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Promoting Positive Health Behaviours – 'Tooth Worm' Phenomenon and its Implications

X.L. Gao[1], C.Y.S. Hsu[2], Y.C. Xu[3], T. Loh[2], D. Koh[4] and H.B. Hwarng[5]

[1] Dental Public Health, Faculty of Dentistry, The University of Hong Kong. [2] Department of Preventive Dentistry, Faculty of Dentistry, National University of Singapore. [3] School of Management, Fudan University. [4] Department of Epidemiology and Public Health, Yong Loo Lin School of Medicine, National University of Singapore. [5] Department of Decision Sciences, School of Business, National University of Singapore

'Tooth worm' is a traditional belief about the pathogen of dental caries (tooth decay). Nevertheless, in our previous study, parental 'tooth worm' belief was linked to a reduced caries risk of their children. ***Objectives:*** This study aimed to further characterize the impact of parental 'tooth worm' belief on their children's caries experience and its psychobehavioural mechanisms. ***Basic Research Design:*** analytic observational study. ***Setting:*** Thirteen randomly selected kindergartens in Singapore. ***Participants:*** 1,782 preschoolers aged 3-6 years. ***Methods:*** Each child received an oral examination and microbiological tests. Parents completed a self-administered questionnaire on their socio-demographic background, oral health knowledge/attitude and child's oral health habits. ***Results:*** Multivariate analysis confirmed a reduced chance of 'high caries rate' (number of affected teeth>2) among children whose parents held the 'tooth worm' belief (Odds Ratio=0.41; 95% Confidence Interval=0.19-0.89). With such perception among parents, children brushed their teeth more frequently (p=0.042). Since no difference in oral hygiene was observed, the health benefit of the "tooth worm" perception may be acquired through the delivery of fluoride (an agent with proven anti-caries effect) during frequent toothbrushing episodes. ***Conclusions:*** This study revealed a 'tooth worm' phenomenon, indicating that parental 'tooth worm' belief is associated with early establishment of regular toothbrushing habit and reduction of dental caries in children. This phenomenon and its psychobehavioural mechanisms, enriching our understanding of oral health behaviours, have implications for effective health education.

Key words: health belief, health behaviour, culture, oral health, oral hygiene

Introduction

'Tooth worm' is a traditional belief about the pathogen of dental caries. The formation of this perception dates back to 5000 BC, evidenced by a Sumerian text discovered on a clay tablet known as the 'legend of the worm', which described 'tooth worms' as the culprit of caries (Suddick and Norman, 1990). Although there was no proof that tooth worms ever existed, some people believed that tooth worms bore a hole through the tooth and cause toothache by wriggling around (Suddick and Norman, 1990). Evidence of this 'tooth worm' belief is also found in some other countries, such as India, Egypt, Japan, and China (Suddick and Norman, 1990).

The history of oral science has witnessed a gradual rejection of the 'tooth worm' concept. During the Age of Enlightenment, the 'tooth worm' legend was no longer accepted in the European medical community (McCauley and Fauchard, 2001). With the influential chemicoparasitic theory proposed by WD Miller and the subsequent research, caries is understood as a result of mineral dissolution induced by the metabolism of the acidogenic bacteria in the biofilm (plaque) on tooth surfaces, with sugar as the substrate (Suddick and Norman, 1990).

Despite the long history of the knowledge refuting 'tooth worm' as a pathogen for caries, the 'tooth worm' belief still exists in some populations. A report has described a procedure filmed by a dentist who witnessed a quack using the smoke from burned herbs to expel tooth worms from a patient (Hsu and Ring, 1998). Nevertheless, a fading-off of the 'tooth worm' belief has been seen and is often regarded as an evidence for the improvement of public's oral health knowledge and the success of health promotion campaigns.

It was assumed, if not taken for granted, that expelling the traditional perception and imparting scientific knowledge of caries aetiology would assist the public to make informed decisions, empower them to adopt dentally healthy behaviours, and thus improve their oral health. However, this assumption has been recently questioned in our report (Gao *et al.,* 2010). Primarily focused on building biopsychosocial models for caries risk assessment, our report has suggested a reduced caries rate, rather than an elevated caries risk as assumed, in children whose parents held the 'tooth worm' belief (Gao *et al*., 2010). This seemingly 'unexpected' finding compelled us to further scrutinize the association between parental 'tooth worm' belief and their children's caries experience. It would also be relevant to explore the possible psychobehavioural mechanisms for this association so that any practical implications for health education and promotion could be derived.

The dental profession is increasingly recognizing the great impacts of cultural beliefs on multiple dimensions of oral health (Butani *et al*., 2008). Cultural factors are often implied as causes of ethnic and socioeconomic

Correspondence to: Dr. Xiao-Li Gao, Dental Public Health, Faculty of Dentistry, University of Hong Kong, Prince Philip Dental Hospital, 34 Hospital Road, Sai Ying Pun, Hong Kong. Email: gaoxl@hkucc.hku.hk

disparities in oral health; however, the current literature on the impact of specific cultures on oral health is scant (Butani *et al*., 2008). 'Tooth worm' conception is a cultural belief existing in some populations, particularly in underdeveloped and developing countries and among ethnic minorities in some developed countries. Investigating the 'tooth worm' conception with its regard to oral health and related behaviours is of obvious relevance to public health and is thus the objective of this study.

Methods

Research participants

After obtaining ethical approval and parental informed written consent, we recruited 1,782 preschoolers (889 males and 893 females; 3-6 years in age) from 13 randomly selected kindergartens in Singapore. The response rate was 86%. Details of the sampling and recruitment have been reported in a preceding paper (Gao *et al*., 2009).

Questionnaire survey

A self-administered questionnaire pre-tested in our previous studies was completed by parents. Information was collected on the demographic background (age, gender, and ethnicity), socioeconomic status (parents' education attainment and type of housing), and parental knowledge, attitude, and practice (infant feeding history, dietary habits, oral hygiene practice, and dental attendance) related to children's oral health.

Through one of the questions evaluating parental knowledge on oral health, parents' opinions on caries aetiology were sought. Parents were requested to indicate whether they perceived each of the following factors as a main reason of tooth decay: 'sugar/snacking', 'insufficient toothbrushing', 'bacteria', 'tooth worms', and 'excess heat' (an Asian belief emphasizing a particular humoural imbalance characterized by excess heat).

Oral examination

Oral examinations were conducted for all children by the same trained examiner. The examiner was blinded to the parental opinions on caries aetiology. Duplicate examinations were carried out on 10% randomly selected children to assess the intra-examiner reliability.

Caries was registered according to the World Health Organization methods and criteria (WHO, 1997). Tooth status was evaluated using visual inspection and aided by tactile inspection where necessary. Caries were recorded as present when there was a cavity, undermined enamel or a detectable softened surface. The disease (caries) outcome measure was 'number of decayed, missing, and filled teeth (dmft)'.

The oral hygiene status was evaluated using modified Silness-Löe Plaque Index, with 6 index teeth (1E, 1B, 2D, 3E, 3B, and 4D) (Silness and Loe, 1964). The oral hygiene score of each tooth surface ranged from 0 to 3. The average score of all index teeth was further categorised to represent four levels of mouth cleanliness: very good (Plaque Index<0.4), good (Plaque Index 0.4-1.0), less than good (Plaque Index >1.0, ≤ 2.0), and poor (Plaque Index>2.0).

Microbiological tests

The participating children were instructed to chew paraffin for 5 minutes and stimulated saliva was collected. The abundance of main cariogenic bacteria, *mutans* Streptococci (MS) and Lactobacilli (LB), in saliva was assessed with Dentocult® SM Strip mutans and Dentocult® LB kits (Orion Diagnostica, Finland), respectively. Manufacturer's instructions were followed.

Data analysis

The data were analysed with Statistical Package for Social Sciences (SPSS V15). Two outcome variables were used for describing children's caries experience, including 'affected by caries' (dmft>0) and 'high caries rate' (dmft>2). With consideration of the current caries distribution in developed countries (*i.e.* 75% caries lesions occurring in 25% of children), identifying and targeting the one quarter of children with high caries risk is considered as a rational approach for caries control at the population level (Beck *et al*., 1992). In our study, 22.5% (about one quarter) children had a dmft>2. These children were thus defined as with 'high caries rate'.

Bivariate analysis was first applied to test the relationship between children's caries experience (disease outcome) and parental 'tooth worm' belief together with the possible confounders, including demographic variables (age, gender, and ethnicity) and socioeconomic factors (parents' education attainment and housing condition). If a factor reached ($p<0.05$) or approached ($0.05\leq p<0.1$) a significant correlation with one or both outcome variable(s) in the bivariate analysis, it was included as an independent variable in the multiple logistic regressions, with a forced entry method. Odds Ratio (OR) and its 95% Confidence Interval (CI) were used for comparing the caries risk between strata.

Behaviourally, the oral health practices (infant feeding, diet, oral hygiene, and dental attendance) of children with and without parental 'tooth worm' belief were compared by using parametric or non-parametric methods, as appropriate. Besides information collected through the questionnaire, some clinical and biological indicators were incorporated for evaluating oral health behaviours, such as LB count as a biological indicator for intake of cariogenic foods (Staat *et al*., 1975) and the Plaque Index and MS level as the clinical and biological indicators for oral hygiene status, respectively (Marsh and Martin, 1999; Silness and Loe; 1964).

Results

The intra-examiner reliability was high for caries examination (Kappa=0.958) and oral hygiene evaluation (Intra-class Correlation Coefficient=0.946). With a total of 1,782 children examined, 1,754 (98.4%) questionnaires were completed by parents; 1,716 (96.3%) parents answered the question on caries aetiology. The data collected from these 1,716 cases were included in the analysis, while 66 cases with missing data were excluded. The socio-demographic characteristics of the study sample are described in Table 1.

Table 1. Factors associated with children's caries experience

Factor	*n*	*Children's Caries Experience*							
		Affected by caries (dmft>0)				*High caries rate (dmft>2)*			
		%	*p* [3]	*OR*	*(95% CI)* [4]	*%*	*p* [3]	*OR*	*(95% CI)* [4]
Parental 'tooth worm' belief									
No	1651	39.9	0.897	1	(reference)	22.9	0.048*	1	(reference)
Yes	65	38.5		0.78	(0.46-1.32)	12.3		0.41	(0.19-0.89)
Gender									
Male	853	39.2	0.555	--		23.1	0.564	--	
Female	863	40.6				21.9			
Age									
3-4 years	179	26.4	<0.001*	1	(reference)	11.2	<0.001*	1	(reference)
4-5 years	871	35.8		1.55	(1.08-2.22)	19.7		2.06	(1.25-3.40)
5-6 years	666	48.9		2.65	(1.84-3.82)	29.1		3.33	(2.02-5.48)
Ethnicity									
Chinese	1167	39.4	0.163	1	(reference)	21.8	0.013*	1	(reference)
Malays	323	43.0		1.12	(0.87-1.45)	26.3		1.17	(0.87-1.58)
Indian	162	34.0		0.75	(0.52-1.06)	16.0		0.64	(0.41-1.01)
Others	64	46.9		1.25	(0.74-2.11)	32.8		1.54	(0.88-2.71)
Parents' educational attainment [1]									
Primary and below	280	46.4	0.001*	1	(reference)	28.6	0.006*	1	(reference)
Secondary/polytechnic	1167	36.8		0.69	(0.52-0.91)	20.4		0.67	(0.49-0.92)
Bachelor and above	269	46.5		1.10	(0.77-1.58)	25.3		0.94	(0.63-1.41)
Housing [2]									
HDB 1-3 rooms	357	42.3	0.563	1	(reference)	28.9	0.005*	1	(reference)
HDB 4-5 rooms	1070	39.3		0.96	(0.75-1.24)	21.0		0.71	(0.54-0.94)
Private housing	289	38.8		0.96	(0.68-1.33)	20.1		0.69	(0.47-1.02)
Total	1716	39.8				22.5			

(1) Parents' education attainment was calculated by averaging fathers' and mothers' highest education levels.
(2) HDB stands for Housing and Development Board, the main authority managing the development of economic public housing in Singapore.
(3) p values were obtained through bivariate analysis (Chi-Square tests). An asterisk (*) indicates significant difference in children's caries rate between/among strata of a certain factor.
(4) Odds Ratios (OR) and their 95% Confidence Intervals (CI) were obtained through multiple logistic regressions. Besides parental 'tooth worm' belief, two demographic variables (age and ethnicity) and two socioeconomic variables (parents' education attainment and housing) reached ($p<0.05$) or approached ($0.05 \leq p<0.1$) a significant correlation with one or both disease outcome(s) in the bivariate analysis. These variables were included as independent variables in the multivariate analysis. Since "gender" did not reach or approach a significant correlation with either disease outcome(s) in the bivariate analysis, it was not entered as an independent variable in the multivariate analysis. Kruskal-Wallis tests or Mann-Whitney tests (as appropriate) were conducted for comparing means when the normality of distribution or homogeneity of variance was violated.

Parental 'Tooth Worm' belief and children's caries experience

As shown in Table 1, among the 1,716 children, 684 (39.8%) were affected by caries (dmft>0), including 386 (22.5%) children with 'high caries rate' (dmft>2). Parents of 65 (3.8%) children considered 'tooth worm' as a main reason for tooth decay, while the rest of parents did not. Bivariate analysis showed that parental 'tooth worm' belief is correlated with 'high caries rate (dmft>2)' ($p=0.048$) of the children. With parental 'tooth worm' belief, only 12.3% children had 'high caries rate', while for those children whose parents did not believe the 'tooth worm' concept, 22.9% had 'high caries rate'. Parental 'tooth worm' belief is, however, not correlated with 'affected by caries' (dmft>0) ($p=0.897$). The '% affected' rates were 38.5% and 39.9% among children whose parent held and did not hold the 'tooth worm' belief, respectively. Several demographic (age and ethnicity) and socioeconomic variables (parents' education attainment and housing condition) reached ($p<0.05$) or approached ($0.05<p<0.1$) a significant correlation with one or both outcome variable(s) for the caries experience of the children. These socio-demographic variables were included as independent variables in the multivariate analysis.

The association between children's caries experience and parental 'tooth worm' belief was further evaluated through multivariate analysis controlling for possible confounders (age, ethnicity, parents' education attainment, and housing). No significant association was found

Table 2. Parents' "tooth worm" belief and children's oral health practice

Children's Oral Health Practice	*Parents' 'Tooth Worm' Belief*	
	Held n=65	*Not held n=1651*
Infant Feeding		
Breastfeeding	p=0.840	
No more than 1 year	90.8	88.8
More than 1 year	9.2	11.2
Bedtime feeding at 1-year-old	p=0.896	
Nothing/pacifier/water	61.5	62.9
Breast/milk/formula/juice/sweets	38.5	37.1
Milk bottle before sleep at 1-year-old	p=0.430	
Never/occasionally	30.8	36.2
Frequently/almost every night	69.2	63.8
Diet		
Diet Frequency	p=0.569	
No more than 5 times a day	84.6	87.2
6 times a day or more	15.4	12.8
Frequency of sweets	p=0.900	
No more than once a day	53.8	54.8
Twice a day or more	46.2	45.2
Bedtime sweets	p=0.848	
Never/occasionally	89.3	87.5
Frequent/almost every night	10.7	12.5
Parent efficacy in controlling sweets from child	p=0.090	
High	81.3	71.2
Low	18.8	28.8
LB (diet indicator) *	p=0.267	
$<10^3$ CFU/ml saliva	77.2	71.5
10^4 CFU/ml saliva	3.5	10.9
10^5 CFU/ml saliva	5.3	7.1
$>10^6$ CFU/ml saliva	14.0	10.5
LB score	p=0.970	
Mean	0.56	0.57
(SD)	(1.10)	(1.01)

Children's Oral Health Practice	*Parents' 'Tooth Worm' Belief*	
	Held n=65	*Not held n=1651*
Oral Hygiene		
Toothbrushing frequency	p=0.042**	
None or once a day	20.0	31.9
Twice a day or more	80.0	68.1
Length of toothbrushing	p=0.329	
Less than 2 mins	76.6	70.0
2mins or more	23.4	30.0
Adult guidance in toothbrushing	p=0.528	
Yes	41.5	45.7
No	58.5	54.3
Parent efficacy in monitoring child's toothbrushing	p=0.359	
High	69.2	63.0
Low	30.8	37.0
Oral hygiene status (clinical indicator)*	p=0.856	
Very good (PI<0.4)	21.5	22.5
Good (PI 0.4-1.0)	49.2	51.8
Less than good (PI >1.0, ≤2.0)	29.2	25.3
Poor (PI>2.0)	0	0.4
Plaque Index (PI) (continuous)	p=0.152	
Mean	0.82	0.75
(SD)	(0.40)	(0.42)
MS (biological indicator for oral hygiene) *	p=0.420	
$<10^4$ CFU/ml saliva	40.0	34.4
10^4 -10^5 CFU/ml saliva	6.2	12.9
10^5 -10^6 CFU/ml saliva	24.6	24.1
$>10^6$ CFU/ml saliva	29.2	28.7
MS score	p=0.801	
Mean	1.43	1.47
(SD)	(1.29)	(1.23)
Dental Attendance		
Annual dental check	p=0.165	
Yes	3.1	8.1
No	96.9	91.9

* Lactobacilli (LB) count was regarded as an indicator for intake of cariogenic foods. Mutans Streptococci (MS) level was used as a biological indicator for oral hygiene status, together with the clinical indicator Silness-Löe Plaque Index (PI).

** Significant difference ($p<0.05$) in oral health practice between children of parents who were holding or not holding the 'tooth worm' belief. Chi-square tests were employed for comparing proportions. Tukey's pos-hoc tests or independent t-tests (as appropriate) were used for comparing means when the normality of distribution and homogeneity of variance were supported by skewness test and Levene's test, respectively.

between children's being 'affected by caries' (dmft>0) and parental 'tooth worm' belief. Compared with their counterpart, children whose parents believed the 'tooth worm' concept had 0.78 (95% CI=0.46-1.32) times the odds of being affected by caries. When 'high caries rate' (dmft>2) was taken as the disease outcome, a significantly lower caries risk was found among children of parents with the 'tooth worm' belief, as compared with their counterpart (OR=0.41; 95% CI=0.19-0.89).

Parents' 'Tooth Worm' belief and children's oral health practice

Table 2 shows the comparisons of oral health practice between children of parents with and without 'tooth worm' belief. The main findings are (1) there was no significant difference in their infant feeding history, dietary habits, LB count (the biological marker for cariogenic diet), and dental attendance (all p>0.05); (2) there was significant difference in brushing frequency of children in the two groups (Chi-square=4.12; degree of freedom=1; p=0.042); 80% of children whose parents held the 'tooth worm' belief brushed their teeth at least twice a day, while only 68% of children did so in the other group; (3) there was no significant difference in other aspects of oral hygiene, including parental self-efficacy in monitoring child's toothbrushing, length of toothbrushing each time, adult guidance of toothbrushing, oral hygiene status, and MS count (all p>0.05).

Discussion

Caries risk reduction associated with 'Tooth Worm' belief and its possible mechanisms

As suggested in our preceding report (Gao *et al*., 2010), our further analysis has confirmed that children with parental 'tooth worm' belief were less likely to have 'high caries rate (dmft>2)', as compared with other children. Amidst all the efforts focused on expelling the 'tooth worm' belief from the public, our finding seemed to reveal the other side of the coin and compelled us to further explore the possible psychobehavioural mechanisms of this association.

For this intriguing paradox of the role of parental 'tooth worm' belief in lowering children's caries risk, an intuitive but legitimate speculation is that the unpleasant imagination of 'tooth worm in the mouth' may serve as a strong motivator for the children to adopt dentally healthy behaviours, and for the parents to monitor and discipline their children more fervently.

Pertaining to the specific behaviours mediating the effect of 'tooth worm' belief on caries risk, our results showed that, with the 'tooth worm' belief among parents, children tended to brush their teeth more frequently (p=0.042). However, no significant difference was found in their dietary habits and LB count, the biological indicator for intake of cariogenic foods (all p>0.05). This finding is in line with the notion that dietary habits, pervading many aspects of people's daily lives, are hard to change, while brushing habits are more circumscribed and thus more ready to be modified (Rollnick *et al*., 1999). Furthermore, toothbrushing may appear to be a direct and effective solution to eradicate 'tooth worms' from the mouth, while controlling sweets as a way of 'starving' the tooth worms may be regarded as indirect and less appealing.

Interestingly, despite the higher toothbrushing frequency in the group with parental 'tooth worm' belief, both groups have similar oral hygiene status and MS level (both p>0.05), possibly due to the insufficient effectiveness of toothbrushing among young children (Blount *et al*., 1987). It is therefore inferred that the beneficial effect of 'tooth worm' belief in lowering the caries risk was not achieved by improved oral hygiene through frequent toothbrushing. Instead, as fluoride-containing toothpastes are dominating the market in Singapore as in most developed and developing countries (Seppa, 2001), the health benefit associated with the parental 'tooth worm' belief may stem from the more frequent delivery of fluoride (an agent with proven anti-caries effect) into the oral biofilms through the frequent toothbrushing episodes. This inference echoes the theory attributing the caries-reducing effect of toothbrushing more to the fluoride in toothpaste rather than to the mechanical cleaning (Zimmer, 2001). Even after brushing, a slightly elevated level of fluoride can be maintained for hours in the tooth-biofilm interface, due to the fluoride deposition and intake by biofilm and/or enamel surfaces, which serve as fluoride reservoirs (ten Cate, 1999). Collective evidence has substantiated that a continuous presence of fluorides in low concentration contributes to preventing caries (ten Cate, 1999). With more frequent fluoride loading of the biofilm reservoir through toothbrushing, a low concentration of fluoride can be maintained to inhibit demineralisation, promote remineralisation, and suppress the acid production of cariogenic bacteria (ten Cate, 1999), leading to less chance for children with parental 'tooth worm' beliefs to be high risk individuals.

'Tooth Worm' belief in eliciting positive health behaviour changes

Since Ancient Greek times, it has been believed that the three basic tools of medicine are 'the herb', 'the knife', and 'the word' (Grant, 1995). The power of the 'word' (health education) has been greatly valued, especially when the main health concerns have shifted from the epidemic of infectious diseases to chronic 'lifestyle' diseases (Lalonde, 1974). However, despite the endeavours of health workers in disseminating health information and delivering health education, changing people's health behaviours appears to be extremely difficult. On many occasions, people show low readiness and motivation to contemplate, act upon, and maintain a positive behaviour change (Rollnick *et al*., 1999).

In the arena of health education and promotion, professionals often rely on two methods to motivate or persuade people to make a behavioural change: (a) alarming them with the long-term health risk; and (b) informing them the health gain (avoidance of disease) that can be expected through a behaviour change (Rollnick *et al*., 1999). Nevertheless, health psychologists have elucidated that being concerned about future health risks is not always a precipitant of a behaviour change (Rollnick *et al*., 1999). The contemporary advances in health technology may have further alleviated the fear

of the public toward various health risks. Pertaining to dental caries, it is quite a common encounter to dentists that their patients regard caries as totally curable through restoration, without realizing that a restored tooth is no more comparable to a healthy tooth in their longevity and many functions. Furthermore, the recent exaggerated promotion of dental implants as 'the third set of human teeth' may mislead the public and impart a false impression that, even if one fails to protect his/her oral health and eventually loses the whole set of teeth, the current technology is able to re-engineer a perfect tooth set at a certain cost (Rose, 2008).

Since long-term health risk fails to serve as a strong motivator for the public to adopt and maintain healthy lifestyles, especially in the face of multiple life priorities, obligations, and stress, exploring alternative motivators and stimuli for eliciting healthy behaviours would be of practical importance in public health (Rollnick *et al*., 1999).

Instead of focusing on the long-term consequences of a behaviour, psychologists have pointed out that the closer the consequence is to the behaviour (event) in time, the more powerful is the influence of the consequence (Dignan and Carr, 1992). For people holding the 'tooth worm' belief, oral hygiene measure (toothbrushing) not only represents a way to protect long-term oral health, but also brings about a positive short-term consequence (expelling 'tooth worms' from the mouth), which imparts great psychological comfort to them. This positive reinforcement could be a driving force for them to improve their health behaviours continuously.

Implications for practice

This study revealed a 'tooth worm' phenomenon, suggesting that 'tooth worm' belief in parents may facilitate early establishment of regular toothbrushing habit among children; such a positive behaviour in toothbrushing, probably through the delivery of toothpaste fluoride, may aid in our battle against dental caries, the most common chronic childhood disease.

With various ethical considerations, spreading the 'tooth worm' belief to the public is certainly unjustifiable and is not what we are trying to advocate. However, the results of this study enrich our understanding of oral health behaviours from a different perspective and stimulate further thinking on alternative approaches for achieving effective health education. Education materials pertaining to caries prevention shown in Figure 1 are examples of psychological mechanisms similar to the 'tooth worm' phenomenon. With the microbiological views, scientific knowledge on the cause of caries (biofilm/microorganisms), which may be abstract and profound, can be communicated to the public in an explicit way. The cartoon animations depicting the life adventures of 'creatures' residing on the tooth surfaces in episodes of sugar intake and associated oral hygiene measures, may convey health messages with greater inpact. The 'tooth worm' phenomenon and its implications may be particularly relevant for health education in cultures where the 'tooth worm' concept is part of people's belief system, such as in Asia Pacific regions and ethnic minorities in developed countries.

Limitations and future investigations

Although this report is derived from a large-scale population based research, the current evidence has its limitation due to the small number of parents holding the 'tooth worm' belief, the marginally significant findings ($0.04<p<0.05$), and the cross-sectional nature of the investigation. Future longitudinal investigations with larger samples will be useful for deepening our understanding of the 'tooth worm' phenomenon in the context of various populations and cultures.

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Figure 1. *Oral health education materials that might have similar effects as the 'tooth worm' concept. The images were obtained from various websites. The source of each image is indicated in the figure.*

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