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Demographic status, eating behaviour, and fruit and vegetable intake in children aged 4 to 6 years

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ABSTRACT

Introduction: Fruits and vegetables (FV) are packed with nutrients; high consumption of FV offers various health benefits. However, consumption is reported to be below recommendation among children worldwide. Current evidence related to environmental and personal factors on FV intake in Malaysia is limited. Therefore, this study aimed to determine environmental and personal factors associated with FV intake among children aged 4 to 6 years in Malaysia. **Methods**: 278 children participated and questionnaires were distributed to seven preschools in Setiu, Terengganu. Parents were asked to complete the questionnaire to assess demographic data, children's eating behaviour, FV intake and liking. **Results**: Girls consumed more vegetables than boys (p=0.041). Parental education was significantly associated with vegetable intake. Frequency of purchasing FV had a significant association with fruit (p=0.014) and vegetable (p<0.001) intakes among children. Meanwhile, frequency of family mealtimes was associated with vegetable intake. Furthermore, children's eating behaviour was found to be related to FV intake. Three eating behaviour characteristics, namely food responsiveness, satiety responsiveness, and food fussiness, were significantly associated with vegetable intake, while enjoyment of food, food responsiveness, and emotional overeating had significant associations with fruit intake. Additional robust regression analyses demonstrated that only frequency of purchasing FV was a significant predictor of both FV intakes (p=0.018; p=0.001), while gender was a predictor of vegetable intake (p=0.011), but not fruit intake. **Conclusion**: Demographic status and children's eating behaviour were among the factors involved in determining FV intake among children.

Keywords: children, child eating behaviour, fruit intake, predictors, vegetable intake

INTRODUCTION

Research has established that eating habits start to develop in childhood and track into adulthood (Movassagh *et al.,* 2017). Fruits and vegetables are essential sources of fibre, vitamins, minerals, and antioxidants, playing a significant role in health (Yahia, García-Solís & Celis, 2019). High consumption of fruits and vegetables in daily diets has been associated with reduced risks of coronary heart disease and stroke (Mo *et al.*, 2019). Despite the health benefits fruits and vegetables have to offer, intake among children is below recommendation in many countries

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worldwide, including in Malaysia (Chong *et al.,* 2017).

As literature suggests, both environmental and personal factors have roles in children's vegetable intake and liking. For example, higher household income (Shariff *et al.,* 2015) and parental education level (Flores-Barrantes *et al.*, 2022) are associated with higher consumption of fruits and/or vegetables among children. However, results are inconsistent, as de Wild *et al.* (2018) did not discover a significant association between parental income and education with children's vegetable intake. Other than that, the home food environment has often been associated with children's fruit and vegetable intake. Hillesund *et al.* (2021) reported that regular family mealtimes have been linked with an increased intake of fruits and vegetables among children. Fruits and vegetables are typically served at mealtimes, especially during lunch or dinner. Therefore, it allows children to copy what their parents eat.

In terms of personal factors, Vereecken *et al.* (2015) found that gender may be one of the determinants of fruit and vegetable consumption among children. Nonetheless, there are discrepancies in research findings, as Hillesund *et al.* (2021) reported that gender did not play a role. Children's eating behaviour also appears to predict eating patterns. The Child Eating Behaviour Questionnaire (CEBQ) was developed by Wardle *et al.* (2001) to measure a child's appetite traits. It comprises four 'food approach' traits (food responsiveness, enjoyment of food, emotional overeating, and desire to drink) and four 'food avoidant' traits (food fussiness, emotional undereating, slowness in eating, and satiety responsiveness). Previous studies reported that food fussiness (Kutbi, 2021), satiety responsiveness, food responsiveness (Maneschy *et al.*, 2024), food enjoyment, and slowness in eating (Fildes *et al.*, 2015) were associated with fruit and/or vegetable preferences. A review by Kininmonth *et al.* (2021) suggested that children who scored higher in food approach traits and lower in food avoidant traits had higher chances of being overweight.

Although the determinants of fruit and vegetable intake have been widely studied, very few studies were done in Malaysia and results have been inconsistent. To the best of our knowledge, the relationship between a child's eating behaviour and fruit and vegetable intake has never been investigated in Malaysia. It is important to have a clear understanding of these relationships in order to plan long-term effective strategies to encourage healthy eating among children. Hence, this current study aimed to examine the influence of environmental and personal factors on fruit and vegetable intake among 4- to 6-year-old children in Malaysia.

MATERIALS AND METHODS

Study design

The study received ethical approval from the Sultan Idris Education University's Research Ethics Committee (Reference no: 2021-0189-01). Sample size was determined using Krejcie & Morgan's (1970) table for determining sample size from a given population. This table was constructed using a formula illustrated in Figure 1. To use the table, the total number of preschoolers (4 to 6 years old) needed to be obtained first. According to the Setiu Education Office, in 2020, there were 976 preschoolers in Setiu, Terengganu. Based on the table, for a population of 976, a total number of 278 preschoolers was needed in this study. Therefore, a letter explaining the study was distributed to seven preschools in Setiu. Once permission was granted from the head teacher, an information sheet

$$s = X^2NP(1-P)/ d^2(N-1) + X^2P(1-P),$$

where
s = required sample size

X^2 = the table value of chi-square for one degree of freedom at the desired confidence level (3.841)

N = the population size

P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size)

d = the degree of accuracy expressed as a proportion (0.05)

Figure 1. Formula to determine sample size by Krejcie & Morgan (1970)

explaining the details of the study, a consent form, and a set of questionnaires were distributed to parents if they agreed to participate. The parent-completed questionnaire consisted of three measures (demographic characteristics, child's eating behaviour characteristics, and fruit and vegetable intake and liking). This study sought to establish the determinants of fruit and vegetable intake. Therefore, fruit and vegetable intakes were the primary outcomes, while demographic and children's eating behaviour characteristics were the independent variables.

Measures

Demographic characteristics

These demographic characteristics were collected: child's gender, age, body mass index (BMI), ethnic origin; parental education background; household income; frequency of purchasing fruits and vegetables; and frequency of family mealtimes. The demographic characteristics of participants are displayed in Table 1.

Child eating behaviour characteristics

Parents reported their child's eating behaviour using the Child Eating Behaviour Questionnaire (CEBQ) (Wardle *et al.,* 2001), which has been translated into the Malay language and validated in a previous study (Md Yasin, 2013). Permission was granted by the author for the Malay version of CEBQ to be used in this study. From the questionnaire, these characteristics were measured: food responsiveness, enjoyment of food, emotional overeating, satiety responsiveness, slowness in eating, emotional undereating, and food fussiness. During analyses, the desire to drink was excluded as it was unrelated to fruit and vegetable consumption. Items were scored on a 5-point scale (1=never, 2=rarely, 3=sometimes, 4=often, and 5=always). Subsequently, negative-worded statements were reverse-coded. These scores were averaged; higher scores indicated greater expression of each characteristic.

Fruit and vegetable intake and liking

Parents were asked to report how frequently their child consumed one serving of the fruits and vegetables (NCCFN, 2023) listed in the questionnaire. In the questionnaire, there were 22 vegetables and 21 fruits commonly found in Malaysia. The questionnaire was validated by three dietitians and pre-tested before it

Table 1. Demographic characteristics of participants

	n	%
Gender		
Boys	133	47.8
Girls	145	52.2
Ethnic group		
Malay	278	100.0
Parental education		
No school/primary education	14	5.0
Secondary education	140	50.4
Tertiary education	124	44.6
Household income		
Low income	233	83.8
Middle income	40	14.4
High income	5	1.8
BMI status (*n*=234)		
Normal	232	99.1
Overweight	1	0.4
Obese	1	0.4
Frequency of purchasing fruits and vegetables		
<Once a month	10	3.6
1-3 times per month	46	16.5
1-2 times per week	116	41.7
3-6 times per week	76	27.3
Every day	30	10.8
Frequency of family mealtimes		
1-2 times per week	20	7.2
3-6 times per week	21	7.6
Once a day	67	24.1
2 times per day	97	34.9
3 times per day	73	26.3

BMI: Body mass index
Unless stated otherwise, the total number of participants is *N*=278

was distributed to participants. The responses were '1=never tried, 2=<once a month, 3=1-3 times per month, 4=1-2 times per week, 5=3-6 times per week, 6=once a day, 7=2 times a day, and 8=3 times a day'. As reported by Fatihah *et al.* (2015), the number of servings of daily fruit and vegetable intake was calculated by multiplying the conversion factor of the reported frequency of intake (e.g., 1-3 times/month calculated as 2/30 = 0.07) with serving size.

For fruit and vegetable liking, parents rated how much their child liked fruits and vegetables on a 6-point scale: '0=never tried (which was excluded from the analyses), 1=extremely dislikes, 2=dislikes, 3=neutral, 4=likes, and 5=extremely likes'. In this study, fruit and vegetable intakes were the primary outcomes. Since fruit and vegetable liking is directly related to intake (Cooke *et al.,* 2004), it was set as the secondary outcome.

Statistical analysis

Normality test was performed using the Shapiro-Wilk test, with no data

Table 2. Mean servings (± standard deviation) of fruit and vegetable consumption in children according to demographic characteristics

	n	*Fruits*	*Vegetables*
Gender			
Boys	133	0.21±0.24	0.13±0.18[b]
Girls	145	0.22±0.25	0.21±0.34[a]
Parental education			
No school/primary education	14	0.32±0.53	0.25±0.63[ab]
Secondary education	140	0.20±0.23	0.21±0.27[a]
Tertiary education	124	0.21±0.21	0.13±0.21[b]
Household income			
Low income	233	0.21±0.24	0.18±0.29
Middle income	40	0.24±0.26	0.11±0.15
High income	5	0.25±0.31	0.24±0.21
Frequency of purchasing fruit and vegetables			
<Once a month	10	0.10±0.09[b]	0.08±0.11b[c]
1-3 times per month	46	0.21±0.19[ab]	0.04±0.10[c]
1-2 times per week	116	0.18±0.23[b]	0.16±0.26[b]
3-6 times per week	76	0.22±0.22[ab]	0.20±0.21[ab]
Every day	30	0.36±0.39[a]	0.42±0.48[a]
Frequency of family mealtime			
1-2 times per week	20	0.20±0.41	0.19±0.53[b]
3-6 times per week	21	0.13±0.12	0.14±0.22[ab]
Once a day	67	0.24±0.19	0.10±0.26[b]
2 times per day	97	0.20±0.26	0.16±0.20[ab]
3 times per day	73	0.23±0.24	0.26±0.28[a]

Mann-Whitney U tests were used for analyses. Different superscript letters indicate significant differences in serving between each other within the group.

being normally distributed. Hence, non-parametric tests were used. Spearman's correlation, Mann-Whitney U test, and Kruskal-Wallis tests were used to examine the relationship of all variables with fruit and vegetable intakes as appropriate. A significance value of $p<0.05$ was used and the Bonferroni correction was applied for testing pairwise comparisons. The main analysis did not include fruit and vegetable liking, which was analysed using Spearman's correlation to determine the correlations with fruit and vegetable intakes and also to determine the mean liking scores of fruits and vegetables. In addition, robust regression was conducted to determine the predictors of fruit and vegetable intakes. All data were analysed using IBM SPSS Statistics for Windows version 27.0 (IBM Corporation, Armonk, New York, USA).

RESULTS

Fruit and vegetable intakes and liking

Results found that the mean total intake of vegetables was 0.17 servings/day and 0.21 servings/day for fruits. Cucumber, carrot, mustard greens, cauliflower, and water spinach were among the most consumed vegetables. Meanwhile, bananas, oranges, watermelons, mangoes, and grapes were among the most consumed fruits.

Results demonstrated that vegetable intake and liking were positively correlated (r_s=0.54, p<0.001), but there was no significant correlation between fruit intake and liking (r_s=0.07, p=0.252). The mean liking scores of fruits and vegetables were 3.80±0.62 and 2.70±0.84, respectively (1-5 scale). Among the most liked fruits were bananas, watermelons, grapes, oranges, and apples; while carrots, cucumbers, cauliflower, lettuce, and broccoli were among the most liked vegetables.

Factors determining fruit and vegetable intakes in children

Demographic characteristics

There was a significant difference between genders in vegetable intake (p=0.041), where girls ate more vegetables than boys (0.21±0.34 servings/day versus 0.13±0.18 servings/day). However, there was no significant difference between genders in fruit intake. Results showed a negative correlation between children's vegetable intake and parental education (r_s=-0.17, p=0.005); no significant correlation was found for fruit intake. Parents with secondary education had children with a higher intake of vegetables compared to parents with tertiary education (p<0.001) (Table 2). An analysis was also done to balance out the data in the parental education category, where data from no school/ primary education were combined with data from secondary education. This provided 55.4% for secondary education and lower versus 44.6% for tertiary education. Results remained the same, where children whose parents had secondary education and lower had a significantly higher vegetable intake than children whose parents had tertiary education. Besides that, household income had no significant association with children's fruit and vegetable intakes. However, there was a significant positive correlation between household income and parental education (r_s=0.42, p<0.001).

Children whose parents frequently bought fruits and vegetables consumed more fruits (r_s=0.15, p=0.014) and vegetables (r_s=0.44, p<0.001). For fruit intake, children whose parents bought fruits and vegetables every day consumed more fruits than children whose parents bought fruits and vegetables less than once a month (p=0.001) and 1-2 times per week (p=0.002). For vegetable intake, children whose parents bought fruits and vegetables every day had a significantly higher vegetable intake than children whose parents bought fruits and vegetables less than once a month (p=0.002), 1-3 times per month (p<0.001), and 1-2 times per week (p<0.001). Results also demonstrated that children whose parents bought fruits and vegetables 1-2 times per week and 3-6 times per week had a significantly higher vegetable intake than children whose parents bought fruits and vegetables 1-3 times per month (p<0.001; p<0.001, respectively). There was an inverse association between the frequency of parents buying fruits and vegetables with parental education (r_s=-0.18, p=0.003).

Besides that, family mealtime was also significantly correlated with children's vegetable intake (r_s=0.34, p<0.001). As presented in Table 2, children who had three mealtimes a day with their family had the highest vegetable intake. Furthermore, children who had three family mealtimes a day significantly consumed more vegetables than children who had 1-2 family mealtimes per week (p=0.002) and children who had one family mealtime a day (p<0.001). Those who had meals with family two times per day consumed significantly more vegetables than those who had one meal per day with their

Table 3. Correlation between children's eating behaviour characteristics and fruit or vegetable intake

Items	*Fruits*		*Vegetables*	
	Spearman's correlation (r_s)	*p-value*	*Spearman's correlation (r_s)*	*p-value*
Food responsiveness	0.19	0.001	-0.12	0.042
Enjoyment of food	0.13	0.028	0.01	0.823
Emotional overeating	0.14	0.025	0.11	0.081
Satiety responsiveness	0.10	0.103	-0.29	<0.001
Slowness in eating	-0.01	0.902	0.001	0.983
Emotional undereating	0.09	0.126	0.03	0.637
Food fussiness	-0.07	0.248	-0.12	0.050

family (p<0.001). In contrast, there was no significant association between family mealtimes and fruit intake. Parental education was negatively associated with family mealtimes (r_s=-0.18, p=0.002).

Child's eating behaviour characteristics

Food responsiveness was positively correlated with fruit intake (r_s=0.19, p=0.001) and negatively correlated with vegetable intake (r_s=-0.12, p=0.042) (Table 3). Emotional overeating was positively correlated with fruit intake (r_s=0.14, p=0.025) and there was a tendency that emotional overeating was positively correlated with vegetable intake (r_s=0.11, p=0.081). Satiety responsiveness was negatively correlated with vegetable intake (r_s=-0.29, p<0.001), but not with fruit intake (r_s=0.10, p=0.103). Enjoyment of food was positively correlated with fruit intake (r_s=0.13, p=0.028), but not with vegetable intake. Food fussiness was negatively correlated with vegetable intake (r_s=-0.12, p=0.050), but there was no significant correlation between food fussiness and fruit intake.

Predictors of fruit and vegetable intake

Variables that were found to have significant relationships with fruit and/or vegetable intake were tested with regression analyses to determine predictors of fruit and vegetable intake. Frequency of purchasing fruits and vegetables was a significant predictor of fruit and vegetable intakes in children (B=0.05, p=0.018; B=0.08, p=0.001), respectively (Table 4). Gender was a predictor of vegetable intake (B=-0.08, p=0.011), where girls had a higher vegetable intake. However, gender was not a significant predictor of fruit intake. No other variables were found to be significant predictors of fruit and vegetable intakes in these analyses.

DISCUSSION

Results from this study demonstrated that fruit and vegetable intakes were below the recommendations among Malaysian children. According to the Malaysian Dietary Guidelines for Children and Adolescents (NCCFN, 2023), children below 4 to 6 years old should eat two servings of fruits and two servings of vegetables daily. Previous studies have also reported the same findings; Chong *et al.* (2017) discovered that fruit and vegetable intakes among Malaysian children aged 1 to 6 years were low, at 0.91 servings/day and 1.07 servings/day, respectively. Chong *et al.* (2017) further reported that Malay children had significantly lower intake of vegetables than other ethnic groups, which was 0.87 servings per day. In

Table 4. Robust regression (B) and standard errors for demographic characteristics and children's eating behaviour characteristics in predicting fruit and vegetable intakes

	Fruits			*Vegetables*		
	B	*Standard error*	*p-value*	*B*	*Standard error*	*p-value*
Gender	-0.01	0.03	0.759	-0.08	0.03	0.011
Parental education	-0.02	0.04	0.679	-0.04	0.04	0.278
Frequency of purchasing fruits and vegetables	0.05	0.02	0.018	0.08	0.02	0.001
Frequency of family mealtimes	-0.004	0.02	0.833	0.004	0.03	0.864
Food responsiveness	0.01	0.03	0.583	-0.03	0.02	0.205
Enjoyment of food	-0.002	0.03	0.956	0.05	0.03	0.097
Emotional overeating	0.04	0.03	0.092	0.03	0.03	0.215
Satiety responsiveness	0.02	0.02	0.534	-0.03	0.02	0.142
Fussiness	-0.01	0.03	0.838	-0.02	0.03	0.389

comparison to a previous study done in Terengganu, Malaysia (the state where data collection was done in this current study), 91% of adolescents consumed fewer vegetables than recommended (Rohin *et al.,* 2021). These findings suggest that low consumption of fruits and vegetables is a common problem among children and adolescents in Malaysia, particularly in Terengganu. When comparing fruit and vegetable intake to wider regions, similar findings were reported in other Southeast Asian countries (India, Indonesia, Myanmar, Sri Lanka, and Thailand) (Peltzer & Pengpid, 2012), where only 23.7% of children consumed enough fruits and vegetables as recommended. Results also showed that vegetable intake was positively correlated with vegetable liking, suggesting that as vegetable intake increases, the liking also increases. As supported by Mohd Nor *et al.* (2021), food exposure increases acceptance of foods.

It was reported that girls consumed more fruits and vegetables than boys (de Oliveira Figueiredo *et al.*, 2019). As Lehto *et al.* (2015) proposed, girls have lower perceived barriers when eating fruits and vegetables. The study also found a moderate effect of parental demands to eat vegetables, which was more frequent in girls than boys. However, the authors suggested that there may not be a difference between genders in parental demands. Instead, the finding may reflect that girls gave more attention to these demands. The present study discovered the same results, where girls had a higher intake of vegetables.

Parents who bought fruits and vegetables more frequently had children who ate more fruits and vegetables. The same findings were reported by Ong *et al.* (2017), where home availability of fruits and vegetables had a positive influence on children's fruit and vegetable consumption. The current study also found a positive correlation between family mealtimes and children's vegetable consumption. Hillesund *et al.* (2021) reported the same findings where family mealtimes were associated with a higher intake of vegetables. Family mealtimes encourage good eating habits among children and adolescents, increasing the consumption of fruits and vegetables. It is known that children learn through modelling; perhaps children learn to like fruits and vegetables when they see their family members eat these foods during mealtimes.

Considering parental education, results indicated that children's vegetable intake was negatively associated with parental education and parents with secondary education had children with the highest intake of vegetables. Consistent with a previous study, Łuszczki *et al.* (2019) reported a higher fruit and vegetable intake among children whose parents had secondary education. In addition, this current study also found that parents with a higher education level bought fruits and vegetables less frequently. However, findings from other studies were contradictory; Flores-Barrantes *et al.* (2022) found a positive relationship between parental education with fruit and vegetable intake among children, while Kähkönen *et al.* (2020) did not find an association between these variables. In addition, Wolnicka *et al.* (2015) interestingly found no association between parental education and children's vegetable intake, but parental dietary knowledge had a positive association with children's vegetable intake. It can be interpreted that parents' level of education did not reflect parents' dietary knowledge, and perhaps there were other factors not related to socio-economic status that played roles in determining children's fruit and vegetable intake. This current study showed that parental education was negatively associated with family mealtimes. Parents with a higher education level may have busy jobs or tight schedules and thus, fewer family mealtimes. Therefore, this also indirectly explains the inverse correlation between parental education and children's vegetable consumption. This matter, however, needs to be studied more thoroughly.

From the perspective of children's eating behaviour, this study found that emotional overeating was associated with fruit intake. Emotional eating has been linked with parental feeding practices. Steinsbekk, Belsky & Wichstrøm (2016) reported that parents who use foods as rewards will likely have children with emotional eating. However, these associations could not be determined as the current study did not measure these variables. Among other eating behaviours, our study presented that food enjoyment was associated with fruit intake, while food responsiveness was associated with both fruit and vegetable intakes. Compared to previous studies, Cooke *et al.* (2004) and de Wild *et al.* (2018) determined that food enjoyment was associated with fruit and/or vegetable intake, but there was no association between food responsiveness and fruit and/or vegetable intake. From a broader point of view, results indicated that food approach traits (food responsiveness, emotional overeating, and enjoyment of food) were positively correlated with fruit intake, which meant that the higher the food approach traits scores, the higher the intake of fruits. Higher scores on these traits showed that children had a bigger appetite (Kininmonth *et al.,* 2021), which explains our findings. In contrast, results showed a negative correlation between food responsiveness and vegetable intake. This suggests that although children may have a big appetite, they may not like to eat vegetables. Fruits are easily accepted and more preferred by children than vegetables due to their tastes (Krølner *et al.*, 2011). Apart from that, our study also found that children with greater food fussiness and satiety responsiveness had a lower intake of vegetables. As supported by de Wild *et al.* (2018), fussier children aged 2 to 6 years ate fewer vegetables. In addition, as food fussiness and satiety responsiveness are food avoidant traits, Kininmonth *et al.* (2021) suggested that higher scores indicate smaller appetites in children.

Further analyses with robust regression indicated that frequency of buying fruits and vegetables strongly

predicted both fruit and vegetable intakes. Gender was a predictor of vegetable intake, but not of fruit intake.

The limitations of this study should be acknowledged. Parents reported children's fruit and vegetable intake and liking. It may be possible that parents were under-reporting, as results showed that both intakes were far below the recommendations. Parents may not be aware of their children's fruit and vegetable intake, especially when they are at school. Another limitation was that participants were 100% of Malay ethnicity and predominantly from lower-income families. Therefore, the results could not be generalised to other populations. Future research needs to be conducted among diverse populations. Results in this study cannot be generalised to children who are underweight and overweight/obese since 99% of children in this study had a normal BMI. Despite these limitations, this current study added to the limited literature, especially on the eating behaviour of children with normal BMI and its association with fruit and vegetable intakes. To our knowledge, this was the first study that investigated such associations in the Asian population. In addition, our results confirmed previous findings that demographic characteristics such as gender, parental education, frequency of buying fruits and vegetables, and family mealtimes are among the essential factors in determining children's fruit and vegetable intake.

CONCLUSION

Fruit and vegetable intakes among children aged 4 to 6 years in Setiu, Terengganu were low. Many factors were found to be related to fruit and vegetable intake: gender, parental education, frequency of purchasing fruits and vegetables, frequency of family mealtimes, and children's eating behaviour. Further analyses showed that frequency of purchasing fruits and vegetables was correlated with intakes of both fruits and vegetables, and gender was correlated with vegetable intake. These factors should be considered when planning strategies to encourage fruit and vegetable consumption among children.

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Authors' contributions

Nurfarhana Diana MN, involved in conceptualisation, visualisation, formal analysis and writing; Che Nur Hasniza CR, involved in visualisation and investigation.

Conflict of interest

None

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