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Caries Increment Among Army Personnel: A 5-Year Longitudinal Study

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Abstract
To assess the progression of dental caries among Malaysian infantry soldiers after 5 years in military service. A retrospective cohort study with a self-administered questionnaire and a clinical oral examination. Data were available for 173 (67.3%) soldiers. Mean decayed, missing, or filled teeth had increased significantly by 20.6% ($P = .001$) over 5 years. The highest increase was in the missing teeth component (+120%), followed by filled teeth (+23%). This was accompanied by a decrease in decayed teeth (−23.5%; $P < .05$). In terms of surfaces, mean decayed, missing, or filled surfaces, missing surfaces, and filled surfaces had increased significantly ($P < .05$). Caries experience was significantly associated with smoking status and rank ($P < .05$). Dental caries experience was worse after 5 years in military service compared with during recruitment, and there were more tooth extractions than restorations. Health promotion interventions are needed to prevent further tooth loss among soldiers.

Keywords
caries prevalence, caries increment, military, tooth loss

Introduction
Professional soldiers are at high risk of developing pathological conditions in the oral cavity as a result of difficult psychological, physical, and environmental conditions during military maneuvers in peace time but especially during war.¹ Suman et al² reported that “participation in war and the time spent in battlefields has a significant influence on the increased prevalence and severity of periodontal disease and tooth decay, as well as on the changes in dental behavior and diet” (p.73). Therefore, it is important to maintain a high level of oral health fitness among soldiers to avoid disruptions to the readiness and operational ability of the combat units.

In Malaysia, the infantry regiments of the Army are the backbone of the combat units of the Malaysian Armed Forces (MAF). Infantry soldiers are actively involved in military operations

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and exercises throughout the year and are often stationed at national borders, jungles, and isolated islands, which are far from dental centers. Although a few studies have reported on the oral health status of Malaysian soldiers and the impacts on their daily activities, very little is known about the rate of dental caries progression among these young adults. Soldiers would be the best population to estimate the rate of caries progression between the age of 20 to 30 years old because of the availability of baseline data and the nature of the captive population.

The aim of the study was to estimate the rate of caries progression in a population of young adults in military service over a period of 5 years by using the decayed, missing, or filled teeth (DMFT) and the decayed, missing, or filled surfaces (DMFS) indices.

Methods

This study used a retrospective cohort study design, whereby the dental health status of the infantry soldiers at recruitment was compared with their current dental health status obtained during a clinical oral examination after 5 years of military service. A self-administered questionnaire was used to collect data on demographic background, oral health practices, and utilization patterns. The inclusion criteria were as follows: soldiers who had served continuously for 5 years since recruitment (2002/2003) and had complete dental records since recruitment. All eligible individuals from 5 infantry battalions in Kuala Lumpur and Selangor (3 battalions from Royal Malay Regiments and 2 from Royal Ranger Regiments) were included as the study sample.

In each battalion, all dental records of soldiers who had served for 5 years since recruitment were identified. The minimum sample size needed for the study based on the dental caries prevalence for this age group, α level of 5%, and 95% confidence interval was 164. From the 5 battalions, 257 soldiers met the inclusion criteria. Dental records of the 257 soldiers were checked for completeness of data at recruitment, and the mean values for DMFT and DMFS were scored. The DMFS data were collected to complement the DMFT because the former is more sensitive to measure changes in caries experience over time because it takes into account all surfaces of the teeth rather than 1 score per tooth. For example, in a molar tooth, the DMFS index will measure caries experience of 5 surfaces independently, whereas the DMFT index will only provide 1 score, regardless of whether the tooth is decayed, missing, or filled. The 257 soldiers were invited to participate in the study.

On the examination day, informed consent was sought from each soldier. The soldiers were asked to answer the questionnaire followed by an oral examination conducted by the author (AWA). The self-administered questionnaire was designed to collect sociodemographic data (age, gender, race, and rank) and information on prevalence and impact of dental pain during the previous 3 months and oral health practices (tooth brushing, flossing, and health service use). Face validation of the questionnaire was carried out by 5 dental public health specialists of the MAF. Pretest of the questionnaire to assess its clarity and logistic feasibility was conducted on a group of infantry soldiers in Sungai Besi Camp, Kuala Lumpur.

Caries was diagnosed by using a mouth mirror and a standard dental chair light. The clinical diagnostic criterion for dental caries was based on visually apparent cavitation into the dentine. Caries experience was recorded by DMFT and DMFS indices. At the end of the session, reexamination of 10% of the sample was done to assess intraexaminer reliability. The data were analyzed using SPSS version 15. Significant increment (or decrement) in the proportions of caries experience over the 5-year period was analyzed using McNemar statistics. Mean differences in caries experience were analyzed using the paired t test. The main effects of demographic and oral health–related characteristics on caries increment over 5 years were analyzed using repeated-measures ANOVA. The significance level was set at $P < .05$. Ethics approval for the study was granted by the ethics committee of the Dental Faculty, University of Malaya.
Results

Of the 257 soldiers who met the inclusion criteria, only 173 were available for clinical examination, giving a response rate of 67.3%. The reason for nonresponse was because the soldiers were on military duty, attending courses or sports training, or on sick leave. There were no refusals to participate. The intraexaminer reliability was very good, with intraclass correlation of 0.901 for DMFT scores and 0.820 for DMFS scores. The minimum age was 22 years, with a mean of 24.6 years (standard deviation [SD] = 1.6). All the soldiers were male. Table 1 shows the demographic and oral health–related characteristics of the sample.

Table 2 shows the prevalence of dental caries by year of study, assessed using the DMFT index. Although the overall dental caries prevalence (DMFT ≥ 1) had increased over the 5-year period, the increase was not statistically significant. However, the prevalence of missing (MT)
and filled teeth (FT) components had increased significantly over the 5-year period. In contrast, the prevalence of decayed teeth (DT) had decreased, but it was not statistically significant.

Table 3 shows an overview of the mean DMFT and DMFS over 5 years with net caries increments. It was noted that the mean DMFT and DMFS had increased significantly between 2002/2003 and 2008. Significant increases were also observed for the mean number of MT and FT and mean missing and filled surfaces. Overall, the mean values for MT and missing surfaces showed the highest increase: they had more than doubled compared with 2003. On the other hand, the mean for DT had significantly decreased over the 5-year period. However, no significant increase was observed for the mean decayed surface.

Table 4 shows the effects of independent variables on caries increment over 5 years. Interactions between the repeated-measures variables, that is, DMFT and DMFS, and the independent variables were shown in the tests of between-group effects in the table. Levene’s test showed that the variances were homogeneous for all levels of the repeated-measures variables. The condition of sphericity (Mauchly’s test) was also met for all variances in the repeated-measures analysis. From the table, only 2 independent variables were significantly associated with caries increment over 5 years. There was a significant main effect of smoking status on the estimated mean DMFT \(F(1, 171) = 3.75\). There was also a significant main effect of rank on the estimated mean DMFS \(F(1, 171) = 6.84\).

**Discussion**

Longitudinal studies investigating changes in dental caries experience among young adults are difficult to conduct because this age group is very mobile. A good estimate of caries increment in young adults can be obtained by investigating soldiers over a period of time because soldiers are a relatively captive population, and their oral health records can be made accessible. The outcome of this study would be useful to estimate the dental caries increment profile in young adults and the oral health intervention needs of the soldiers over time. The findings could also be used to evaluate improvements in oral health and guide future oral health program planning and resources.

In this study, about one third of the identified sample who fulfilled the inclusion criteria was not present. Despite prior arrangements, some soldiers were not available for examination because of commitments such as being involved in military operation exercise, being on active duty, attending courses, and being posted to other units or because they were on leave. However,
a comparison of baseline data between respondents and nonrespondents showed no statistically significant differences; hence there was no evidence of systematic bias (respondents’ mean DMFT = 3.4 [SD = 3.4], nonrespondents’ mean DMFT = 4.1 [SD = 3.0], \( P = .153 \); respondents’ mean DMFS = 6.6 [SD = 8.2], nonrespondents’ mean DMFS = 7.5 [SD = 7.4], \( P = .446 \)).

This study investigated dental caries experience in a group of infantry soldiers who lived in army camps over a period of 5 years. Overall, the study found that caries prevalence had generally increased over 5 years. What was alarming was the very significant increase in the number of missing teeth and to a lesser extent, filled teeth. This suggests that the most popular treatment was extraction, followed by restorations (fillings). The increased restorations also resulted in a significant reduction in the number of active caries (mean decayed teeth, DT). In other words, although restorative treatment made an impact on reducing the number of active decayed teeth among the soldiers, it was not enough to reduce the rate of tooth loss by extractions.

It was unclear whether the high rates of tooth loss were brought about because of accelerated rates of tooth decay over the 5-year period, to the extent that many teeth could not be saved by simple restorations (ie, they were beyond repair) or that the nature of the soldier’s vocation does not allow prolonged periods away from military duty to undergo complex restorations, which resulted in extractions as the fastest and most convenient treatment of choice. What is clear is that if this was allowed to continue, the high prevalence of tooth loss among soldiers would lead to an increase in need for prosthetic teeth.
The present study also found that smoking status and rank of soldiers have significant effects on caries increment. Soldiers who smoked had a significantly higher caries increment (DMFT) than soldiers who did not smoke. This finding is in agreement with a recent study, whereby cigarette smoking was shown to have a significant association with higher caries occurrence (DMFT). Smoking leads to gum disease, whose clinical presentation ranged from gingival swelling and inflammation, deep periodontal pockets, loss of gingival attachment, and gingival recession. It is likely that smokers with poor attitudes toward oral health tend to disregard their teeth, have poorer periodontal health, and end up with more fillings and extractions than nonsmokers. Thus, smoking habits coupled with cariogenic diets might be responsible for the accelerated tooth loss in this population. More studies are needed to study this problem.

We found that noncommissioned officers had a significantly higher caries increment than army privates over the 5 years. The reason for this is not very clear. One explanation is that because noncommissioned officers have administrative jobs, they preferred to have their teeth extracted to save time, which resulted in a larger increase in the DMFS index.

Caries prevalence in the present study (76.9%) was much lower compared with that in soldiers from the infantry regiment of the Malaysian Territorial Army (96.0%; DMFT = 8.0, SD = 5.5). Nevertheless, this comparison should be treated with caution as the latter group had a wider age difference of between 20 to 50 years. The prevalence of caries in the present study was also lower than that in the National Adults Survey in 2000 (prevalence 82.6% and 91.5% for age groups 20-24 and 25-29 years old, respectively). Similarly, caries prevalence in this study was lower compared with that in a group of Malaysian Army commandoes (prevalence 87.2%; DMFT = 5.62; SD = 4.20). Based on these comparisons, it could be argued that the overall caries prevalence among the soldiers was comparable with that in the general adult population.

In this study, dental extraction appeared to be the main mode of treatment carried out by the Dental Services of the MAF (DSMAF). This finding agreed with those of Razak et al. This treatment trend is highly unfavorable and not sustainable. Immediate actions by the DSMAF are needed, so that dental problems are dealt with much earlier and teeth extraction can be discouraged.

Dental caries is theoretically easy to prevent, and simple, effective technologies are easily available. Preventive measures should include introducing a range of health-promoting policies that take into consideration health (and oral health) impacts of daily activities. Examples are healthy policy at work, healthy food policy, compulsory routine dental check up, dental treatment policy, and regular health promotion and disease prevention programs. Tooth extraction should be avoided if possible. Conservative approaches such as root canal treatment should be adopted. During outstation postings, it is suggested that a dental kit containing a toothbrush, toothpaste, and dental floss becomes part of essential items for military deployment, especially in remote areas. A top-down initiative is vital for the sustainability of such a campaign.

The DSMAF should also strengthen efforts in oral health promotion and disease prevention using the common risk factor approach that addresses a common factor for many diseases. For example, a health promotion campaign that seeks to reduce sugar consumption would not only prevent dental caries but also other health problems such as diabetes and obesity. Similarly, oral health promotion programs aimed at stopping smoking will have a positive impact on periodontal disease and must be given priority. Nonsmoking soldiers are healthier and would certainly improve the performance and combat readiness of the armed forces.

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