

Prevalence of Developmental Dental Anomalies and Defects: A Clinical Survey

Muhannad Ali Kashmoola¹, Nazih Shaaban Mustafa^{1*}, Syaza Mohd Noor²,
Ramizah Rozaimée², Firas Abdul Ameer³

1. Lecturer, Department of Oral Maxillofacial Surgery and Oral Diagnosis, Faculty of Dentistry, International Islamic University Malaysia.
2. Dentist, Ministry of Health, Malaysia.
3. Lecturer, Department of Prosthodontics, College of Dentistry, University of Baghdad.

Abstract

Developmental dental defect can be defined as alteration of teeth from normal in term of number, size, shape and structure. Therefore, knowing the prevalence of developmental dental defect among population may assist in further management of oral health problem. The aim of this study was to explore the developmental dental defect in Malaysian patients in general and particularly among those who were attending at IIUM dental clinic.

A cross-sectional descriptive and analytical study was carried with face-face interview, clinical examination and panoramic radiographic examination by Planmeca digital x-ray with Romexis software among 100 patients who were selected by inclusion and exclusion criteria from total 2300 patient attending IIUM dental clinic. All types of dental anomalies regarding number, size, shape and structure were recorded and analyzed by different races (Malay, Chinese, Indian) of Malaysian by chi square test.

The most common types of dental anomalies encountered were cusp of carebelli (55%), dilacerations (54%), microdontia (38 %) and hypercementosis (38 %). There were no significant differences, ($p > 0.05$) regarding the types of developmental dental defect ; number(hypodontia, hyperdontia), size (microdontia, macrodontia), shape (fusion, dens evaginatus, cusp of carebelli, taurodontism, ectopic enamel, dilacerations, supernumerary roots, hypercementosis),and structure among different Malaysian races.

Other uncommon types of dental anomalies found in the study were dens evaginatus (24%), ectopic enamel (20%), discoloration (20%), hypodontia (19%), supernumerary roots (13%), hyperdontia (11%), taurodontism (11%), macrodontia (7%), cocresence (2%), fusion (1%) and dens invaginatus (1%). There were also no significant differences ($p > 0.05$) regarding the uncommon types of dental defects among races in Malaysia.

In conclusion, cusp of carabelli, dilaceration, microdontia and hypercementosis were the major common dental anomalies in comparison to other type of anomalies. Majority of Malays, Chinese and Indians were observed to have cusp of carabelli and dilacerations.

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Introduction

Developmental dental defect can be defined as alteration of teeth from normal structures which can be categorized into 4 main categories. The categories are abnormality in shape, size, structure and number of teeth. There

***Corresponding author:**

Nazih Shaaban Mustafa,
Kulliyah of dentistry, IIUM Kuantan Campus, Bandar Inderah
Mahkota, 25200, Kuantan- Pahang, Malaysia.
E-mail: dnazih@iium.edu.my

are different types of anomalies in every category. Developmental dental defect can occur on both deciduous and permanent dentitions. However, these anomalies are more frequent seen in permanent dentition as supported by a study in which incidence of 1.6% to 9.6% of dental agenesis is reported to be in permanent teeth excluding third molars whereas 0.5% to 0.9% of cases occurs in deciduous teeth.¹ Also, a study proposed by Harold Agurto Goya, hypodontia preferably affects permanent teeth rather than deciduous teeth.²

Alteration in number of teeth is a condition where there is extra or deficient number of teeth.

Usually in permanent dentition there are 32 teeth including 3rd molars. However, in some people, they do not have 3rd molar which make them to have a total number of 28 teeth. Anadontia and hypodontia can be defined as reduced number of teeth presented in oral cavity due to congenitally missing of certain teeth. Hypodontia usually associated with condition such as Ectodermal dysplasia. Meanwhile, hyperdontia is a condition where there is extra number of teeth. Usually it can be classified as mesiodens (extra teeth in anterior region usually between central incisors) and paramolar (extra teeth in molar area). Hyperdontia usually associated with certain diseases such as cleido-cranial dysplasia.³

Developmental defect in shape of teeth is alteration of teeth shape from normal morphology. There are many types of shape alteration in these categories which include taurodontism (hypotaurodontism, mesotaurodontism, hypertaurodontism), germination, fusion, dilaceration, Talon's cusp or Leong cusp⁴.

Developmental defect in structure of teeth usually comprise of amelogenesis imperfecta, dentinogenesis imperfecta, enamel hypoplasia and several other types. Dentinogenesis imperfect, radiographically, the teeth appear solid, lacking pulp chambers and root canals.

The etiology of developmental dental defects is multifactorial, more than 60 syndromes categorized in On-line Mendelian Inheritance in Man (OMIM) are associated with tooth anomalies, implying that common molecular mechanisms are responsible for tooth and another organ development. Agenesis of numerous teeth is commonly associated with specific syndromes or systematic abnormalities and particularly related to ectodermal dysplasia. In addition to inherited defects, somatic diseases such as syphilis, scarlet fever, rickets, or nutritional disturbances during pregnancy or infancy can affect tooth and other organ development, thereby, leading to tooth agenesis in association with other anomalies. Further, cranial irradiation early in development can produce glandular dysfunction as well as dental anomalies. However, the genetic modification becomes the most prominent reasons for alteration from normal tooth anatomy. Twin studies have been historically used to show the importance of the genetic component acting during tooth development to control both tooth size and form.⁵ However, there are reported cases of

monozygotic twins concordant for tooth agenesis, as well as cases where variation in the expressivity is observed.

Developmental defects of teeth have always been very intriguing. Attempts were made to explain them with evolutionary and anatomic models such as Butler's field theory, odontogenic polarity, or Sofaer's model of compensatory tooth size interactions.⁶

The term odontogenesis has been initially used to describe events related to the origins and initiation of tooth formation. Ten Cate has expanded this definition even further so that it also includes the origins and formation of tooth-supporting tissues, namely cementum, periodontal ligament, and alveolar bone, all tissues of dental descent. A lot of information on tooth formation has been accumulated recently.⁷ Much study had been done in this region to investigate about dental defect, most studies are focusing on single tooth defect such as Talon's cusp, supernumerary teeth and others. None of the study in this region is looking for types of dental anomaly which is in high occurrence among community. Some of the studies done by other researcher investigating on types of dental anomalies which present on symptomatic patient like in patient with ectodermal dysplasia and cleft lips and palate.⁸

In this study we are focusing on prevalence of developmental dental defects on Kuantan community. Kuantan, Pahang is situated in East Cost of Malaysia which comprised of more than 400 000 populations. The population in Kuantan mainly contains 3 major races which are Malay, Chinese, and Indian. This study is properly designed in order to investigate the prevalence of developmental dental defects among patients attending IIUM dental clinic in Kuantan, Pahang. This study also designs in order to investigate types of dental anomalies which commonly present in Kuantan population. In this study we also are going to investigate the association of 3 main races with developmental dental defect presented among them.

Materials and methods

Selection of sample

This study was a cross-sectional study which was conducted in Kuantan, Pahang with population size of 422020 people. The subjects for this study were selected among patients

attending the IIUM dental clinic only. The sample size for this study was calculated by using Epi Info version Statcale software. The reference for population for this study was based on the prevalence of developmental dental defect among Indian population (Kruthika S Guttal, 2010). The expected frequency of the study was 35%. This reference was chosen for calculating sample size because of similarity in population of interest. With the worst acceptable value of 25%, the final calculated sample size was 100 subjects with 95% confidence level. The subjects were selected by systematic random sampling from 2280 patients attending the IIUM dental clinic. The sampling interval was 1:4 in which the subjects were collected from a list of patients attending the IIUM dental clinic. This study focused on developmental disturbance in permanent teeth only. Therefore, the inclusion criterion was patients that have permanent dentition only.

The exclusion criteria for the research subjects were:

- 1) Pediatric patients (age 13 and below)
- 2) Patient with cranio-facial defect such as cleft lips or cleft palate.
- 3) Patient with syndrome such as Down's syndrome, Ehler Danlos and others.
- 4) Patient with dental anomalies which is secondary to developmental structure defect and secondary to systemic problem.

Interview of the subjects

All consented subject undergoes a simple interview. During the interview session, the data regarding socio-demographic were collected. Consented subjects undergo dental check-up in IIUM dental clinic by trained dental students. In this study, only permanent teeth will be included. All collected data were recorded in a special case sheet that has been designed for this study. All teeth were evaluated in form of size, shape, number and structure.

All selected subjects undergo radiographic examination, panoramic radiographs was taken by using Planmeca digital x-ray with Romexis software, all radiographic data were recorded and subjected for further investigation.

All data that has been recorded was analyzed using SPSS version 16.0. The descriptive statistics were used for the data such as mean and standard deviation was used for

continuous variable and percentage and frequency will be used for categorical variables will be calculated. We are going to use Chi Square test in this study.

Results

Regarding gender, 40% of participants were male and 60% were female. This study was participated by 50 (50%) Malays, 30 (30%) Chinese and 20 (20%) Indians. These 3 races represent the major ethnic groups in Malaysia.

The age ranged of the sample was between 13-year-old and 72-year-old with mean of 32.63 ± 13.45 .

Participants were divided according to education level, 4 participants had primary education only, 34 participants had secondary education, 40 participants had at least High school and 22 participants had degree/master/PhD.

Forty-one of participants involved in this study were students, 16 of them work in administrative field, 8 participants were involved in business, 10 participants involve in academic field, 11 participants involved in technical field and 14 were jobless.

Twenty-two participants had positive family history of developmental defect. Meanwhile 49 participants had no history of developmental defect. The rest of participants 29 were not sure about familial history of developmental dental defect.

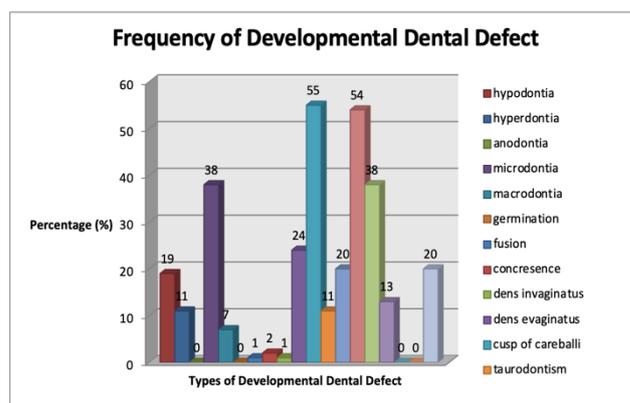


Figure 1. Frequency distribution of developmental dental defects.

From figure 1, we can see that cusp of Carabelli was the most common dental anomaly found in this study group which was 55% followed by dilacerations (54%), whereas the

least was taurodontism (1%), fusion (1%) and dens invaginatus (1%).

As seen in figure 2, the prevalence of having cusp of carabelli was higher in females (35%) than males (20%). It was noted that females have higher prevalence of dilacerations compared to males which was 35% and 19% respectively. However, microdontia was seen to be equal in both males and females which was 19%. Hypercementosis was more frequent observed in females which were 23% than males which were 15%.

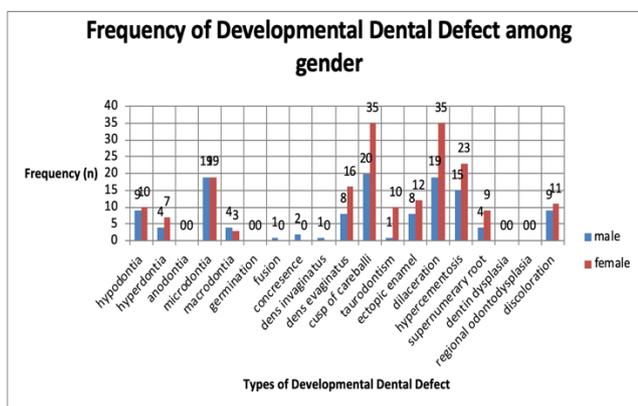


Figure 2. Distribution of frequency of developmental dental defect among gender.

All defects show no significant relationship to gender, except for taurodontism, which shows significant value with $p = 0.027$.

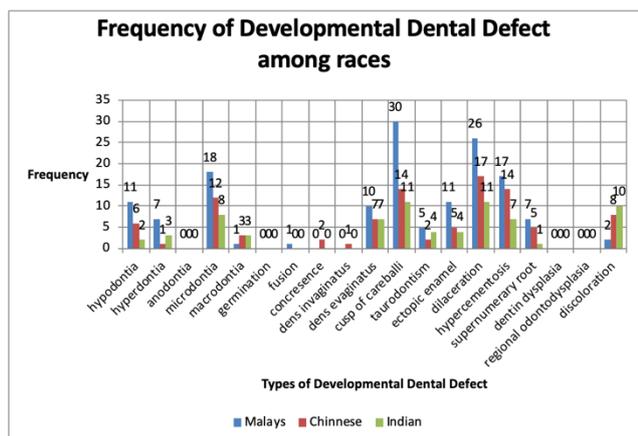


Figure 3. Frequency of developmental dental defect among different races (Malays, Chinese, Indians).

Based on this graph, cusp of carabelli were more common among Malays population which was 30 cases. While 50% of Indians

population were found to have discoloration of enamel surface.

Statistical analysis showed no significance correlation between developmental dental defect and races except between discoloration and races with a p value equal to 0.00.

Discussion

Numerous studies had been conducted world-wide regarding developmental dental defect among different populations. In this study, cusp of carabelli was the most frequent anomaly found among the subjects which was 55% of all anomalies which comprised majority of the subjects from each race. This was supported by a local study that 52.2% of the subjects were observed to have cusp of carabelli.⁹ However, it was mentioned in another study that 17.4% to 90% of the white population were reported to have cusp of carabelli but rarely occurred in Asians.¹⁰ Cusp of carabelli is abnormal or additional cusp that usually located in palatal surface of upper molar, According Alvelosa, 20% of Faithi population shows positive cusp of carabelli presented on upper molar. There was no sexual dimorphism either in the occurrence or in the degree of expression of character. Results of the statistical analyses suggested low heritability of the character. However, the dichotomy of having a cusp or not may have genetic basis, but there is large variation in the expression of the "cusp-genotype" (1988). Our finding had been supported by a study on the prevalence of Carabelli cusps among Hungarians population which found 65.34 per cent in the contemporary population had Carabelli cusp.¹¹ Cusp of carabelli does not bring much problems in dental management. However, cusp of carabelli still had potential to cause premature contacts and periodontal problem. It also affects fixed prosthesis preparation as it can affect parallelism in preparation.

Dilaceration was observed to be the second most common anomaly with percentage of 54%. However, a study on Australian population showed that dilaceration was the least prevalence occurred which was 1.8%.¹² In present study, females have higher prevalence of dilacerations than males which was 35% and 19% respectively. In contrast to a study of Indian population, dilacerations was seen more in males

than females which were 12.9% and 9.7% respectively.¹³ Dilaceration was recognized to be important during root canal treatment as failure to diagnose dilaceration may lead to failure of the treatment.¹⁴ A common error in endodontic treatment was failed to maintain root canal curvature, which lead to ledging, apical cavitation (transport and zipping), perforation and instrument breakage.¹⁵ H. Jafarzadeh mentioned in his study that dilacerations was frequently found in posterior teeth and in the maxilla.¹² A review literature reported that dilacerations can occurs in both deciduous and permanent dentition. It can be cause by mechanical trauma to deciduous tooth, scar formation, developmental anomaly of the primary tooth germ, facial clefting (24), advanced root canal infections, ectopic development of the tooth germ and lack of space the effect of anatomic structures (for example, the cortical bone of the maxillary sinus, the mandibular canal, or the nasal fossa, which might deflect the epithelial diaphragm), the presence of an adjacent cyst, tumor, or odontogenic hamartoma (for example, odontoma and supernumerary tooth), orotracheal intubation and laryngoscopy, mechanical interference with eruption (for example, from an ankylosed primary tooth that does not resorb), tooth transplantation, extraction of primary teeth, and hereditary factors. It can present range from 0.35% to 90% depending on the etiology as well as hereditary factor.¹⁶

Microdontia was the third common anomaly found in this study which was 38%. In Thailand, 13.7% of subjects were observed to have microdontia.¹⁷ whereas, in Kuwaiti population, microdontia was the least prevalent with percentage of 3.5%.¹⁸ According to Gupta, microdontia are very common occur in maxilla than in mandible and the common tooth affected was upper lateral incisors.¹³ Upper lateral incisors and third molars are frequently affected. When lateral incisors are affected, there is a reduction in mesiodistal diameter and convergence towards the incisal edge which is referred to as peg shaped incisors. The condition is largely of genetic origin.¹⁹

Macrodontia was seen to be less than microdontia. In present study, the percentage was 7%. This was also supported by Suwadee in his study that only 1.4% of subjects have macrodontia. Problem with abnormalities in size of tooth may lead to crowding and spacing.²⁰

Hypercementosis was reported to be 38% of all anomalies in this study which in contrast to a study of Thai population that hypercementosis occur at very low rate.²¹ In another study of 137 individuals, 3.8 teeth per individual were observed to have hypercementosis and it is reported that premolars were the most affected teeth.²² It has been proposed that hypercementosis may occur in an individual tooth or may be observed in several teeth of a same person.

It was noted that hypodontia comprised only 19% of all anomalies in the study sample. This finding was much higher compared to a study of Indian population done by where hypodontia occurred in 10.6% of study subjects.²³ Whereas, in a study of Saudi Arabian and Kuwaiti populations, hypodontia was the most common anomaly occurred which constituted 70.8% and 52.7% of study sample respectively.²⁴ However, it has been reported that Asian population including Vietnamese, Japanese, Chinese and Malaysian have higher rate of missing teeth than white and black population.²⁵ This could be due to racial differences from where the studies were conducted. Congenitally missing teeth more frequently occur with maxillary laterals, 2nd premolars and mandibular central incisors. In dentistry, missing tooth or teeth may lead to malocclusion and create an aesthetic problem. Hypodontia can be managed by orthodontic treatment, osseointegrated implant, fixed partial dentures, removable partial dentures and overdentures.²⁶

Hyperdontia or additional teeth are usually of conical shape (supernumerary teeth), but it may resemble teeth of the normal series (supplemental teeth). Supernumerary teeth commonly form in incisor or molar region and very seldom in the midline (mesiodens). Occasionally, an additional maxillary incisor, premolar or rarely, a fourth molar develops.²⁷ It has been noted that mesiodens is the most common found followed by fourth molars, premolars and maxillary lateral incisors.²⁸ A study of Indian population showed that there was higher occurrence of paramolars, followed by mesiodense and supernumerary of anterior region.²⁸ In present study, 11% of the subjects have hyperdontia. Extra teeth frequently erupt in an abnormal position. This, it may cause aesthetic problem as well as caries, gingivitis and periodontitis. Also, they sometimes block or

prevent permanent tooth from erupting. Normally, the additional teeth should be extracted.

Dens evaginatus can be defined as cusp like enamel usually located in central groove or lingual ridge as a result of evagination of enamel from tooth structure. It also being called Talon's cusp or Leong cusp. It usually occur in lower premolar and incisor. Based on the result of this study we found that dens evaginatus comprised of 24% of the sample population. In a study by Kocsis, dens evaginatus was reported to have high prevalence among Asian people which vary from 0.5% - 4.3% of population group studied.²⁹ Also, a higher incidence of dens evaginatus were observed in Eskimo and North American Indian.³⁰ Because tubercle of dens evaginatus may extend above the occlusal surface, thus it may lead to premature contact or even malocclusion. Traumatic occlusal force may then cause wear or fracture of tubercle and sometimes pulp exposure may occur.³¹ The presence of dens evaginatus on occlusal surface can also leads to periodontal problem due to excessive pressure being exerted by this opposing tooth to this cusp. Thus, it will cause development of periodontal problem either on the tooth with dens evaginatus or opposing tooth. Dens evaginatus also can cause sensitivity of tooth structure if there is any breakdown of enamel surface. This is because there usually pulp horn projection into dens evaginatus. This projection will increase sensitivity because it quite close to external surface and it also leads the pulp exposure. Thus, the need for root canal treatment will increase. The talon cusp remains as one of the more uncommon dental anomalies worldwide and in Turkey and presents with different clinical features.³² According to a study conducted in Jordan population, only 52 teeth from 3024 teeth examined by periapical radiograph shows positive dens evaginatus. The common teeth involve was maxillary canine and maxillary central incisor.

Dens invaginatus is an anomaly resulting from invagination in the surface of a tooth crown or rarely the root and which is lined by enamel and dentin.³³ Dens invaginatus was only observed in 1% of the subjects in this study. Study of patient charts at the College of Dentistry, King Saud University showed 1.7% of them have dens invaginatus.³⁴ The prevalence was much lower compared to Australian population, 26.1% of the subjects have dens invaginatus. It has

been proposed by the study that maxillary lateral incisors were commonly seen to be invaginated followed by maxillary central incisors.³⁵

Fusion was reported to have less than 1% of prevalence in white population however, a higher prevalence of fusion was noted in Japanese and American Indians.¹³ (Clayton, 1956; Grahnen, 1961). In a study done by Knudsen, 68% of population have fusion of maxillary central incisors.³⁶

According to Arslan A, prevalence of accessory roots in different population was not reported in any studies except for individual case reports.²³ These supernumerary roots may be due to the disturbances of the Hertwig's epithelial root sheath forming the root. Cases have been reported where in both the deciduous and permanent dentition exhibiting supernumerary roots. Here with we are presenting cases of supernumerary roots in permanent second premolars.³⁷

Discoloration was found to be 20% in this study. Among the other abnormalities, discoloration was the only significant result found in relationship to races. The highest races having discoloration is Indian race when we found 50% of Indian sample having discoloration when compared to other races. Discoloration give a huge impact on esthetic value of the patient. About two-thirds of the sample (67.1%) had at least one tooth affected by enamel defects.³⁸ Discoloration on enamel surface include discoloration that occur during development of tooth. It includes dental fluorosis, tetracycline staining, bilirubin staining, enamel hypoplasia, enamel opacities due to other medical problem that interfere with mineralization of tooth structure.³⁹ According to several study, they found that common viral infections during early childhood have long been blamed for the presence of enamel discoloration. However, Suckling and Pearce, 1984 did not find more enamel defects in children experiencing one or more of these diseases before age 5, but 20 children with a history of serious illness or accident had an increased prevalence of one or more enamel defects, although the type of defect was not specified.⁴⁰

Based on this study we found that about 20% of total sample were having at least one side of tooth surface with ectopic enamel. Mostly were located in molar area which extend under cervical line. Some of the ectopic enamel also

been located in bifurcation or root surface known as enamel pearls. One theory of the enamel pearl etiology is that enamel pearls develop as a result of a localized developmental activity of a remnant of Hertwig's epithelial root sheath which has remained adherent to the root surface during root development. It is believed that cells differentiate into functioning ameloblasts and produce enamel deposits on the root.⁴¹ A study by Pederson, 1990 found that there is races and ethnicity influence over prevalence of ectopic enamel. He found that ectopic enamel has higher prevalence among Eskimo rather than other race.⁴¹ In the present study, no occurrence in deciduous teeth was found. Complications arising from enamel pearls found in primary dentitions may include slower processes of enamel resorption, delayed exfoliation of the primary teeth, and/or deviation of the succedaneous tooth.⁴¹

Taurodontism can be defined as a change in tooth shape caused by the failure of Hertwig's epithelial sheath diaphragm to invaginate at the proper horizontal level. An enlarged pulp chamber, apical displacement of the pulp floor, and no constriction at the level of the cemento-enamel junction are the characteristic features. In our study we found that about 11% of sample having taurodontism. It is more common in female rather than male. Taurodontism also occur in all races with Malays have higher frequency with 5 cases compared to Indian and Chinese with 4 cases and 2 cases respectively. Our finding has been supported by A study on a group of Jordanian dental patients has shown an overall prevalence of 8% for individuals. Ruprecht et al, 1998 found a prevalence of 11.3% for individuals in Saudi dental patients.⁴²

Conclusions

This study was to determine the type and frequency of non-syndromic patients attending International Islamic University Malaysia (IIUM) dental clinic. It can be concluded that developmental dental defects were found more common in females compared to males. Also, it was noted that cusp of carabelli, dilaceration, microdontia and hypercementosis were the major common dental anomalies observed in comparison to other type of anomalies. Based on the result, we found that developmental dental

defect as relationship between gender, races and ethnic group.

The result cannot be used to generalization into population as the sample sizes were small compared to actual population. Therefore, we recommended that this study should be conducted in community level to get accurate result.

The findings of this study can be applied to the students as well as clinicians in managing and constructing treatment plans for the patients. The result of this study can give an idea to clinician and students on what are the dental problems exist among population. Therefore, we can predict what will be the chief complain of patient other than pain. It also will help clinician to do proper treatment planning for a better outcome treatment.

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Declaration of Interest

The authors report no conflict of interest.

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