study, of these 1,101 students were aged 12 years while 813 students were aged 15 years, 971 students were from schools in the central region and 943 were from the southern region. The study sample included 633 girls (33.1 percent) and 1281 boys (66.9 percent) (Table I).

Ethical approval for the study was obtained from ethical committee of the Royal Medical Services (RMS) - JAF. The data were collected by clinical examination which was performed by a single qualified examiner (RAO) who was calibrated for reliability and consistency before data collection. According to WHO criteria,⁽¹⁷⁾ the subjects were seated in a chair inside the classroom. Teeth of the subjects were not brushed or professionally cleaned prior to the examination. No radiographic examinations were performed.

Table I: Demographic profile of study population

	12 years old		15 years old		Total
	Boys	Girls	Boys	Girls	
	No. (%)	No. (%)	No. (%)	No. (%)	
Southern Jordan	379 (78.1)	106 (21.9)	382 (83.4)	76 (16.6)	943
Central Jordan	370 (60.1)	246 (39.9)	150 (42.3)	205 (57.7)	971
Total	749 (68.0)	352 (32.0)	532 (65.4)	281 (34.6)	1914

Table II: DMFT Index and GI scores in relation to location, age and gender (Pearson's Chi-Square test)

	DMFT M ± SD	P- value	GI M ± SD	P- value
Southern Jordan (N=943)	2.62 ± 1.15		1.00 ± 0.95	
Central Jordan (N=971)	2.83 ± 1.63	0.00	0.17 ± 0.38	0.00
12 years (N=1101)	2.65 ± 1.15		0.47 ± 0.81	
15 years (N= 813)	2.82 ± 1.36	0.00	0.73 ± 0.83	0.00
Boys (N= 1281)	2.75 ± 1.16		0.59 ± 0.78	
Girls (N= 633)	2.68 ± 1.83	0.00	0.56 ± 0.9	0.00

All present teeth were examined including primary teeth if present. Caries experience for subjects under study was registered using DMFT index and means ± SD of DMFT were calculated.⁽¹⁷⁾

Gingival scores were recorded for each child using the criteria of Loe and Silness (1963) gingival index (GI).⁽¹⁸⁾ The index scores are based on a 0-3 scale that combines an assessment of tissue colour and form with bleeding on stimulation assessment. According to this method, each of the four gingival areas of the tooth (facial, mesial, distal, and lingual) is assessed for inflammation and given a score from 0 to 3. Bleeding is assessed by running a periodontal probe along the soft tissue wall of the gingival crevice. The scores for the four areas of the tooth were added and divided by four to give a tooth score. By adding the tooth scores together and dividing by the number of teeth examined, an individual's GI score can be obtained.

Processing and analysis of data were carried out by means of the Statistical Package for the Social Sciences (SPSS - PC Version 16.0). Descriptive statistics, including means, standard deviations (SD) and frequency distribution, were calculated. Cross tabulation and Pearson Chi-square test used for analysis of data. $P < 0.05$ was considered statistically significant.

Results

Caries experience and gingival status for the study population is given in Table II. Results showed that older subjects tended to have significantly higher DMFT and gingival scores than younger subjects ($P = 0.00$). DMFT scores were also higher in the middle regions of Jordan (2.83 ± 1.63) compared to the southern ones for the 12 and 15 year-old schoolchildren. On the contrary, GI scores were higher in the southern regions (1.00 ± 0.95) compared to the middle ones (0.17 ± 0.38). The difference in mean DMFT and GI between the two regions was statistically significant ($P = 0.00$). Moreover, boys had higher DMFT index and GI than girls ($P = 0.00$).

Dental caries in 12-year-olds:

The prevalence of dental caries for school children in Southern Jordan was 96.3% (caries free, 3.7%) while in Central Jordan it was 84.6% (caries free, 15.4%). There was a statistically significant difference in prevalence of dental caries in this age group and both gender and location ($P = 0.00$).

Analysis of data revealed that caries experience (mean ± SD) in this age group in the south regions of Jordan was 2.68 ± 1.66 (Table III). In the middle regions however, it was lower (2.63 ± 1.15) and the difference was statistically

Table III: DMFT Index and GI scores of 12 and 15- year old school children of both genders in relation to location (Pearson Chi-Square test)

			DMFT M ± SD	GI M ± SD
Southern Jordan	12 years	All	2.68 ± 1.66	0.89 ± 1.00
		Girls	3.16 ± 1.78	1.48 ± 1.21
		Boys	2.55 ± 0.86	0.73 ± 0.87
	15 years	All	3.17 ± 1.15	1.11 ± 0.87
		Girls	2.24 ± 1.5	1.58 ± 0.94
		Boys	2.62 ± 1.1	1.02 ± 0.82
Central Jordan	12 years	All	2.63 ± 1.15	0.13 ± 0.34
		Girls	2.34 ± 2.0	0.16 ± 0.37 #
		Boys	2.83 ± 1.3	0.11 ± 0.32
	15 years	All	2.55 ± 1.51	0.23 ± 0.42
		Girls	3.00 ± 1.58	0.19 ± 0.39
		Boys	3.41 ± 1.37	0.29 ± 0.45

All variables have $P < 0.05$ except #

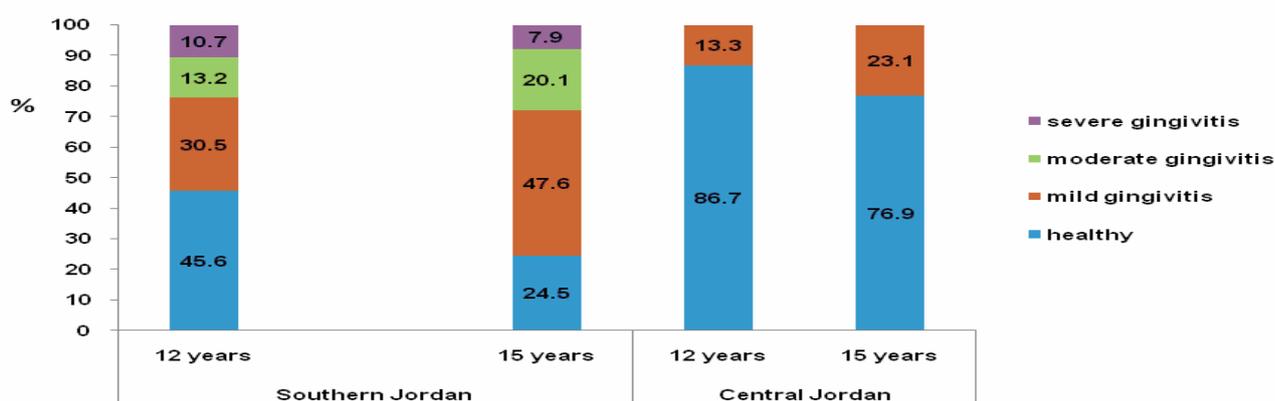


Fig. 1: Percentages of 12 and 15 year old school children by GI scores

significant ($P = 0.00$). Girls in Southern Jordan had significantly higher DMFT scores (3.16 ± 1.78) compared to boys (2.55 ± 0.86). In Central Jordan the opposite was found where girls tended to have lower caries experience than boys ($P = 0.00$) (Table III).

Dental caries in 15-year-olds:

Results of prevalence and severity of dental caries in 15-year-olds showed that 95.2% had experienced dental decay in the south regions compared to 94.4% in the middle ones. Similar to school children aged 12 years, a statistically

significant relationship found between prevalence of dental caries in this age group and both gender and location ($P = 0.00$).

Table III shows that, caries experience (mean DMFT ± SD) in south regions of Jordan is higher (3.17 ± 1.15) than that recorded for 12-year olds (2.68 ± 1.66). Middle regions however, showed lower DMFT scores for this age group compared to 12-year olds and the difference between age groups was statistically significant ($P = 0.00$). There was a slight tendency for boys to have higher DMFT scores in both regions compared to girls ($P = 0.00$).

Gingival condition in 12-year-olds:

Gingival status, as measured by GI, for 12 and 15-year-old school children is shown in Figure 1. Overall in south regions, less children (45.6%) aged 12-years had healthy periodontal tissues compared to children in the middle regions (86.7%). Boys showed better gingival health (lower mean GI \pm SD) than girls in both regions (Table 3). However, in the middle regions of Jordan, no statistically significant relationship could be found between gingival status and gender ($P = 0.63$).

Gingival condition in 15-year-olds:

For 15 year olds, 24.5% of school children in south regions had healthy gingiva compared to 76.9% in middle ones (Fig. 1), and the difference was statistically significant ($P = 0.00$). In Southern Jordan, boys got better gingival health (lower GI, 1.02 ± 0.82) than girls, 1.58 ± 0.94 (Table 3) however; boys got higher GI in Central Jordan than girls (Table III), ($P = 0.00$). The percentage of schoolchildren with healthy periodontal tissues was lowest among 15-year-old school children compared to 12-year-olds in both regions (Fig. 1).

Discussion

Schools of MDCE and side to side with Ministry of Education schools provide free basic education for boys and girls living in different regions of Jordan. Our study was part of the annual medical screening program conducted by the Preventive Medicine Department -RMS for students receiving their education at schools of MDCE. School children are screened annually for presence of dental caries, gingivitis and malocclusion. Subjects who need treatment are referred to the nearest military medical centre/hospital to receive the appropriate dental treatment.

In Jordan, the oral health system is in a transitional developmental stage, and systemic data collection is needed to plan oral health care for the public. Unfortunately, no systematic oral health surveillance systems have been established in Jordan and comprehensive preventive programs for oral health care are still lacking.⁽¹⁹⁾ Few studies have described the oral hygiene, gingival status and dental caries in Jordanian children.^(9,11,12,15) However, none of these studies

were related to children living in south regions of Jordan except one report⁽¹⁶⁾ by Moller and Merza. In 1981 they investigated only 300 children aged 12 years and living in Southern Jordan, Amman and Jerash. DMFT value for Jordan was 3.15.

Thus, the present study intended to assess the oral disease pattern of school children in the south and middle regions of Jordan. Different oral health components were chosen in order to provide data at national level. Due to the high rates of participation the results of the present survey are considered having national relevance representing Jordanian school children and the sample size in each age group was sufficiently large for statistical analysis. Schools used for collection of clinical data in this study may be used in the next years to monitor the change in prevalence of oral diseases.

The clinical data were collected according to the standardized criteria of the WHO⁽¹⁷⁾ which include dental caries and periodontal disease because these diseases are highly relevant conditions in the planning of community oral health programs. It is a global experience that this recording system may provide reliable data on the occurrence of oral disease. However, dental epidemiologic measures such as the DMFT index do not imply the full scope of the disease's impact on children, families, society and the health care system. Jacques⁽²⁰⁾ considered the important value of classification system to be in its ability to provide information that assist in understanding and solving clinical problems.

It was decided to survey 12- and 15-years-olds school children because 12 years represents a standard age category used by the WHO to assess and compare dental caries levels in the permanent dentition of children worldwide⁽¹⁷⁾ and by the age of 15 years the majority of the permanent dentition has been present in the mouth for 2-3 years and the children are likely to be still in school. Moreover, preventive programs are often planned and implemented at 12 years of age.

In this study we examined children receiving education in schools following MDCE-JAF located in the middle and south regions of Jordan. There were no selection criteria for these schools, which resulted in an imbalance of boys (1281) and girls (633), and stratification of schools by gender may be desirable in the future.

In practice, in this survey, there was little difference in oral disease between boys and girls. The very low rate of non-participation (non-consent or absence from school) is a welcome feature of this study.

In the present study, it was noticed that the number of school children examined in Southern Jordan was less than Central Jordan. The number of girls examined was also less in Southern Jordan than boys. This can be explained by the fact that cultural barriers against education especially for females are still present in the southern regions of Jordan (rural) compared to the middle ones (urban).

Subjects in both age groups enrolled in Central Jordan schools had better oral health (less gingivitis (healthy gingiva 83.1%) and dental caries (11.8% caries free)) than their counterparts in Southern Jordan (healthy gingiva 35.3%, caries free 4.2%) and the difference between the two regions was statistically significant ($P = 0.00$). The variance noted between these groups based on location may be due to socioeconomic factors. Southern Jordan is considered less well developed, have lower socioeconomic status and it is located away from commercial and political centres compared to Northern and Central Jordan.⁽²¹⁾ Availability, accessibility and affordability of dentists are also other factors to consider. Therefore, it is necessary to implement special programs for the south regions which have a higher prevalence of caries and gingivitis.

Caries experience of school children in Central Jordan however, was higher than subjects in southern regions and the difference between the two groups was statistically significant ($P = 0.00$). These results parallel the socioeconomic development in Central Jordan compared to Southern Jordan and may be related to the western type of diet which is rich in refined carbohydrates, and more frequent consumption of sugars, especially sweets and fruit drinks. Overall, the results indicate that all school children in the regions investigated are below the global target of DMFT (3 or less by the year 2000).⁽²²⁾

There was a statistically significant difference with relation to gingival index for school children under study ($P = 0.00$). In southern regions of Jordan gingival index was higher than that in the middle regions. This could be attributed again to

the higher socioeconomic status for people living in Central Jordan compared to those in the south.

DMFT varied significantly with gender (Table II). The lower mean DMFT component observed among girls than boys might reflect a gender difference regarding awareness over oral appearance. Gingival bleeding was noticed in both genders. The gender differences ($P = 0.00$) with regard to gingival scores may be related to the pattern of personal oral hygiene (lower GI in girls than boys), and grooming behaviour in girls.

Comparing our results with other studies in other regions of Jordan, it is evident that the prevalence of caries in 12 year old schoolchildren resident in south regions of Jordan was even higher (96.3%) than that in north regions of Jordan, (Lemanowesky *et al.* 1995,⁽¹⁴⁾ 65.3%, Al-Bashaireh and Hamasha 2002,⁽²³⁾ 72.9%). For school children aged 15 years, prevalence of dental caries in Southern Jordan was 95.2% which is again higher than counterparts in Northern Jordan, 76%⁽²⁴⁾. Healthy gingival tissue was lower (45.6%) among school children aged 12 years and resident in south regions of Jordan compared to counterparts in the north regions (56.8% to 62.0%).⁽¹³⁾ However, a more recent study⁽²⁴⁾ showed healthy periodontium in 27.5% of 12 year old pupils in Northern Jordan.

Previous studies in Northern Jordan⁽¹⁰⁾ have shown that the DMFT scores in 13-15-year-old school children were between 4 and 5. More recent studies in the same region^(23,25) revealed a lower DMFT scores (around 3). The present study showed even a slightly lower DMFT scores among school children in Southern and Central Jordan, 2.62 and 2.83 respectively. Studies investigating gingival status revealed that GI in school children under study (1.00 in Southern Jordan and 0.17 for Central Jordan) was lower than results shown for school children in similar age groups in Northern Jordan (1.4 -1.9).^(13,24,26) Such tendency for lower caries experience and GI might be due to improved health condition today compared to that encountered many years ago and also to the raised awareness about oral hygiene.

Comparing caries experience for 12 year old children from countries geographically close to Jordan, the 2.65 DMFT for Jordan in this study is higher than values recorded in Iraq, 1.7⁽²⁷⁾ and Syria, 2.3.⁽²⁸⁾ However, other countries (Saudi

Arabia,⁽²⁷⁾ Northern West Bank Palestine⁽²⁹⁾ and Lebanon⁽³⁰⁾ reported a higher DMFT: 5.9, 3.45 and 5.0 respectively. Caries experience for certain countries was lower than Jordan: China, 1.0,⁽³¹⁾ Iran, 1.5,⁽³²⁾ Portugal, 1.5,⁽³³⁾ Burkina Faso,⁽³⁴⁾ 0.7, and UAE, 1.6,⁽³⁵⁾ whereas other countries showed higher DMFT values such as Vietnam⁽³⁶⁾, 4.6.

The 15-year-olds in Jordan had a mean DMFT of 2.82 in this study. Values for the same age in some neighbouring countries were higher: in Saudi Arabia, 3.8⁽²⁷⁾ and 7.7 in Lebanon.⁽³⁰⁾ Other countries however showed lower values: UAE,⁽³⁵⁾ 2.5, China,⁽³¹⁾ 1.4 and USA, 1.78.⁽³⁷⁾

The percentage of 12 year-old school children with healthy periodontal tissues in our study was higher (68.6%) than that in other countries: China, 14.3%,⁽³¹⁾ Burkina Faso, 22%⁽³⁴⁾ and Portugal 4.4%.⁽³³⁾ For 15-year-old school children, healthy gingiva was seen in 47.4%, while values were lower in UAE, 37%,⁽³⁵⁾ China,⁽³¹⁾ 1.2%, Lebanon,⁽³⁰⁾ 24%, Saudi Arabia, 15%⁽²⁷⁾ and Syria,⁽²⁸⁾ 14%. Gingival inflammation shown in our study, however, is preventable primarily through proper oral hygiene and self-care practice.

Conclusion

This study has shown that caries experience and gingival scores were significantly higher in boys than in girls, in 15 year olds than 12 year olds and in Southern than Central Jordan. Therefore, the development of a government policy in terms of school-based oral health promotion, prevention programs and health education, as well as organization of care services is mandatory, especially in South regions of Jordan.

References

1. **WHO.** The world oral health report 2003. http://www.who.international/oral_health/publications/report03/en/prInternational.html.
2. **Edelstein B.** The dental caries pandemic and disparities problem. *BMC Oral Health* 2006; 15 (Suppl 1): S2.
3. **Sheiham A.** Dental caries affects body weight, growth and quality of life in pre-school children. *Br Dent J* 2006; 25: 625-626.
4. **Baelum V, Van Palenstein Helderma W, Hugoson A, et al.** Global perspective on changes in the burden of caries and periodontitis: implications for dentistry. *J Oral Rehab* 2007; 34: 872-906.
5. **Petersen PE.** Challenges to improvement of oral health in the 21st century- the approach of the WHO global oral health programme. *Int Dent J* 2004; 54: 329-343.
6. **Albander JM, Brown LJ, Loe H.** Clinical features of early-onset periodontitis. *J Amer Dent Assoc* 1997; 128:1393-1399.
7. <http://www.emro.who.int/jordan/>
8. **WHO- Assignment Report.** Oral health analysis in Jordan. Copenhagen. WHO, 1984.
9. **Taani DQ.** Caries prevalence and periodontal treatment needs in public and private school pupils in Jordan. *Int Dent J* 1997 Apr; 47: 100-104.
10. **Taani DS.** Oral health in Jordan. *Int Dent J* 2004 Dec; 54 (6 Suppl 1): 395-400.
11. **Taani DQ.** Trends in oral hygiene, gingival status and dental caries experience in 13-14-year-old Jordanian school children between 1993 and 1999. *Int Dent J* 2001 Dec; 51(6): 447-450.
12. **Taani DQ.** Relationship of socioeconomic background to oral hygiene, gingival status, and dental caries in children. *Quintessence Int* 2002 Mar; 33 (3): 195-198.
13. **Taani DQ, Alhaja ES.** Self-assessed bleeding as an indicator of gingival health among 12-14-year old children. *J Oral Rehabil* 2003 Jan; 30 (1):78-81.
14. **Limanoska, Hollist O, Abu-Mowais, M.** Pilot epidemiological survey of 12 years-old school children of Irbid governorate of Jordan. *Odontostomatologie Tropic* 1995; 21-24.
15. **Hamdan MA, Rock WP.** Dental caries experience in Jordanian and English schoolchildren. *Community Dent Health* 1993 June; 10 (2); 151-157.
16. **Moller IJ, Mirza K.** WHO/ORH 2nd Jordan Assignment Report, 1981; Geneva.
17. **World Health Organization:** Oral Health Surveys- Basic Methods 4th edition. Geneva, World Health Organization; 1997.
18. **Loe H, Silness J.** Periodontal disease in pregnancy. Prevalence and severity. *Acta Odontol Scand* 1963; 21: 533-551.
19. **Al-Omiri M K, Al-Wahadni AM, Saeed KN.** Oral Health Attitudes, Knowledge, and Behavior Among School Children in North Jordan. *J Dent Edu* 2006; 70: No. 2,179-185.
20. **Jacques DP.** Measuring morbidity. *Ann Surg* 2004; 240(2): 214-215.
21. **Jordan Human Development Report, 2004.** The Ministry of Planning and International Cooperation, the Hashemite Kingdom of Jordan, and the United Nations Development Program (Amman- Jordan).
22. **WHO.** Oral health global indicators for 2000, May 1991; (unpublished document No.

- WHO/ORH/DMFT/12.91 available from the Oral Health Unit, WHO headquarters, Geneva).
23. **Albashaireh Z, Hamasha AA.** Prevalence of dental caries in 12-13-year-old Jordanian students. *South Afr Dent J* 2002; Mar; 57(3): 89-91.
 24. **El-Qaderi SS, Quteish Ta'ani D.** Dental plaque, caries prevalence and gingival conditions of 14-15-year-old schoolchildren in Jerash District, Jordan. *Int J Dent Hyg* 2006; 150-153.
 25. **Hamasha AA, Albashaireh Z.** Periodontal treatment need of the 6th-grade Jordanian pupils. *Int J Paediatr Dent* 2006 May; 16 (3): 181-185.
 26. **Taani DQ, El-Qaderi SS, Abu Alhaija ES.** Dental anxiety in children and its relationship to dental caries and gingival condition. *Int J Dent Hyg* 2005; May; 3(2): 83-87.
 27. **WHO** Oral Health Country/Area Profile Programme
<http://www.whocollab.od.mah.se/index.html>
 28. **Beirut N, Taifour D, van Palenstein Helderman WH, Frencken JE.** A review of the oral health status in Syria. *Int Dent J* 2001; 51: 7-10.
 29. **Sabha B.** The prevalence of dental caries in permanent dentition for 12 -year- old school children in Northern West Bank. Submitted in partial fulfillment of the requirements for the degree of master of public health, Faculty of Graduate Studies, at An-Najah National University, Nablus Palestine, 2007.
 30. **Hussain SA, Doumit M, Doughan B, El Nadeef M.** Oral health in Lebanon: a pilot pathfinder survey. *East Mediter Health J* 1996; 2: 299-303.
 31. **Wang HY, Petersen PE, Bian JY, Zhang BX.** The second national survey of oral health status of children and adults in China. *Int Dent J* 2002; Aug; 52(4): 283-290.
 32. **Pakshir HR.** Oral health in Iran. *Int Dent J* 2004; 54: 367-372.
 33. **de Almeida CM, Petersen PE, André SJ, Toscano A.** Changing oral health status of 6- and 12-year-old schoolchildren in Portugal, *Community Dent Health* 2003; 20: 211-216.
 34. **Varenne B, Petersen PE, Ouattara S.** Oral health status of children and adults in urban and rural areas of Burkina Faso, Africa. *Int Dent J* 2004; 54: 83-89.
 35. **El-Nadeef MAI, Al Hussani E, Hassab H, Arab IA.** National survey of the oral health of 12- and 15-year-old schoolchildren in the United Arab Emirates. *East Mediterr Health J* 2009; 15: No. 4, 993-1004.
 36. **Tayanin GL, Ramanathan J, Bratthall D.** Caries prevalence and some caries related factors for 12-year-old children from Vietiane and Luang Prabang provinces in Lao People's Democratic Republic. *Odontostomatologie tropic* 2002; 25(98): 19-26.
 37. **Trends in Oral Health Status:** United States, 1988-1994 and 1999-2004, CDC vital and health statistics, April 2007, series 11, No. 248.