

### 3 Years Data of Paediatric Patients Treated Under General Anaesthesia for Caries Management

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#### Abstract

There is a scarcity of data available in Malaysia regarding the utilization of GA for management of dental caries among paediatric patients. This study aims to investigate the dental records of paediatric patients treated under general anaesthesia (GA) for caries management at Hospital Canselor Tuanku Muhriz (HCTM), Kuala Lumpur.

This is a retrospective cross-sectional study between January 2017 to December 2019 on patients who underwent caries dental treatment with ICD-10 Code K02.9 under GA. Data extracted includes demographic data, referral source, comorbidities, treatment done and dental treatment procedural time. Mean age of children treated is 5.91 years. Males were higher with 62.1%. Majority of the referrals are from internal referral with 65%. 60% of the children had comorbidities. 94.3% of children had extraction of their primary teeth. Mean dental treatment time was 52.87 minutes.

Younger children utilized dental GA more often than older ones. More than half of the cases required extraction of deciduous teeth. There is also high utilization of GA among medically ill patients. Oral health of children with medical illness is often neglected because of their systemic disease and ongoing medical treatment. By the time the child gets a dental treatment, it is too late to save the tooth.

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#### Introduction

In 2017, the Global Burden of Disease study estimated that close to 3.5 billion people worldwide are affected by oral diseases, out of which, caries of permanent teeth is the most prevalent condition<sup>1</sup>. Globally, it is estimated that 2.3 billion people suffer from caries of permanent teeth and more than 530 million children suffer from caries of primary teeth<sup>2</sup>. Dental caries is considered to be the single most common chronic childhood disease<sup>3</sup> and is the primary cause of oral pain and tooth loss<sup>4</sup>. It has shown an increasing prevalence among children worldwide<sup>5</sup>. A systematic review and meta-analysis conducted by Kazeminia et al. showed that the prevalence of dental caries worldwide in primary dentition is 46.2% and shows a gradual increase by year from 1995 - 2019<sup>6</sup>. By

continent, Africa has the highest caries prevalence of primary teeth with 53.1 % followed by Asia with 52.6% then America, Australia and Europe with 45.8%, 28.5% and 21.4% respectively<sup>6</sup>.

In Malaysia, the preventive school dental programme has seen much improvement in the oral health status of Malaysians. Despite a general increase in the prevalence of dental caries globally, caries prevalence among Malaysians has reduced over the years. The National Oral Health Survey of Preschool Children (NOHPS) was targeted on children aged 5 years old and has been conducted 3 times with a gap of 10 years; 1995, 2005 and 2015. From this survey, the prevalence of caries among pre-school children shows a decreasing pattern from 87.1% in 1995 to 76.2% in 2005 and further reduced to 71.3% in 2015<sup>7</sup>. The same decreasing pattern was also seen in children aged 12 years old. Based on the National Health and Morbidity Survey, it showed that the prevalence of caries among 12-year-old children in 1970/71 was 78.4%. This figure reduced in 1988 to 71.3 % and further reduced to 60.9% in 1997, 41.5% in 2007 and the latest is 33.3% in

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2017<sup>8</sup>. Even though the prevalence of dental caries among children in Malaysia shows a decreasing pattern, the incidence is still high compared to other continents in the world.

Behavioural management plays a crucial part in managing caries among paediatric dental patients. The American Academy of Paediatric Dentistry (AAPD) has divided behavioural guidance into two i) basic behavioural guidance and ii) advanced behavioural guidance. In basic behaviour guidance, communicative management and appropriate use of commands are applied. In children where basic behavioural management fails, advanced management can be used. This includes conscious sedation and general anaesthesia (GA). Most children can be managed effectively using basic behavioural management or using conscious sedation techniques. However, some children occasionally present with behavioural considerations that require GA due to a lack of psychological or emotional maturity and/or mental, physical, or medical disability. GA is defined as “a drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation”<sup>9</sup>. It is associated with an impairment to independently maintain ventilatory function which requires assistance in maintaining a patent airway and impairment in cardiovascular function.

Dental treatment under GA is known as one of the most common reasons for hospitalization among children<sup>10</sup>. One in every ten patients who are seen in paediatric dental clinic requires treatment under GA<sup>11</sup>. However, there is a scarcity of data available in Malaysia regarding the utilization of GA for management of dental caries among paediatric patients. Karim et al. reported on utilization of dental general anaesthesia for children in 2008<sup>12</sup>. This study was conducted at a teaching university in Kelantan. In this study, they included all dental cases treated under GA, including caries management and surgical procedures. Nadeem et al. also reported the same characteristics of dental treatments of children under GA in 2020<sup>13</sup>. This study was done in a teaching university in Pulau Pinang. To our best knowledge, there is unavailable data regarding utilization of GA among paediatric patients for treatment of caries in the capital city of Malaysia, Kuala Lumpur and none of these papers touched on the factors influencing the duration of treatment to perform these treatments. Hence, this study aims to

investigate the demographic characteristic, treatment modalities performed, and duration taken to treat paediatric patients under GA for caries management at Hospital Canselor Tuanku Muhriz (HCTM), Kuala Lumpur.

## Materials and methods

This is a retrospective cross-sectional study to investigate the characteristics of paediatric patients treated under GA at HCTM, Kuala Lumpur from January 2017 to December 2019. This study was conducted after obtaining approval from Secretariat of Medical Research and Innovation, National University of Malaysia (UKM PPI/111/8/JEP-2020-675).

Inclusion criteria in this study include Malaysian citizens less than 16 years when the treatment was done, and treatment done for management of dental caries with ICD-10 code K02.9 with complete documentation in patient's medical folder. Patients with combine treatment with other specialities or other dental treatment besides caries management were excluded from this study. Based on data obtained from International Centre for Casemix and Clinical Coding (ITCC), HCTM, a total of 180 paediatric patients with ICD-10 code were treated for management of dental caries from January 2017 to December 2019. Sample size calculation was calculated using the Krejcie & Morgan sample size calculation<sup>14</sup>. Using this method, no calculations are needed instead, a table is provided to determine the sample size. Based on this sample size with a known population size of  $N = 180$ , the sample size representative of this study using the table proposed by Krejcie & Morgan is 123 subjects. However, since randomization was unable to be carried out, universal sampling was done where all subjects who fit the inclusion criteria were selected for this study.

Strict confidentiality was maintained throughout the data collection process as proposed by the Patient Medical Record Unit, Department of Health Information, HCTM. No personal identifying data was obtained to maintain patient's confidentiality. Extraction of data was done after obtaining the list of patients who underwent dental treatment with ICD-10 Code K02.9 under general anaesthesia from January 2017 to December 2019 from ITCC. Once the list was obtained, a request was sent to

Patient Medical Record Unit, Department of Health Information, HCTM to trace patient's dental record. Data that were extracted is explained in Table 1 and was tabulated in Microsoft Excel. Microsoft Excel 2020 (Microsoft, Redmont WA USA) was used to tabulate all data and analyze it.

Parameter	Explanation
Demographic	Patient's age, gender, ethnicity was recorder
Age	Age was further categorized as continuous data divided into 3 categories: i. Preschool: 0 – 6 years old ii. Primary school: 7 – 12 years old iii. Secondary school: 12 – 16 years old
Gender	Male or female
Ethnicity	Malay, Chinese, Indian and others
Source of referral	Referral sources were recorded: i. Internal referral ii. Government sector iii. Private sector
Comorbidities	Absence or presence of any medical condition
Treatment done	All caries management under general anaesthesia were recorded. Each child might have 1 or more than 1 type of treatment. Management includes: i. Fissure sealant of deciduous teeth ii. Fissure sealant of permanent teeth iii. Restoration of deciduous teeth using glass ionomer cement iv. Restoration of deciduous teeth composite resin v. Restoration of deciduous teeth strip crown vi. Restoration of deciduous teeth stainless steel crown vii. Restoration of permanent teeth using composite resin viii. Pulpotomy of deciduous teeth ix. Pulpotomy of deciduous teeth x. Extraction of deciduous teeth xi. Extraction of permanent teeth xii. Scaling  These treatments were then further categorized into: a. Extraction only which includes patients who had: i. Extraction of deciduous teeth ii. Extraction of permanent teeth b. Extraction and restoration which includes patients who had: i. Fissure sealant of deciduous teeth ii. Fissure sealant of permanent teeth iii. Restoration of deciduous teeth using glass ionomer cement iv. Restoration of deciduous teeth using composite resin v. Restoration of deciduous teeth using strip crown vi. Restoration of deciduous teeth using stainless steel crown vii. Pulpotomy of deciduous teeth viii. Pulpotomy of deciduous teeth ix. Extraction of deciduous teeth x. Extraction of permanent teeth
Procedural time	Total time taken for comprehensive dental care under general anaesthesia (excluding GA time)

**Table 1.** Data collection from patient's medical folder.

## Results

In total, there were 180 patients who were treated for caries management under general anaesthesia at HCTM between January 2017 to December 2019. Out of these 180 patients, 140 patients were included in this study based on the inclusion criteria. The remaining 40 children were excluded due to i. combine treatment with other specialities or other dental treatment besides caries management (20 patients), ii. incomplete documentation (19 patients) and iii. foreigner (1 patient). A sample of 140 children aged 0 to 16

years old who had undergone caries treatment under general anaesthesia at HCTM between January 2017 to December 2019 was obtained. The demographic characteristics are shown in Table 2.

Category	Frequency	Percentage (%)	Mean and standard deviation
Age (years)			Mean: 5.91 Standard deviation: 2.83
0 – 6	95	67.8	
7 – 12	40	28.6	
13 -16	5	3.6	
Gender			
Male	87	62.1	
Female	53	37.9	
Ethnicity			
Malay	127	90.7	
Chinese	12	8.6	
Indian	1	0.7	
Referral source			
Internal (HCTM)	91	65.0	
Government sector	12	8.6	
Private sector	37	26.4	
Comorbidities			
Has comorbidities	84	60	
No comorbidities	56	40	

**Table 2.** Demographic characteristics of patients treated under GA at HCTM between 2017- 2019.

In total, there were 12 types of different treatment modalities for caries management under GA, namely fissure sealant for primary teeth, fissure sealant for permanent teeth, glass ionomer cement (GIC) restoration for primary teeth, composite restoration (CR) restoration for primary teeth, CR restoration for permanent teeth, strip crown restoration, stainless steel crown restoration, pulpotomy, pulpectomy, extraction of primary teeth, extraction of permanent teeth and scaling. Each child might have one or more types of treatment modality and each modality might involve one or more teeth in each child. For example, a child might have 1 fissure sealant of permanent teeth, 4 strip crowns and 10 extractions of primary teeth. In this case, the patient had 3 treatment modalities with 15 treated teeth. The mean number of modalities per child is 2.70 with a standard deviation of 1.00. Treatment modalities vary between 1 to 6 types of modalities with 3 treatment modalities being the highest at 35.7%. Table 3 describes the number of patients and number of teeth with the treatment modality. Extraction of primary teeth has the highest treatment modality involving 132 children (94.3%) and 1175 teeth.

These treatment modalities were then further divided into 2 categories; i. extraction only

which comprises of extraction of primary and permanent teeth; ii. extraction and restoration which includes GIC restoration of primary teeth, CR restoration of primary tooth, CR restoration of permanent teeth, strip crown restoration, stainless steel crown restoration, pulpotomy, pulpectomy and extraction of both permanent and deciduous teeth. 12.9% of the patients had extraction only, and the rest had a combination of both extraction and restoration.

Treatment modality	Number of patients	Percentage (%)	Number of teeth	Average per person
Fissure sealant of primary tooth	41	29.3	127	3.10
Fissure sealant of permanent tooth	48	34.2	182	3.79
GIC restoration of primary tooth	3	2.1	7	2.33
CR restoration of primary tooth	52	37.1	113	2.17
CR restoration of permanent tooth	13	9.3	28	2.15
Strip crown restoration	10	7.1	18	1.80
Stainless steel crown restoration	57	40.7	127	2.23
Pulpotomy	5	3.6	9	1.80
Pulpectomy	2	1.4	5	2.50
Extraction of primary teeth	132	94.3	1175	8.90
Extraction of permanent teeth	12	9.3	39	3.25
Scaling	6	4.3	-	-

**Table 3.** Type of treatment modalities of caries management under GA.

Table 4 illustrates the time taken to treat these children. The mean time taken was 52.87 minutes with a standard deviation of 21.66. A combination of extraction and restoration took the longest time with a mean of 55.35 minutes whereas cases of extraction only took the shortest time with a mean of 38.22 minutes.

Category Time taken (minutes)	Frequency	Percentage (%)	Mean and standard deviation
All cases			Mean:52.87 Standard deviation:21.66
0 – 30	21	15.0	
31 – 60	85	60.7	
61 – 90	29	20.7	
91 – 120	4	2.9	
>120	1	0.7	
Extraction only			Mean:38.22 Standard deviation: 12.16
0 – 30	6	33.3	
31 – 60	12	66.7	
Extraction and restoration			Mean 55.35 Standard deviation: 22.09
0 – 30	15	12.3	
31 – 60	73	59.8	
61 – 90	29	23.8	
91 – 120	4	3.3	
>120	1	0.8	

**Table 4.** Time taken for caries management under general anaesthesia by category.

## Discussion

Dental caries has been affecting majority of children globally. Despite multiple efforts

taken to reduce caries rate, caries rate is still high<sup>6</sup>. Children with multiple dental caries are treated under GA due to complexity of the treatment where multiple treatments have to be done and also as an advanced behavioural management technique in patients when basic behavioural management technique fails. This treatment modality has been showing an increasing trend among parents since it is known to improve the quality of life of these patients<sup>15</sup>. However, this treatment modality is known to be the most expensive due to the increase in resources used<sup>16</sup>. The increase in cost directly increases the economic burden of dental health expenditure. Hence, it is important to monitor the utilization of GA among these patients.

In this study, the mean age of children treated for caries under GA is 5.91 years. Most number of cases is seen between age 0 to 6 years with 67.8%. This finding is in accordance with multiple reported studies globally and locally. A study done in North Carolina showed that GA utilization for dental treatment peaked at 3 years old<sup>16</sup>. In Taipei, the mean age of these children is 5.77 years<sup>17</sup>. In Malaysia, there are 2 studies done on utilization of GA. Both studies had patients with a median age of 6 years old<sup>12,13</sup>. The reason for higher percentage of younger children being treated under GA can be because they have a previous behavioural problem. It is due to lack of ability to cooperate during dental treatment on chair and the fact that they might be irregular dental attendees increases their anxiety for them to be treated chairside<sup>18</sup>. Besides that, older children who are able to tolerate nitrous oxide sedation do not need to be treated under GA. To reduce the utilization of GA by this younger age group children, oral health preventive measure should start at an earlier age. Implementation of caries preventive treatment such as dental appointment as early as when the first tooth erupts, application of fluoride varnish and fissure sealant treatment can also be done. Besides that, shorter review intervals should be scheduled for high caries risk patients and patients with comorbidities.

In this study, males were higher with 62.1% being males and the remaining 37.9% being female. Similar results were found in a study done in Ireland where 55% of the study population was male<sup>19</sup>. The same scenario was seen in Korea with 66.9% of participants being male<sup>20</sup>. Comparing locally, the same pattern was



seen in Kelantan. Kelantan had 58.5% male patients who underwent dental treatment under GA<sup>12</sup>. However, in Penang, the male to female ratio was almost equal, with 50.4% being male and 49.6% being female. This gender percentage portrays the scenario reported by Department of Statistic Malaysia where for every 106 male population in Malaysia, there are 100 female residents<sup>21</sup>. Globally, even though there are more males, however, the percentage difference is almost negligible with global male population being 50.5% and female 49.5%<sup>22</sup>.

Based on ethnicity, majority of the patients in this study are Malays with 90.7% followed by Chinese 8.6% and Indians 0.7%. Almost similar results were seen in both studies done in Kelantan and Penang with majority of the patients being Malays. Based on Department of Statistics Malaysia, Bumiputera (which includes Malays) are the highest percentage of population in Malaysia with 69.6% followed by Chinese 22.6%, Indians 6.8% and others 1.0% (21).

About 65.0% of referrals are internal referrals from other departments in HCTM. Other referrals are from private sector with 26.4% and 8.6% from government sector. As for medical illness, 60% have a history of medical illness and 40% of them are fit and healthy. Oral health of children with medical illness is often overlooked because of their systemic disease and ongoing medical treatment<sup>23,24</sup>. Children with medical problems are prone to dental caries due to malocclusion, sweetened medication or medication that causes decreased salivary flow and low intellectual abilities<sup>25</sup>. This can be the reason why there is a higher percentage of children from internal referral and those with medical problems. Hence, it is vital for paediatric dentists to work closely together with the other paediatric colleagues for early oral health prevention to reduce to utilization of dental treatment under GA in these medically compromised patients.

In total, there were 12 different types of dental treatment modalities for caries management. The mean modality was 2.7. Extraction of primary teeth had the highest number of patients with 94.3% of patients having this modality and the highest number of teeth, in total 1 175 primary teeth were extracted. These findings are in accordance with multiple other studies<sup>12,13,19</sup>. This indicates that most of the children treated under GA had unrestorable

teeth. This indirectly shows that by the time the child gets treated, it is too late to save the tooth. Early loss of deciduous teeth leads to multiple future problems. A systematic review on the effect of premature extraction of primary teeth shows that these kids suffer from malocclusion and space loss in permanent dentition<sup>26</sup>. Patients with early loss of primary teeth will later on have higher need of dental treatment due to these consequences.

The mean dental time taken to treat these patients under GA is 52.87 minutes. Patients who had a combination of extraction and restoration had a longer mean treatment time 55.35 minutes compared to those who had extraction only 38.22 minutes. Dental treatment under GA is known to be the most expensive care due to the additional cost of anaesthesia and hospital facility fees involved. Increase in time of dental treatment will further increase the cost due to two reasons; i. higher quantity of anaesthesia medication needed during dental procedure and ii. cost of personnel emolument increases with time. Increase in cost will increase the financial burden of healthcare providers and in the long run can negatively affect the quality of treatment provided due to limited resources available.

The limitation of this study is that the data is limited to a local hospital and does not represent the total population. However, the design of this study is beneficial to other researchers in investigating the characteristic of dental treatment under GA such as treatment modalities and duration of treatment.

## Conclusions

From this study, we can conclude that younger children utilized dental GA more often than the older ones. More than half of the cases required extraction of deciduous teeth. There is also high utilization of GA among medically ill patients. Oral health of children with medical illness is often neglected because of their systemic disease and ongoing medical treatment. By the time the child gets a dental treatment, it is too late to save the tooth. Hence, it is vital for us to always work closely together with our paediatric colleagues for early oral health prevention.

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## Declaration of Interest

The authors report no conflict of interest.

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