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Fluoride toothpaste utilization behaviour among preschool children in Perlis, Malaysia

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Background Very mild fluorosis is quite prevalent in children and one of the sources may be attributed to poor fluoride toothpaste utilization habits. ***Aim*** To investigate the frequency of toothbrushing, parental supervision, the person who usually applied the toothpaste, toothpaste swallowing and spitting habits, size of toothbrush, type of toothpaste used and amount of toothpaste used by shape and weight. ***Methodology*** Observational cross-sectional study of a representative random sample of 373 children aged 5-6 year-old. The children were interviewed using a structured close ended questionnaire. Direct observations were made on their toothpaste dispensing habit during a toothbrushing exercise. ***Results*** All children reported practising toothbrushing with 90% on a daily basis. Almost all used fluoridated toothpaste (91.4%). About one-half (50.7%) reported that their parents never supervised them. More than one-third of children used adult toothpaste and 60.1% of the toothpaste was flavoured. Most (92%) used toothbrush meant for children. About 40% applied a pea-sized amount of toothpaste. The mean weight of toothpaste applied was 0.43g (SD+0.35g). ***Conclusions*** The majority used the recommended child-sized toothbrush and toothpaste that contained fluoride but less than one-half of the parents supervised their children. Most children used flavoured children's toothpaste but a sizable proportion used toothpastes meant for adults. The amount applied by shape and weight exceeded the amount recommended by experts.

Key words: Fluoride, fluorosis, preschool children, toothpaste.

The Oral Health Division (OHD) has implemented a nationwide community water fluoridation programme since 1972 and encouraged the use of fluoridated toothpastes to control dental caries. Fluoridated water is supplied to about 62.4% of the total population in Malaysia, but in Perlis it covers 90.3% (OHD, 2003).

In Malaysia, almost all toothpastes sold locally contain fluoride (Abdul-Kadir and Abdol-Latif, 1998). Fluoride overdose during the growth period in children can lead to developmental defects of enamel. There have been calls in the United States (US) to reduce the fluoride concentration in toothpaste for preschool children to 400-500ppm. In Malaysia, a study among 16 year-old schoolchildren found 74.7% prevalence of fluorosis in fluoridated areas compared to only 14.2% in non-fluoridated areas (OHD, 2001). More than one-half (54.9%) of children used a full-brush length of toothpaste but only 5% used a pea-sized amount.. There was increasing public concern over the effects of fluoride on teeth and general health expressed in local newspapers. However, the psychological impacts of the mild dental fluorosis in Malaysian schoolchildren were actually quite low. Only 3.6% of those with fluorosis said it affected their decision to go out with friends. Thus the perceived social impact was mild and did not affect their lives considerably (Maznah *et al*, 2006).

Fluoride ingestion by young children occurs because they inadvertently swallow toothpaste during toothbrushing (Levy et. al, 1992; Bently *et al*., 1999). Among the factors that increased the risks for fluorosis were "using fluoride toothpaste before the age of six years" (Mascarenhas and Burt, 1998), "no adult supervision while brushing" and "children who used more than 0.5g (0.5mgF) of toothpaste per brushing" (Loveren *et al*, 2004).

To reduce the risk of fluorosis, O'Mullane (2004) recommended that toothbrushing with fluoride toothpaste should start no sooner than 2 to 2.5 years to prevent fluorosis of maxillary central incisors. Konig (2002) recommended that parents brush their children's teeth with a pea-sized toothpaste once a day, starting when the first deciduous teeth erupt. However, the weight of a pea-sized toothpaste varies across cultures. In Malaysia, Amdah (2000) measured a pea-sized toothpaste to be about 0.35g. A pea-size in Shanghai China was 0.25g (Zhou *et al*, 2002), whereas in the West, Loveren *et al* (2004) reported that a small pea was about 0.50g.

Rock (1994) reported that even a pea-sized quantity of toothpaste may be too much because children may swallow up to half of the toothpaste dispensed. He recommended that young children use only a smear of low fluoride toothpaste under parental supervision. Thus the key factor is parental supervision during toothbrushing. Curnow *et al* (2002) found that high caries risk children have significantly less caries after participating in a toothbrushing programme with toothpaste containing 1000ppm fluoride supervised by local mothers.

Since 1984, dental nurses of the Perlis Oral Health Department have been carrying out special programmes

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for preschool children. Activities include oral health education, exhibitions, role play, and toothbrushing exercises, including the safe use of fluoride toothpaste. The visits were conducted at least twice a year for each preschool. Teachers were also trained to conduct the oral hygiene drills daily.

There is therefore a need to assess the degree of compliance on the safe usage of fluoridated toothpaste in pre-school children during toothbrushing. This would be useful to gauge the effectiveness of oral health education messages and as a basis to modify the existing toothbrushing messages especially for children between the critical ages of two to five years.

The aim of this study was to investigate the toothbrushing behaviour of preschool children aged five and six years old in relation to fluoride toothpaste usage in Perlis. The objectives were to investigate their toothbrushing habits in terms of frequency, parental supervision, toothpaste application, toothpaste swallowing and spitting habits, tooth brush size**,** type of toothpaste used and the amount of toothpaste applied by shape and weight.

Method

This is an observational cross sectional study using a stratified random sample. The sampling frame comprised all preschool children aged 5-6 years in Perlis. The total population of preschool children enrolled in 241 preschools was 7018. Based on a 95% confidence, an estimated prevalence of about 40% of preschoolers who applied pea-sized amount of toothpaste (Amdah, 2000), the minimum sample size needed was 292 (Epi-Info 3.3.2). To compensate for dropouts or non-response the total sample size was inflated to the final sample of 373. The population was first stratified by schools. Fourteen preschools were then randomly selected from which all 5-6 year-old children were included until the quota was met.

Permission to conduct the survey was sought from the relevant authorities. The parents were informed of the objectives in order to obtain their written consent. The children were asked to bring their own toothbrush and toothpaste that they were currently using at home for the toothbrushing exercise. The dental nurses and their assistants helped to conduct a toothbrushing exercise at the end of each survey.

The questionnaire was adopted from a previous study (Amdah, 2000) which has been pretested and validated and used with permission. It consists of two sections. Section A contained questions related to toothbrushing habits and toothpaste use. Section B collected information based on observation of the toothbrush and toothpaste used by every child and their toothpaste dispensing habit before the toothbrushing exercise was carried out. The observations recorded were toothpaste-brand used, adult/child formulation, fluoride status, flavour status, toothbrush-size used and the amount of toothpaste applied by shape and weight.

A pre-test was conducted on a group of preschool children with similar characteristics to the proposed sample to help plan the flow of the survey. A few questions were simplified to make it easier for children to understand. The data was collected in January and February 2005.

A day before the survey, the children were told to bring the toothbrushes and toothpastes that they were currently using at home. Only children who brought letters of consent from their parents were included. The children were first interviewed individually using a structured questionnaire. The toothbrush of each child was examined, weighed before- and after- application of toothpaste by the child (using Analytical balance model Santorius Basic BA1605) and the readings recorded. The children subsequently participated in the toothbrushing exercise conducted in groups by the dental nurses.

The data was coded, cleaned and 10% was counter checked for accuracy. Analysis was done using SPSS version 11.0 and was limited to descriptive statistics.

Results

Of the 373 preschool children selected, only 337 (90.3%) participated in the survey. Two refused, 25 were absent and nine had no parental consent. Nevertheless, the final sample size still exceeded the minimum sample size needed.

There were almost equal proportion of males (53.7%) and females (46.3%). The majority were 6 years-old (68%) and the rest were 5 year-old (32%). The majority were Malays (83.1%), followed by Chinese (11.6%) and the remaining few were Siamese.

Every one claimed that they brushed their teeth. About 90% said that they brushed at least once a day. In other words about 10% did not practice daily toothbrushing. Of those who brushed, most of them (60.8%) brushed twice or more a day (Table 1). The majority (82.8%) reported that it was mainly their mothers who taught them how to brush their teeth; followed by the nurses (30.6%), others (28.5%) and then the teachers (27.0%) (Table 1).

With regards to parental supervision, about one-half (50.7%) reported that their parents "never supervised" them during toothbrushing (Table 2). Only 28.5% of children claimed that their parents supervised them "every time" they brushed at home, while 20.8% reported parental supervision as "sometimes". Almost all (99.1%) of the children reported that they used toothpaste during toothbrushing (Table 1). However, nearly one-half (45.1%) said that they dispensed the toothpaste themselves, while 43.3% claimed that their mother dispensed it for them (Table 1).

For swallowing and rinsing habits, the majority (76%) claimed that they never had the habit of swallowing toothpaste and almost all (97.6%) claimed that they rinsed after toothbrushing. Most (62.1%) were observed to use toothpaste formulated for children and 91.4% of them used fluoridated toothpaste (Table 4). The majority (60.1%) used fruit-flavored toothpastes and 91.7% of them used toothbrush designed for children (Table 2).

Only 39.5% of children applied a pea-sized amount of toothpaste (Table 2). The proportion who applied toothpaste of partial- and full-length of the toothbrush head was 39.2% and 8.6%, respectively. Only 12.8% of the children applied a "smear" of toothpaste on their toothbrush. The weight of toothpaste applied by the children ranged from 0.01g to 2.38g with a mean of 0.43g (SD: 0.35).

Table 1. Toothbrushing habits and parental supervision

	Question		*n*	*%*
1	Frequency of toothbrushing	Once daily	98	29.1
		Twice daily	129	38.3
		3 times or more daily	76	22.5
		Sometimes, not daily	34	10.1
		Total	337	100
2	Individual/s who taught child to brush teeth*	mother	279	82.8
		teacher	91	27.0
		nurse	103	30.6
		others	96	28.5
3	Does your parent/guardian supervise you during toothbrushing?	yes, every time	96	28.5
		sometimes, not daily	70	20.8
		never	171	50.7
		Total	337	100
4	Do you use toothpaste during toothbrushing?	yes	334	99.1
		no	3	.9
		Total	337	100
5	Person who usually applied the toothpaste for child	mother	146	43.3
		father	22	6.5
		myself	152	45.1
		others	17	5.1
		Total	337	100

* multiple responses allowed

Discussion

The majority of children in the sample were six years old. There were almost equal proportion of males and females. The ethnic composition of the sample reflects the state of Perlis where the Malays form the majority, followed by the Chinese and Siamese. Thus the sample population is a typical representation of the general preschool population in Perlis.

Most of the children (91.4%) were using fluoridated toothpaste. The majority of them brushed twice or thrice daily and were also exposed to fluoridated public water supply which put them at greater risk of fluorosis. Teeth which would be at risk of fluorosis for the age group of five to six years are the canines, second premolars and the second molars. In other words if the incisors and first molars were to be spared from fluorosis, the toothbrushing habits must be controlled much earlier than that.

The amount of fluoride ingestion from toothpaste by young children is influenced by the degree of adult supervision. Thus, Holt et. al (1996) recommended that parents must supervise the amount of toothpaste used up to the age of six years. The present study found that about one-half (50.7%) said that they were "never supervised" when toothbrushing at home whilst about one-fifth reported only occasional supervision ("sometimes"). This study supports the findings of Amdah (2000) that 52% of Malay preschool children in Kuala Langat, Selangor reported that they were never supervised when toothbrushing at home. This shows that regular supervision by parents/guardians was not a norm. This may be due to ignorance, lack of time or low motivation on the part of the mothers/guardians.

Many of these children (45%) were dispensing the toothpaste themselves which is not a recommended practice. Mothers (43.3%) appear to be the most important and therefore the most suitable person to educate and play this role. This confirms the importance of targeting toothbrushing education to mothers besides their children.

The majority (76%) claimed they did not swallow toothpaste during toothbrushing. However, inadvertent ingestion may still occur because swallowing reflexes of children below six years are not fully developed (Mascarenhas & Burt, 1998). Zhou et. al (2002) reported that fluoride intake was influenced by accidental swallowing of fluoride toothpaste among preschool children. In the present study, the lack of supervision during toothbrushing and the widespread use of flavoured toothpaste may actually encourage swallowing which might increase the risk for fluorosis.

The amount of fluoride ingested from toothpaste may be significantly reduced by rinsing and/or spitting during toothbrushing (Loveren et. al, 2004). Although this practice may reduce the duration of enamel contact with free fluoride ions and thus reduce its effectiveness, it has to be balanced against the risk of fluorosis from ingestion. Hence in Perlis, children were taught to rinse and spit after toothbrushing due to widespread use of fluoridated public water supply. The present study found

Table 2. Toothbrush and toothpaste used by children before the toothbrushing exercise.

	Item		*n*	*%*
1	Commercial brand of toothpaste used	Colgate	153	45.5
		Kodomo	81	24.1
		Darlie	40	11.9
		Raiya Junior	14	4.2
		Pro Dental B	13	3.9
		Sparkle	9	2.7
		Others	26	7.7
		Total	336	100
2	Formulation of toothpaste used (child or adult)*	children	208	62.1
		adult	127	37.9
		Total	335	100
3	Fluoride content in toothpaste (fluoridated or non fluoridated)*	with fluoride	307	91.4
		no flouride	29	8.6
		Total	336	100
4	Type of toothpaste used (flavoured or non-flavoured)	with flavour	202	60.1
		no flavour	134	39.9
		Total	336	100
5	Size of toothbrush used**	child	308	91.7
		adult	28	8.3
		Total	336	100
6	Amount of toothpaste applied by child by shape	pea size	133	39.5
		partial length	132	39.2
		full length	29	8.6
		smear	43	12.8
		Total	337	100

1 child did not bring toothpaste
* 1 child had toothpaste without information on formulation
** 1 child did not bring toothbrush

that almost all children (97.6%) rinsed after brushing their teeth. Thus in addition to rinsing after brushing, the children should be reminded to spit regularly during brushing. This is especially important for children using adult-formulated toothpastes which contain more than 1000 ppm fluoride (Loveren et. al, 2004).

About nine in every ten children (91.1%) used fluoridated toothpastes. This showed that parents were probably aware of and accept the beneficial effects of fluoride.

Although the majority of children used toothpastes formulated for children, more than one-third (37.9%) used toothpastes meant for adults. Adult-formulated toothpastes typically contain between 1000-1500 ppm fluoride which may put the children at higher risk for fluorosis if they ingest large amounts and do not spit regularly during toothbrushing. Flavoured toothpaste may also encourage voluntary ingestion by children. For children who habitually swallow toothpaste, their parents should be advised to switch to non-flavoured regular toothpaste (Levy *et al*., 1992).

The amount of toothpaste applied tends to be more when larger toothbrushes are used because the user tends to spread the toothpaste over the large bristle head (Glass et. al., 1975). Fortunately, the present study found that most children (90%) used small-sized toothbrushes meant for children.

Among the contributing factors affecting the ingestion of fluoride through toothbrushing by young children, the quantity of toothpaste used was found to be the most important factor (Naccache et. al, 1992). Bently *et al* (1999) observed that the mean weight of toothpaste applied by 50 children aged 30 months in England was 0.36g (SD 0.21) and 72% of the toothpaste applied to the brush was retained in the mouth and presumably ingested. It was subsequently recommended that parents of children below seven years should dispense only a small pea-sized amount and to discourage swallowing. In the present study, about one-half (47.8%) of the children applied partial- to full-length amount of toothpaste which was larger than the recommended pea-sized amount. This is despite the advice from dental nurses during their twice yearly visit to the kindergartens. Perhaps the children were influenced by commercial television advertisements which usually show full-length application of toothpaste on the

toothbrush head or because they like the taste of flavoured toothpaste. Thus the industry leaders should be advised to change their standard advertisements to show pea-sized dispensed toothpastes rather than full-length.

The present study found that the mean weight of toothpaste dispensed by the children was significantly more than the weight of standard pea-size toothpaste dispensed by experts at the Faculty of Dentistry, University Malaya (Amdah, 2000) and that recommended by Zhou *et al* (2002). This shows that it is difficult for the public to visualize the size of a pea which may vary in different countries. Alternatively, it may be safer to adopt the recommendation by Rock (1994) that the brush should merely be smeared with toothpaste. This strengthens the case to revise future oral health education messages to use only a smear amount of toothpaste, especially if the toothpastes contain more than 1000ppm fluoride.

However, this study has some limitations. First, the young respondents may be unable to understand or recall accurately the information asked. Secondly, some children may have attempted to present themselves more favourably instead of telling what they usually do at home. For example, the children were informed to bring the toothbrush and toothpaste they regularly used at home on the survey date. However, it was observed that some participants brought brand new looking toothbrushes and toothpastes to school specially for the survey. This may differ from what they normally used at home.

Based on the findings of this study, it is recommended that:

1. The dental nurses in Perlis should emphasize the use of small pea-sized child-formulated toothpaste for daily toothbrushing or just a smear amount of it, if it is an adult-formulated toothpaste.
2. Parents should be encouraged to supervise toothbrushing of their children from two to six years of age. Below two years old, fluoride toothpastes should be avoided. Parental supervision will also improve the effectiveness of toothbrushing.
3. The preschool teachers should be given a set of guidelines on fluoride toothpaste usage for preschool children to enable them to incorporate these messages into their lesson plan. They should supervise the children during their daily toothbrushing routine after tea break.
4. The major players in the toothpaste industry should be encouraged to disseminate the recommended amount of toothpaste for young children on their packaging, advertisements and public education programmes.

Therefore it was concluded that the majority of children were taught by their mothers to brush their teeth at least once or twice a day using fluoridated children's toothpaste but unfortunately about one-half of the children dispensed the toothpaste themselves and were unsupervised during brushing. In addition, only about one-third applied the recommended pea-sized amount which was much heavier than the average weight recommended by public health experts. Thus there is a need to promote the safe usage of fluoridated toothpaste in this population to reduce the possible risk of fluorosis.

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