

## Parental Awareness and Knowledge of Vitamin D and Its Health Benefits for Children

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### Abstract

Vitamin D inadequacy in children is a global medical problem, yet there is little known about the knowledge of parents regarding this issue in South East Asia, including Malaysia. The current study aimed to assess parental awareness and knowledge about vitamin D, its sources and health benefits for their children and identifies related factors that may influence their knowledge. A questionnaire was distributed to parents asking them about demographic variables and knowledge of vitamin D for their children. Descriptive statistics and bivariate analyses were performed.

Most respondents were aware of vitamin D and knew that sun exposure is the prime source of vitamin D (70.6%, 86.3% respectively). Inconsistencies among the respondents were found concerning the vitamin D sources, health benefits and risk factors of its inadequacy or deficiency in children. Newspaper, Internet, and books were the most common sources of their information about vitamin D (41.6%, 40.7%, 36.3% respectively). The majority of respondents (91.5%) indicated that they would like to have more information about the importance of vitamin for their children; however, only (63.1%) were very willing to get it.

Parents' basic knowledge about vitamin D for their children was limited and key information about it should be improved about its sources, health effects and risk factors of its inadequacy or deficiency through the development of appropriate education program for the public.

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### Introduction

Recently vitamin D has become a popular topic globally, and its deficiency is recognized as a major public health concern and one of the most common undiagnosed medical conditions worldwide.<sup>1</sup>

Vitamin D plays an important in maintaining the normal growth and mineralization of the bone and other calcified tissues, including teeth.<sup>2</sup> It has been proven to be beneficial for general well-being.<sup>3</sup> The most natural way to get

vitamin D is by exposing the skin to sunlight. Foods or supplements are other ways to obtain vitamin D.

Generally lack of vitamin D can lead to rickets and muscle weakness in children. The affected children may have difficulty in standing and walking.<sup>4-6</sup> Recent studies have reported a significant association between vitamin D inadequacy and a higher occurrence of dental caries among children.<sup>7-9</sup> Moreover, enamel developmental defects such as enamel hypoplasia may occur as a result of vitamin D deficiency.<sup>10,11</sup>

Additionally, there is some evidence indicated that vitamin D exposures in early life might play a role in caries prevention. A meta-analysis of historical trials of vitamin D supplementation reported that supplementation was associated with a 47% caries reduction in children.<sup>12</sup>

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Vitamin D inadequacy/ deficiency is considered an unrecognized epidemic in many countries worldwide including sun-rich Asian countries such as India and Arab countries.<sup>13-15</sup> Although tropical countries and subtropical countries including Malaysia receiving more sunlight as located near to the equator.<sup>16</sup> However, children and young adults are still potentially at high risk for vitamin D deficiency. In Malaysia, recent studies involving children and adolescents have indicated the presence of vitamin D deficiency within those populations.<sup>17,18</sup> It is an unexpected outcome given that Malaysia is a tropical country and only 6-8 minutes needed for adequate vitamin D production to occur.<sup>18</sup> Nutrition Survey of Malaysian Children (SEANUTS Malaysia) aged six months to 12 years showed that almost half of children (47.5%) had vitamin D insufficiency.<sup>19</sup> A study conducted by Khor et al. (2011)<sup>17</sup> highlighted the presence of a high prevalence of vitamin D deficiency and insufficiency among urban primary school children (35.3%, 37.5% respectively). In 2016, Al-Sadat and her team<sup>16</sup> revealed a higher prevalence of vitamin D deficiency among Malaysian adolescents of 13-year-old age (78.8%). In literature, low sunlight exposure and vitamin D dietary intake are possibly the main contributing factors for the low vitamin D level among Asian children.<sup>20</sup>

This significant increasing in vitamin D deficiency in children worldwide including Malaysia may be because of the lack of awareness about the importance of vitamin D for children and its health benefits. Since children's health is influenced by their parent's knowledge and beliefs, which affect their children's overall health and healthy lifestyle/eating habits.<sup>21,22</sup> Hence, parents' basic knowledge is essential in any disease prevention strategy.<sup>23</sup> Previous studies performed in few countries showed that vitamin D-related knowledge was limited.<sup>24-27</sup> To our knowledge, no studies have conducted in Malaysia. Therefore, the aim of this study was to assess the level of knowledge about the vitamin D regarding its sources, health benefits, sunlight exposure and the sources of the information amongst the parents attending the pediatric dental clinic at Faculty of Dentistry (UiTM), Malaysia. A secondary aim was to identify those factors that may be influencing parental knowledge.

## Materials and methods

### Participants

All parents attending the pediatric dental clinic at Faculty of Dentistry (UiTM) for the dental check-up or seek dental treatment for their children were invited to participate in this study within five months period from October 2016 until February 2017.

### Data Collection

An estimation sample size of 328 participants was calculated with a confidence interval of 95%, an alpha level of 0.05, and power of study of 85%. Data were collected using a structured questionnaire survey (modified from Schroth et al. (2013) to assess parents' knowledge and practice about vitamin D for their children. The original tool was in the English language. Therefore, the questionnaire was translated into Bahasa Malaysia (BM) using the forward-back translation protocol to use it for Malaysian population. The forward translation performed by a professional translator whose first language was BM. The BM version was back-translated into English by a bilingual dentist. The validity of the questionnaire was tested independently by two dentists to double check the clarity of the questions and the accuracy of correct responses. The finalized BM version questionnaire was pre-tested among ten parents attending the pediatric clinic at Faculty of Dentistry, UiTM before data collection to check the clearness and understanding of the questions. During the pediatric clinical session, the questionnaires distributed to all participants. They were asked to fill and return it back before the end of the clinical session.

### Survey instruments

The questionnaire divided into three sections. The first part consisted of questions on demographic information about the parents including age, gender, ethnic and educational background. The second part addressed participants' general knowledge which covered the knowledge about vitamin D concerning its sources, health benefits, and sunlight exposure and sources of their information about vitamin D. Third section on parents' practice of sun exposure and vitamin D for their children.

### Data analysis

Data were recorded and tabulated using Statistical Package for Social Science (SPSS) version 20.4. The analysis included basic descriptive statistics [frequencies and mean± standard deviation (SD)], and bivariate analysis [Chi-square( $\chi^2$ )] were performed. Chi-square test was used to determine the association between categorical variables. An alpha level of statistical significance was set  $\leq 0.05$ .

### Results

A total of 360 questionnaires were filled in by participants; 16 were excluded because they were incomplete or unanswered. Hence, only 344 questionnaires were analyzed, and the response rate was 95.5%.

Table 1 shows the demographic and characteristic variables of the 344 parents. The mean age of the respondents was  $34.5 \pm 9.4$

years. A total of 211 (61.7 %) respondents had a high school degree or higher.

Characteristics	N	%
Age (Year)		
<30	33	9.8
31-40	175	51.9
>41	129	38.3
Gender		
Male	112	32.7
Female	231	67.3
Ethnicity		
Malay	332	96.8
Chinese	3	0.9
Indian	3	0.9
Others	5	1.5
Educational level		
Primary level	16	4.7
Secondary level	115	33.6
Tertiary level	211	61.7

Table 1. Demographic Characteristics of the Respondents

Variables	Gender				Age (years)				Educational level			
	Overall N(%)	Females N(%)	Males N(%)	p value	<30 N(%)	31-40 N(%)	>41 N(%)	p value	Primary N(%)	Secondary N(%)	Tertiary N(%)	p value
<b>Do you know that sunlight can give your child vitamin D?</b>	297(86.3)	206(69.4)	91(30.6)	0.043	32(11)	148(50.9)	111(38.1)	0.162	14(4.7)	87(29.4)	195(65.9)	<b>0.001</b>
<b>What is/are the source/s of Vitamin D other than sunlight?</b>												
Dont know	61(71.7)	31(51.7)	29(48.3)	0.004	5(8.3)	31(51.7)	24(40)	0.898	7(11.7)	26(43.3)	27(45.0)	<b>0.002</b>
Fruits	76(22.1)	51(67.1)	25(32.9)	0.959	9(12.3)	42(57.7)	22(30.1)	0.248	2(2.6)	25(32.9)	49(64.5)	0.603
Vegetables	92(26.7)	66(71.7)	26(28.3)	0.294	10(11.2)	51(57.3)	28(31.5)	0.301	2(2.2)	29(31.5)	61(66.3)	0.319
Fatty fish	77(22.4)	55(71.4)	22(28.6)	0.386	8(10.4)	43(55.8)	26(33.8)	0.650	1(1.3)	22(28.9)	53(67.7)	0.134
Cereals	40(11.6)	27(67.5)	13(32.5)	0.982	6(15.4)	20(51.3)	13(33.3)	0.429	0(0)	11(28.2)	28(71.8)	0.205
Milk/ Dairy	109(31.7)	81(74.3)	28(25.7)	0.060	12(11.2)	51(47.7)	44(41.1)	0.548	3(2.8)	37(33.9)	69(63.3)	0.512
Nuts	31(9.0)	27(87.1)	4(12.9)	0.014	2(6.7)	17(56.7)	11(36.7)	0.781	0(0)	8(28.8)	23(74.2)	0.215
Cod liver oil	81(23.5)	60(74.1)	21(25.9)	0.140	11(13.6)	35(43.2)	35(43.2)	0.150	4(4.9)	18(22.2)	59(72.8)	<b>0.044</b>
Chicken	15(4.4)	11(73.3)	4(26.7)	0.613	0(0)	10(66.7)	5(33.3)	0.318	0(0)	4(26.7)	11(73.3)	0.521
Eggs	71(20.6)	55(77.5)	16(22.5)	0.041	8(11.4)	44(62.9)	18(25.7)	0.052	0(0)	16(22.9)	54(77.1)	<b>0.005</b>
Mushrooms	24(7.0)	21(87.9)	3(12.5)	0.029	1(4.2)	13(54.2)	10(41.7)	0.626	0(0)	6(25.0)	18(75.0)	0.284
Fortified food	17(4.9)	10(58.8)	7(41.2)	0.442	1(5.9)	10(58.8)	6(35.3)	0.785	1(5.9)	5(29.4)	11(64.7)	0.916
Vitamin D supplements	74(21.5)	55(74.3)	19(25.7)	0.148	7(9.9)	39(54.9)	25(35.2)	0.83	4(25.0)	21(18.3)	49(23.2)	0.551

Number & % in the table represent those of YES answers only.

Percentage per each subgroup calculated from the total number of its related group. Percentage for the overall sample calculated from the total number of the sample (n = 344).

Table 2. Parents' Knowledge about the sources of Vitamin D.

Variables	Gender				Age (years)				Educational level			
	Overall N(%)	Females N(%)	Males N(%)	p value	<30 N(%)	31-40 N(%)	>41 N(%)	p value	Primary N(%)	Secondary N(%)	Tertiary N(%)	p value
<b>What is/are the health benefit/s of Vitamin D?</b>												
Don't know	86(25.0)	51(60.0)	34(40)	0.096	6(7.1)	38(45.2)	40(47.6)	0.116	9(10.6)	33(38.8)	43(50.6)	<b>0.003</b>
Bone health	162(47.1)	113(69.8)	49(30.2)	0.369	16(10.1)	77(48.7)	65(41.1)	0.534	7(4.3)	50(31.1)	104(64.6)	0.582
Immune health	70(20.3)	52(74.3)	18(25.7)	0.165	8(11.8)	38(55.9)	22(32.4)	0.502	2(2.9)	21(30.0)	47(67.1)	0.499
Prevention of Rickets	108(31.4)	76(70.4)	32(29.6)	0.418	14(13.2)	60(56.6)	32(30.2)	0.077	3(2.8)	31(29.0)	73(68.2)	0.197
Calcium absorption	145(42.2)	108(74.5)	37(25.5)	<b>0.016</b>	15(10.6)	81(57.0)	46(32.4)	0.165	7(4.9)	38(26.4)	99(68.8)	<b>0.050</b>
<b>Does Vitamin D deficiency can lead to rickets in children?</b>	240(69.8)	165(68.8)	75(31.3)	0.398	21(8.9)	131(55.3)	85(35.9)	0.162	8(3.3)	73(30.5)	158(66.1)	<b>0.021</b>

Number & % in the table represent those of YES answers only.

Percentage per each subgroup calculated from the total number of its related group. Percentage for the overall sample calculated from the total number of the sample (n = 344),

Table 3. Vitamin D and its health benefits.

Variables	Gender				Age (years)				Educational level			
	Overall N(%)	Females N(%)	Males N(%)	p value	<30 N(%)	31-40 N(%)	>41 N(%)	p value	Primary N(%)	Secondary N(%)	Tertiary N(%)	p value
<b>What is/are risk factor/s for Vitamin D deficiency?</b>												
Dont know	62(18.0)	10(4.3)	4(3.6)	0.739	3(9.1)	170(2.9)	6(4.7)	0.242	1(6.3)	4(3.5)	9(4.3)	0.854
Skin pigment	68(19.8)	47(69.1)	21(30.9)	0.728	6(9.0)	34(50.7)	27(40.3)	0.918	0(0)	16(23.9)	51(76.1)	<b>0.011</b>
Shade/ clouds	82(23.8)	64(78.0)	18(22.0)	0.018	5(6.3)	51(63.8)	24(30.0)	0.049	1(1.2)	16(19.5)	65(79.3)	<b>0.001</b>
Time of day	40(11.6)	29(72.5)	11(27.5)	0.460	2(5.3)	21(55.3)	15(39.5)	0.605	0(0)	6(15.0)	34(85.0)	<b>0.005</b>
Latitude	22(6.4)	16(72.7)	6(27.3)	0.578	1(4.8)	7(33.3)	13(61.9)	0.069	2(12.5)	4(3.5)	16(7.6)	0.211
Season	56(16.3)	44(78.6)	12(21.4)	<b>0.050</b>	7(12.7)	31(56.4)	17(30.9)	0.415	4(7.1)	17(30.4)	35(62.5)	0.580
Age	99(28.8)	66(66.7)	33(33.3)	0.864	7(7.3)	49(51.0)	40(41.7)	0.527	7(7.1)	30(30.3)	62(62.6)	0.336
Sunscreen use	79(23.0)	58(73.4)	21(26.6)	0.190	8(10.4)	49(63.6)	20(26.0)	0.037	4(5.1)	20(25.6)	54(69.2)	0.236
Vegetarian diets	44(12.8)	31(70.5)	13(29.5)	0.638	8(18.6)	23(53.5)	12(27.9)	0.070	1(2.3)	10(22.7)	33(75.0)	0.145
Lactose intolerance	36(10.5)	24(66.7)	12(33.3)	0.927	7(20.0)	17(48.6)	11(31.4)	0.094	1(2.8)	8(22.2)	27(75.0)	0.221
Dairy allergy	86(25.0)	62(72.1)	24(27.9)	0.278	11(12.9)	45(52.9)	29(34.1)	0.430	2(2.3)	24(27.9)	60(69.8)	0.158
Pollution	75(21.8)	49(65.3)	26(34.7)	0.674	5(6.8)	40(54.8)	28(38.4)	0.615	3(4.0)	18(24.0)	54(72.0)	0.111
Body Mass Index/Obesity	14(4.1)	8(57.1)	6(42.9)	0.406	3(23.1)	5(38.5)	5(38.5)	0.233	0(0)	4(28.6)	10(71.4)	0.601

Number & % in the table represent those of YES answers only.

Percentage per each subgroup calculated from the total number of its related group. Percentage for the overall sample calculated from the total number of the sample (n = 344),

Table 4. Parents' Knowledge about the Risk Factors of Vitamin D Defeciency.

Variables	Gender				Age (years)				Educational level			
	Overall N(%)	Females N(%)	Males N(%)	p value	<30 N(%)	31-40 N(%)	>41 N(%)	p value	Primary N(%)	Secondary N(%)	Tertiary N(%)	p value
<b>Do you expose your child to sunlight?</b>	283(82.3)	189(66.8)	94(33.2)	0.629	27(9.7)	148(53.4)	102(36.8)	0.463	13(4.6)	93(33)	176(62.4)	0.840
<b>Do you think your child have enough exposure to sunlight?</b>	213(62.1)	145(68.1)	68(31.9)	0.677	22(10.5)	113(53.8)	75(35.7)	0.420	7(30.3)	67(31.6)	138(65.1)	0.124
<b>How much time do you think the average fair skinned child needs to spend in the sun?</b>												
Don't know	183(53.2)	116(63.7)	66(36.3)		16(9.0)	87(49.2)	74(41.8)		12(6.6)	65(35.7)	105(57.7)	
Less than 10 minutes per week	29(8.4)	24(82.8)	5(17.2)		4(13.8)	17(58.6)	8(27.6)		0(0)	9(31.0)	20(69.0)	
1-2 hours per week	65(18.9)	50(76.9)	15(23.1)	0.087	5(7.8)	38(59.4)	21(32.8)	0.276	0(0)	18(28.1)	46(71.9)	0.143
More than 2 hours a week	35(10.2)	21(60.0)	14(40.0)		3(8.6)	22(62.9)	10(28.6)		1(2.9)	15(42.9)	19(54.3)	
10-60 minutes per week	32(9.3)	20(62.5)	12(37.5)		5(15.6)	11(34.4)	16(50)		3(9.4)	8(25.0)	21(65.6)	
<b>How much time do you think the average non-fair skinned child needs to spend in the sun?</b>												
Don't know	208(60.5)	131(63.3)	76(36.7)		23(11.4)	94(45.6)	85(42.1)		12(5.8)	74(35.9)	120(58.3)	
Less than 10 minutes per week	26(7.6)	22(84.6)	4(15.4)		2(7.7)	16(61.5)	8(30.8)		0(0)	8(30.8)	18(69.2)	
About 1-6 hours per week	64(18.6)	44(68.8)	20(31.3)	0.075	6(9.5)	36(57.1)	21(33.3)	0.491	1(1.6)	20(31.3)	43(67.2)	0.411
10-20 minutes a week	35(10.2)	28(80.0)	7(20.0)		1(2.9)	22(62.9)	12(34.3)		3(8.3)	8(22.9)	24(68.6)	
More than 6 hours per week	11(3.2)	6(54.5)	5(45.5)		1(9.1)	7(63.6)	3(27.3)		0(0)	5(45.5)	6(54.5)	
<b>How frequent do you expose your child to sunlight?</b>												
One to three times daily	116(33.8)	77(66.4)	39(33.6)		12(10.6)	56(49.6)	45(39.8)		3(2.6)	43(37.4)	69(60.0)	
One to two times per week	125(36.4)	86(68.8)	39(31.2)		12(9.7)	66(53.2)	46(37.1)		10(8)	40(32.0)	75(60.0)	
Three to five times per week	90(26.2)	61(67.8)	29(32.2)	0.803	7(8.0)	49(55.7)	32(36.4)	0.876	2(2.2)	26(28.9)	62(68.8)	0.199
Not sure	12(3.5)	6(54.5)	5(45.5)		2(18.2)	4(36.4)	5(45.5)		1(9.1)	5(45.5)	5(45.5)	
<b>Do you know the best time to expose your child to sunlight?</b>												
Sunrise to 10 am	321(93.3)	217(67.6)	104(32.4)		29(9.2)	166(52.5)	121(38.3)		15(4.7)	106(33.1)	199(62.2)	
10 am 3 pm	9(2.6)	5(55.6)	4(44.4)		1(11.1)	4(44.4)	4(44.4)		0(0)	3(33.3)	6(66.7)	
After 3 pm	7(2.0)	4(57.1)	3(42.9)	0.658	1(16.7)	3(50.0)	2(33.3)	0.608	0(0)	3(42.9)	4(57.1)	0.660
Not sure	7(2.0)	5(83.3)	1(16.7)		2(33.3)	2(33.3)	2(33.3)		1(16.7)	3(50.0)	2(33.3)	
<b>Is your child fully covered during sun exposure?</b>	142(41.8)	97(68.3)	45(31.7)	0.726	13(9.4)	66(47.5)	60(43.2)	0.268	7(4.9)	49(34.5)	86(60.6)	0.910
<b>Do you use sunscreen for your child?</b>	36(10.5)	28(77.8)	8(22.2)	0.158	5(13.9)	16(44.4)	15(41.7)	0.536	2(5.6)	17(47.2)	17(47.2)	0.162
<b>Does your child like outdoors activities?</b>	318(92.4)	210(66.0)	108(34)	0.065	32(10.3)	168(53.8)	112(35.9)	0.006	15(4.7)	106(33.4)	196(61.8)	0.959
<b>How often does your child do outdoors activities?</b>												
One to three times daily	88(25.6)	61(69.3)	27(30.7)		11(12.6)	39(44.8)	37(42.5)		3(3.4)	31(35.6)	53(60.9)	
One to two times per week	148(43.0)	99(66.9)	49(33.1)		13(9.0)	75(52.1)	56(38.9)		10(6.8)	53(35.8)	85(57.4)	
Three to five times per week	102(29.7)	67(65.7)	35(24.3)	0.882	8(7.9)	61(60.4)	32(31.7)	0.109	2(2.0)	30(29.4)	70(68.6)	0.228
Not sure	6(1.7)	4(80.0)	1(20)		1(20.0)	0(0)	4(80.0)		1(20.0)	1(20.0)	3(60.0)	

Number & % in the table represent those of YES answers only.

Percentage per each subgroup calculated from the total number of its related group. Percentage for the overall sample calculated from the total number of the sample (n = 344).

**Table 5. Parents' View about Vitamin D and Sun Exposure.**

Variables	Gender				Age (years)				Educational level			
	Overall N(%)	Females N(%)	Males N(%)	p value	<30 N(%)	31-40 N(%)	>41 N(%)	p value	Primary N(%)	Secondary N(%)	Tertiary N(%)	p value
<b>Have you heard of Vitamin D?</b>	243( 70.6)	179(73.7)	64(26.3)	0.001	27(11.4)	123(51.9)	87.000	0.272	7(2.9)	68(28.1)	167(69)	0.001
<b>Where did you hear about Vitamin D?</b>												
Physician/ Dentist/ Nurse	61(17.7)	47(77)	14(23.0)	0.075	5(8.5)	32(54.2)	22(37.3)	0.896	1(1.6)	20(32.8)	40(65.6)	0.436
Newspaper/ Magazine	143(41.6)	100(69.9)	43(30.1)	0.388	9(6.4)	69(49.3)	62(44.3)	0.069	3(2.1)	44(31.0)	95(66.9)	0.083
Family/ Friends	43(12.5)	31(72.1)	12(27.9)	0.478	6(14.6)	15(36.6)	20(48.8)	0.101	0(0)	18(41.9)	25(58.1)	0.183
Television/ Radio	69(20.1)	50(72.5)	19(27.5)	0.311	4(6.2)	24(36.9)	37(56.9)	0.003	2(2.9)	22(31.9)	45(65.2)	0.658
Poster	40(11.6)	27(67.5)	13(32.5)	0.982	5(13.5)	13(35.1)	19(51.4)	0.095	0(0)	15(38.5)	24(61.5)	0.306
Internet	140(40.7)	101(72.1)	39(27.9)	0.116	14(10.1)	83(60.1)	41(29.7)	0.023	1(0.7)	35(25.0)	104(74.3)	0.001
Books	125(36.3)	92(73.6)	33(26.4)	0.061	10(8.1)	65(52.8)	48(39.0)	0.739	3(2.4)	30(24.0)	92(73.6)	0.002
Dont know/Can't remember	68(19.8)	37(55.2)	30(44.8)	0.018	6(9.1)	33(50.0)	27(40.9)	0.883	9(13.4)	28(41.8)	30(44.8)	0.001
Others/Schools	12(4.5)	8(66.7)	4(33.3)	0.778	2(6.0)	9(5.1)	1(0.7)	0.090	0(0)	5(41.7)	7(58.3)	0.612
<b>Do you want to have more information on importance of Vitamin D for your children?</b>	315(91.6)	215(68.3)	100(31.7)	0.230	30(9.7)	163(52.8)	116(37.5)	0.594	13(4.1)	103(32.8)	198(63.1)	0.116
<b>How willing are you to receive more information?</b>												
Very interested	103(29.9)	68(66.0)	35(34)		7(6.9)	57(55.9)	39(37.3)		5(4.9)	27(26.2)	71(68.9)	
Interested	217(63.1)	146(67.3)	71(32.7)	0.766	23(10.8)	109(51.4)	80(37.7)	0.555	8(3.7)	36(68.7)	129(59.7)	0.089
Not interested	24(7.0)	17(73.9)	6(5.4)		3(13.0)	9(39.1)	11(47.8)		3(13.0)	9(39.1)	11(47.8)	

Number & % in the table represent those of YES answers only.

Percentage per each subgroup calculated from the total number of its related group. Percentage for the overall sample calculated from the total number of the sample (n = 344).

**Table 6. Vitamin D Knowledge and Sources of Information and Continuing Education.**

### Vitamin D and its sources

Most respondents (86.3%) indicated that sun exposure is the prime source of vitamin D. It was known better by mothers (69.3%,  $P=0.04$ ) and participants with higher education

background (65.9%,  $P=0.001$ ). Regarding the other sources of vitamin D, 31.7% of the parents cited milk and dairy products, 23.5% cod liver oil, 22.4% fatty fish, 21.5% vitamin D supplements and 20.6% eggs. Although the respondents inadequately identified common sources of

vitamin D, some of them also named wrong sources such as vegetables (26.7%), fruits (22.1%), nuts (9.0%), or chicken (4.4%), showing some misperception. interestingly, 17.7% of them even did not know the sources of vitamin D (Table 2).

### Vitamin D and its health benefits

Although 69.8% of respondents agreed that vitamin D deficiency could lead to rickets, only small proportions of the respondents recognized the role of vitamin D in bone health, calcium absorption and rickets prevention (47.1%, 42.2%, 31.4% respectively). Mothers and those with a higher educational level had a better knowledge specifically about the role of vitamin D in calcium absorption ( $P=0.016$ ;  $P=0.05$  respectively). It is worth mentioning that one-quarter of the respondents (25%) did not know the role of vitamin D in health (Table 3).

### Vitamin D deficiency and its risk factors

The respondents have suggested a variety of views about the risk factors of vitamin D inadequacy/ deficiency. Merely 28.8% of them stated age factor, 25.0% dairy allergy, 23.8% cloud and 19.8% skin color. These proportions were higher in mothers, age 30-40-year-old and high educational background with significant differences among different groups regarding the presence of clouds as a risk factor for vitamin D deficiency ( $P=0.018$ ;  $P=0.049$ ;  $P=0.001$  respectively). Furthermore, only minuscule proportions of the parents identified the time of day and obesity have an impact on the status of vitamin D in the body (11.6%; 4.1% respectively). The time of day and skin color as risk factors were recognized more by the respondents with better education ( $P=0.005$ ,  $P=0.011$ ). It is notably that 18.0% of the participants could not identify any factor (Table 4).

### Vitamin D and sun exposure

A total of 82.3% of the respondents exposed their children to the sun; however, only 60.1% felt that their children have enough sun exposure. Almost half number of the respondents (41.8%) acknowledged that their children are fully covered during sun exposure. The average time

that parents believed the child should expose to sunlight was (20.67 mins $\pm$ 14.65) per day. Regarding the best time for sun exposure, the majority (93.3%) stated early morning before 10 am whereas only 2.6% of them recognized that 10 am to 3 pm is the best. There were no significant differences between different groups (Table 5).

### Vitamin D knowledge and sources of information

Almost two-third of respondents (70.6%) stated that they had already heard of vitamin D. It was higher among mothers (73.7%) and younger participants (51.9%), as well as in those with higher education (69.0%). There was a significant difference regarding gender and educational levels ( $P=0.001$ ;  $P=0.001$  respectively). The primary sources of vitamin D information were newspaper/ magazines (41.6%), the internet (40.7%), books (36.3%) and followed by media (20.1%). Newspaper/ magazines were selected more often by mothers (43.3%), older participants (48.1%) and those with a higher educational level (45.0%) with no significant differences among different grouping. The internet was quoted more frequently by females (72.1%), and people's age between 30-40 years (60.10%) with higher education (74.3%) with there were significant differences in different age groups and educational levels ( $P=0.023$ ;  $P=0.000$  respectively). Books were chosen more by women (73.6%), parents' age between 30-40 years (52.8%) and those with better education (73.6%) with significant difference among different educational levels ( $P=0.002$ ). Media was cited more by mothers (72.5%), older participants (56.9%) with higher educational levels (65.2%). There was a significant difference among different age groups ( $P=0.003$ ). Where 91.6% of the respondents ask for/want more information about the importance of vitamin D for children; however, only 29.4% of them were very keen/willing to learn more about this topic (Table 6).

### Discussion

To our knowledge, this is the first local study of its kind in Malaysia and Southeast Asia that assessed parental awareness and knowledge of vitamin D for their children. This study surveyed the parents attending university

pediatric dental clinic about vitamin D for their children regarding its sources, health benefits, sunlight exposure and the sources of their information. Evaluating the level of basic knowledge and practice habits on this topic is an essential approach to plan strategies to improve children's health.

Although most respondents have not quoted all the sources, known health effects of vitamin D and risk factors of vitamin D inadequacy, considerable proportions of them stated incorrect sources or they were not sure about its sources and health benefits. Age, gender and educational background of the parents had an impact on their knowledge.

Interestingly 13.7% of parents did not know that sun exposure is a prime source of vitamin D, which is similar to the finding reported by.<sup>28</sup> Likewise, the respondents did not recognize the common dietary sources of vitamin D include cod liver oil, fatty fish, eggs, milk/dairy products, vitamin D fortified food and mushrooms even though the contribution of these sources to vitamin D level is considered low compared to sunlight exposure.<sup>29</sup> 17.70% of them did not know the other sources of vitamin D. Furthermore, only 20-30% of the parents cited milk/dairy products, fatty fish, cod liver oil or eggs as good sources whereas few of them (5-7%) quoted fortified food or mushrooms. Moreover, some participants selected inaccurate sources such as chicken, fruits, vegetables or nuts indicated some confusion. Surprisingly, merely 21.50% of the parents have cited vitamin D supplements as a good source. It is clearly that their knowledge is limited which is similar to the earlier studies.<sup>30,31</sup>

Regarding vitamin D associated health benefits. Current research has suggested a role for vitamin D for health outcomes.<sup>32</sup> However, in our study, it seems there is an insufficient knowledge regarding established health benefits of vitamin D. Even though the majority of participants have heard of vitamin D and agreed that rickets is related to vitamin D deficiency. However, notably, a considerable proportion (25%) of participants was unaware about the health beneficial of vitamin D. This finding was concurrent with other previous studies.<sup>30,33</sup>

Moreover, slightly less than half of the respondents indicated valid responses about the role of vitamin D in bone health and calcium absorption (47.1%, 42.2% respectively). Regrettably, only almost one-third (31.4%) %

and one-fifth (20.3%) of them knew about the role of vitamin D in rickets prevention and immune health respectively. Similar limited vitamin D health-related knowledge was reported by Kung and Lee (2006),<sup>24</sup> where they have found only less than one-fifth of the participants knew about the role of vitamin D in bone health and calcium absorption matters. Indeed our findings showed a very limited basic knowledge about vitamin D related health as compared with previous study done by Deschasaux et al. (2016)<sup>25</sup> who reported 78% of participants associated vitamin D to healthy bones, and 62% to rickets.

Regarding immune health, our respondents showed better knowledge compared to the study done by Kung and Lee (2006),<sup>24</sup> where they reported only (3.8%) of their respondents were aware of vitamin D role in immune health. Knowledge about the health benefits of vitamin D mainly calcium absorption significantly increased with the female gender and the higher level of education. Similar findings were reported by another study.<sup>33</sup> Remarkably there was confusion about the health-related benefits of vitamin D and its role in rickets prevention. This misunderstanding was apparently clear by incorrect responses and mixed responses to the questions: "What is/are the health benefit/s of vitamin D"? "Does vitamin D deficiency lead to rickets in children"?

Inadequate health literacy has associated with a limited understanding of complex health issues, preventative health messages and fewer health services usage.<sup>34</sup> Efforts to increase health knowledge about the benefit of vitamin D and the proper way to obtain its adequate levels are very much needed to be provided in a suitable way to those with low health literacy and educational levels.<sup>33</sup>

Similarly, our participants were unable to identify the risk factors that are related to vitamin D deficiency. Lacked knowledge about these factors was evident from their correct responses that did not exceed 30% in general. Between 20-30% of the respondents were somehow aware of the risk factors of vitamin D deficiency such as age, dairy allergy, cloud, sunscreen use and pollution. Whereas almost complete lack of awareness about the effect of other factors such as the time of day and obesity. Moreover, 18% of them did not know about these factors and their effect on vitamin D status. The findings of the

current study make these factors specifically necessary to be carefully addressed in future health promotion campaigns.

It has been documented that exposing of uncovered arms and legs for 5 to 30 minutes between 10.00 am to 3.00 pm at least twice a week usually sufficient to achieve adequate vitamin D levels.<sup>35</sup> However, this depends on other factors such as time of day, season, latitude, skin pigmentation, obesity, aging, cloud cover, shade, and pollution; thus reducing the synthesis of vitamin D.<sup>35</sup> Although, the majority of our participants (82.30%) stated that they exposed their children to the sun. Nonetheless, still more than a half of them reported that they did not reach the sufficient time required for adequate vitamin D synthesis. The respondents were very much lacked knowledge regarding the best time for sun exposure, where the majority indicated its early morning before 10 am. The only negligible proportion of them (2.6%) knew about the fact that time between 10 am to 3 pm is the best to obtain vitamin D from the sun. Even though more than half of our participants believed that their children have enough sun exposure, however, (41.80%) of them indicated that their children were fully covered during sun exposure which will hinder vitamin D production via the skin. Our respondents showed knowledge regarding getting adequate natural vitamin D amounts and generally on how to obtain vitamin D from the sun, which considered the most cost-effectiveness way.

Media such as the newspaper, magazines, the internet and TV/Radio was the first source of parents' information and most parents in our survey wanted to get more information about this topic. This finding was concurrent with other previous study.<sup>36</sup> Insufficient information among the parents about the importance of vitamin D may reflect on their children since parental health awareness and practices usually have a direct effect on their child's health. Increasing the aspects of vitamin D knowledge among parents is much needed to ensure the children are having and maintaining adequate levels of vitamin D. Parents can be educated through appropriate health education programs and promotion interventions organized by Malaysian Ministry of Health. This may be the first step in addressing poor public's awareness and the prevalent of vitamin D insufficiency/deficiency among Malaysian children.

Furthermore, incorporating health messages within the Malaysian school curriculum could further assist in increasing the awareness among parents and children about vitamin D sources, health-related benefits, the role of sunlight in vitamin D synthesis, and the risk factors slowed down vitamin D production.<sup>22</sup>

Whereas this preliminary study provides important evidence about parents' knowledge about vitamin D for their children, our study was not without limitation. First, there is a potential for recall and responder biases as with many surveys. Second, it was conducted in one district which is university's dental clinic. Hence the findings cannot be generalizable for other parents in Malaysia. Third, assessing the level of vitamin D in the children was not done. Vitamin D screening could offer evidence to find the possible relationship between parents' knowledge and the actual level of vitamin D for their children. Unfortunately, we did not ask parents if they were aware of the potential association between vitamin D and dental caries in children. Despite this, it was clear that parents' knowledge was limited and most likely that public awareness is even lower. Moreover, current local information about Vitamin D knowledge is inadequate.

## Conclusions

There is a significant underlying lack of knowledge and confusion about vitamin D knowledge and its sources, health-related benefits of vitamin D, the role of sunlight in vitamin D synthesis, and the risk factors hindered vitamin D production. Further investigation of these findings, perhaps in a larger population, may help to know more about vitamin D knowledge and practices among Malaysian population. Likew to help in developing effective education strategies to tackle this underlying misunderstanding about this public health issue. Eventually, improving the knowledge through public health education and implementing prevention strategies may be the first step toward increasing personal responsibility for preventing vitamin D deficiency which might address some common pediatric diseases linked to low vitamin D levels in children.



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## Declaration of Interest

The authors report no conflict of interest.

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