REVIEW ARTICLE

# Dietary Patterns among Preschool Children and Its Associated Factors: A Narrative Review

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**ABSTRACT**

Dietary patterns formed during early childhood track into adulthood. Poor dietary patterns during early years may hinder children's normal growth, development, and predispose children to short- or long-term health implications. *A posteriori* dietary pattern analysis has been extensively used to characterise the overall diet of specific populations, providing valuable insights for targeted nutrition intervention. This review aims to unravel the relationship between dietary patterns and its associated factors among preschool children aged two to six years. Article search was performed using electronic databases including Google Scholar, PubMed (Medline), Web of Science and Scopus. A total of 12 studies were included in the review. The commonly identified dietary patterns among preschool children are made up of unhealthy or lower diet quality foods. Various determinants including sociodemographic, socioeconomic and lifestyle characteristics have also been linked with these dietary patterns. Therefore, it is crucial to address these multifactorial determinants when developing healthy eating habits promotion or intervention program at early age to ensure the effectiveness.
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**Keywords:** Dietary pattern analysis, Preschool children, Sociodemographic, Socioeconomic, Lifestyle

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## INTRODUCTION

Early childhood is a very critical phase where physical and mental growth and development occur intensively (1). Consuming an adequate and balanced diet in terms of energy and nutrients is very crucial to ensure optimal development and growth can be achieved (2,3). Poor food choices consisting of imbalanced nutrient intake during this phase can lead to malnutrition such as underweight, stunting or overweight and would also predispose children to the risk of non-communicable diseases in the future (4,5). The preschool age ranging from two to six years is also seen as an important period for the formation of eating habits and exert an influence on food choices in the long term (6).

Dietary intake information, including food types and quantity, is typically captured using food frequency questionnaire, dietary record or by 24-hour dietary recalls (7). The complex interaction between the combination of various nutrients and foods in dietary intake with health risks cannot be adequately explained by traditional analysis methods that focus on the isolated effects of a single food or nutrient (8,9). Growing interest in assessing overall dietary intake and its relationship with health risks has led to the extensive use of *a posteriori* dietary pattern analysis method in epidemiological studies (10). This *a posteriori* approach includes statistical methods, such as factor analysis, principal component analysis and cluster analysis, to derive dietary patterns using the dietary data of the studied population. In principal component analysis and factor analysis, the specific food items or food groups are aggregated based on their underlying interrelationship within the dataset to derive factors or dietary patterns. Cluster analysis on the other hand identifies distinct groups of individuals with similar dietary intake patterns that are mutually exclusive (7,10). This *a posteriori* approach provides a true picture of the dietary intake of the studied population in the form of dietary pattern. Additionally, it will also help in identifying populations with suboptimal dietary patterns, hence can assist in designing specific strategies or interventions in promoting healthy and sustainable

eating patterns.

Previous studies conducted to identify determinants of dietary patterns during early childhood often focus on characteristics of children and their parents including demographics, socioeconomic and lifestyles characteristics (11,12). In general, foods intake of children during early childhood is under supervision of mothers and fathers. Factors, such as the educational attainments of mothers and fathers, as well as their household income level, pose a significant role in influencing children's exposure, acceptance, and response to foods (13). In addition, those aspects can also influence the purchasing power, selection and availability of nutritious food at home which eventually influence the formation eating patterns of their children (14). This underscores the importance of establishing factors that impact the formation of dietary patterns among preschool children, thereby facilitating the development of effective healthy eating promotion or intervention program.

Although previous systematic review conducted among children aged below 24 months has revealed that sociodemographic characteristics are associated with the dietary patterns of children (11), we would not anticipate the factors to exert similar influences on the dietary habits of preschool children. This is because those younger children are usually still in the phase of complementary feeding where they heavily depend on their parents. In contrast, preschool children are starting to experience a degree of independence and may have more autonomy in their food choices and intake as they are more capable to self-feed (15). Moreover, during this phase, they also demonstrated increased ability to make their own decision on food choices related to healthy eating habits (16).

Besides that, fostering healthy eating pattern during preschool years can positively impact their physical, cognitive, and social development. This is crucial in cultivating children who can fully focus and actively engage in the learning process during their school years (17). Therefore, a comprehensive understanding of dietary patterns and their determinants at preschool age is very important to evaluate the adequacy of nutrient intake and its impact on children's health, as well as promoting healthy eating behaviour from an early age.

## METHOD

A comprehensive review of dietary patterns among preschool children and the factors influencing their dietary patterns was conducted. The flow chart presented in Fig. 1 illustrates the methodology outlined at each stage for the number of articles identified and excluded in this review. A search for articles relevant to the study title was conducted using four electronic databases consisting of Google Scholar, PubMed (Medline),

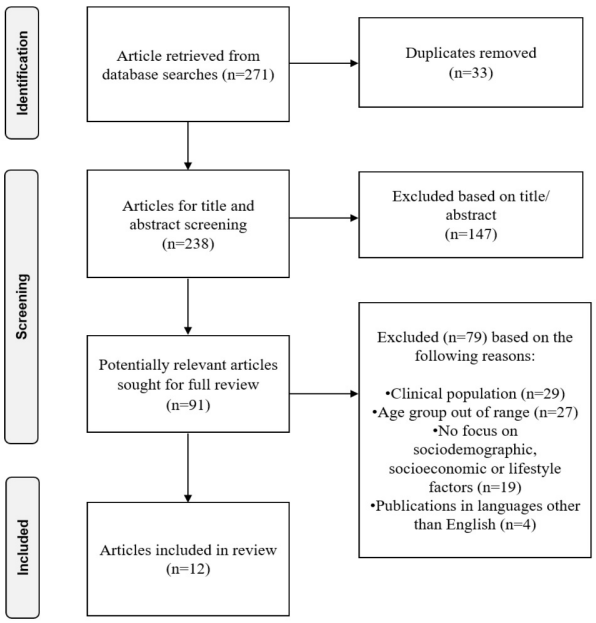


**Fig. 1 Literature review and selection criteria flow chart.**

Web of Science and Scopus, with no publication date limitations. Keywords *'preschooler', 'preschoolers', 'child', 'children', 'preschool children', 'pediatric', 'pediatrics', 'paediatric', 'childhood', 'dietary pattern', 'dietary patterns', 'food pattern', 'food patterns', 'eating pattern', 'eating patterns', 'a posteriori', 'cluster analysis', 'principal components analysis', 'factor analysis', 'reduced rank regression', 'sociodemographic', 'socioeconomic', 'lifestyle factor'* and a combination of these keywords along with Boolean operators, which include the connector terms AND, OR, and NOT was also used to broaden the search.

The articles sought involved studies that evaluate the dietary patterns of preschool children using *a posteriori* method, such as cluster analysis, principal component analysis, and factor analysis, and evaluate the factors that influence the dietary patterns. There were 238 articles remained after screening for the duplicates. Subsequently, the title and abstract were examined for their relevance to the topic, resulting of 147 articles being further excluded. The selection of the remaining 79 articles for full review was also narrowed to studies conducted among preschool children aged between two years and six years (depending on the country of the study). Studies that included children aged below two years or seven years and above, those with clinical conditions or published in languages other than English were excluded from this review, which resulted a total of 12 articles eligible for final review. The full text of the 12 eligible articles were examined to organise the data and summarise the results. The food items reported from food frequency questionnaire, dietary records, or 24-hour dietary recalls are usually being pre-grouped into smaller number of food groups based on their similarities in nutrient profile, ingredients, or preparation methods (7,18). These food groups are then being used as input

variables in statistical analysis to derive dietary patterns, as observed in all 12 articles included in this review. However, individual food items can also be use as input variables (18).

## RESULTS

### Dietary patterns among preschool children

Table I presents 12 studies that identified the prevailing dietary patterns among preschool children conducted in ten countries, including Singapore (19), Lebanon (20), Greece (21), China (22,23), Brazil (24,25), France (26), New Zealand (27), the United States (28), South Korea (29), and the Netherlands (30). The majority of the studies used food frequency questionnaires, with only one study employing a 24-hour dietary recall method to collect data on the dietary intake of the preschool children (20). Principal component analysis was the most employed statistical method, while two studies used factor analysis and one study applied cluster analysis to derive the dietary patterns. As seen in Table II, snacks, healthy and traditional dietary patterns are the three most frequently identified dietary patterns, with the former reflecting the small, light, or casual foods taken in between regular meals among preschool children. Healthy pattern indicates the consumption of variety nutrient-dense foods such as fruits, vegetables, and fish. Traditional pattern, on the other hand, refers to the consumption of traditional or staple foods in the country where the study was conducted. Besides that, these studies have identified between two and seven dietary patterns consisting a range of 17 to 48 food groups among children aged two to six years.

**Table I: Main characteristics of dietary patterns identified using *a posteriori* analysis among preschool children**

| Authors, Year of Publication | Study Location | Study Design | Age | Dietary Assessment | Analysis, Number of Food Groups | Dietary Pattern and Food Items |
|---|---|---|---|---|---|---|
| Sugianto et al. 2022 (19) | Singapore | Cross-sectional | 5 years | Food frequency questionnaire | Cluster analysis (47 food groups) | Healthy: high consumption of vegetables, fruits, fish.<br>Unhealthy: high consumption of fries, processed meat, biscuits, ice cream and low consumption of fish, fruits, vegetables. |
| Nasreddine et al. 2019 (20) | Lebanon | Cross-sectional | 2-5 years | 24-hour dietary recall | Factor analysis (15 food groups) | Fast food and sweets: sweetened beverages, fast food, salty snacks, sweets, meat, fish, poultry, eggs.<br>Traditional Lebanese: bread and cereals, dairy products, teas, fruits, and vegetables, added fats and oils and negative loading on pizza and pies. |
| Leventakou et al. 2016 (21) | Crete, Greece | Cross-sectional | 4 years | Food frequency questionnaire | Principal component analysis (17 food groups) | Mediterranean: pulses, olive oil, vegetables, fish and seafood, fruits.<br>Snacky: potatoes and starchy roots, salty snacks, sugar preserves and confectionery, eggs.<br>Western: cereals and cereal products, cheese, total added lipids, no alcoholic beverages, meat, and meat products. |
| Min et al. 2021 (22) | Beijing, China | Cross-sectional | 3-6 years | Food frequency questionnaire | Factor analysis (25 food groups) | Sugar-sweetened beverage and snack: fresh fruit and vegetable juice, soybean milk, flavoured milk drinks, carbonated drinks, flavoured fruit and vegetable drinks, tea drinks, plant-protein drinks, puffed foods, fried foods, Western fast foods.<br>Chinese traditional: fruits, vegetables, dark-green vegetables, other dark-colour vegetables, meat, poultry, other protein-rich foods.<br>Health conscious: soybean milk, milk, yogurt and other dairy products, nuts, wheat and wheat products, fishery products, other protein-rich foods.<br>Snack: sweets, pastries, puffed foods, fried foods, Western fast foods. |
| Rutayisire et al. 2018 (23) | Anhui and Jiangsu, China | Cross-sectional | 3–6 years | Food frequency questionnaire | Principal component analysis (35 food groups) | Traditional Chinese: wheat, other cereals, tubers, legumes, fruits, vegetables, fresh fruit and fresh vegetable juice, eggs, low-fat dairy products, poultry, fish.<br>Modern: Western fast food, Chinese fast food, preserved food, fried vegetables, fried meat, sweet course, sugary foods, chocolate, ice cream, carbonated drinks, flavoured milk, artificial fruits, or vegetable juice. |
| Nobre et al. 2012 (24) | Minas Gerais, Brazil | Cross-sectional | 5 years | Food frequency questionnaire | Principal component analysis (24 food groups) | Mixed diet: meat and pork, baked beans, milk and milk products, rice and roots, farinaceous, sweet and savoury biscuits, cakes, pastries, fruits, juices.<br>Snack: milk and milk products, sweet and savoury biscuits, fruits, juices, breads, margarine, Nescau/Toddy.<br>Unhealthy: fat snacks, sweet treats, artificial juices, soft drinks, sweets and desserts, stuffed cookies, fried and boiled eggs. |

CONTINUE

**Table I: Main characteristics of dietary patterns identified using *a posteriori* analysis among preschool children (Cont.)**

| Authors, Year of Publication | Study Location | Study Design | Age | Dietary Assessment | Analysis, Number of Food Groups | Dietary Pattern and Food Items |
|---|---|---|---|---|---|---|
| Santos et al. 2016 (25) | Pelotas, Brazil | Cohort | 6 years | Food frequency questionnaire | Principal component analysis (22 food groups) | Fruits and vegetables: raw vegetables, cooked vegetables, fruits, fresh fruit juice.<br>Snacks and treats: candies, sweetened beverages, crisps.<br>Coffee and bread: bread, butter, mayonnaise, margarine, coffee, sugar<br>Milk: milk drinks, chocolate milk powder.<br>Cheese and processed meats: cheese, sliced meats, sausages.<br>Rice and beans: rice, beans.<br>Carbohydrates: pasta, potato, cassava. |
| Camara et al. 2015 (26) | France | Cohort | 2-5 years | Food frequency questionnaire, assessed at the age of 2, 3 and 5 years. | Principal component analysis (26 food groups) | Guidelines: fresh fruits, vegetables, low fat fish, bread.<br>Processed, fast-foods: French fries, processed meat, chips, chocolates, carbonated soft drinks, cookies, meat, fruit juices. |
| Wall et al. 2012 (27) | Auckland, New Zealand | Cohort | 3.5 years | Food frequency questionnaire | Principal component analysis (48 food groups) | Junk: soft drinks, sweets bar, chips, white bread, cordial.<br>Traditional: spinach, pumpkin, carrots, kumera, mixed vegetables, cauliflower, potatoes, peas, beef as part main meals, bananas, apples.<br>Healthy: tomatoes, other green vegetables, celery, cucumber, pineapple, white rice, tuna in water, tinned fish in water, stone fruit. |
| Jansen et al. 2019 (28) | Michigan, the United States | Cross-sectional | 3–5 years | Food frequency questionnaire | Principal component analysis (27 food groups) | Vegetables, healthy proteins and sides: vegetables, non-processed meat, legumes, fish, potato, eggs, rice and low consumption on sugar-sweetened beverages, juice.<br>Breads and spreads: bread, peanut butter and other nuts, spreads with fat, breakfast pastry and low consumption on fruits.<br>Processed and fried: French fries, processed meat, salty snacks, sweets and low consumption on milk and cold cereal. |
| Shin et al. 2007 (29) | Seoul and Uijeongbu, South Korea | Cross-sectional | 5 years | Food frequency questionnaire | Principal component analysis (33 food groups) | Korean healthy: vegetables, kimchi, seaweed, nuts, fruits, milk, dairy products.<br>Animal foods: beef, pork, poultry, fish, fast foods.<br>Sweets: ice cream, sweet drinks, chocolates, sweet baked goods, sugary foods. |
| Rashid et al. 2018 (30) | Amsterdam, the Netherlands | Cross-sectional | 5 years | Food frequency questionnaire | Principal component analysis (41 food groups) | Snacking: savoury snacks, refined breakfast products and low consumption of whole grains breakfast products.<br>Full-fat: full-fat spreads, tomato sauces for pasta and low consumption of low-fat cheese.<br>Meat: low-fat meat, high-fat meat, sauces, refined grain products for warm meal.<br>Healthy: water and tea, vegetables, fish, fruit. |

**Table II: List of the dietary patterns identified in these studies as healthy or high diet quality and unhealthy or lower diet quality**

| Authors, Year of Publication | Number of dietary patterns identified | Healthy or high diet quality | Unhealthy or lower diet quality |
|---|---|---|---|
| Sugianto et al. 2022 (19) | 2 | "Healthy" | "Unhealthy" |
| Nasreddine et al. 2019 (20) | 2 | "Traditional Lebanese" | "Fast food and sweets" |
| Leventakou et al. 2016 (21) | 3 | "Mediterranean" | "Snacky",<br>"Western" |
| Min et al. 2021 (22) | 4 | "Chinese traditional",<br>"Health conscious" | "Sugar-sweetened beverage and snack",<br>"Snack" |
| Rutayisire et al. 2018 (23) | 2 | "Traditional Chinese" | "Modern" |
| Nobre et al. 2012 (24) | 3 | "Mixed diet" | "Snack",<br>"Unhealthy" |

CONTINUE

**Table II: List of the dietary patterns identified in these studies as healthy or high diet quality and unhealthy or lower diet quality (Cont.)**

| Authors, Year of Publication | Number of dietary patterns identified | Healthy or high diet quality | Unhealthy or lower diet quality |
|---|---|---|---|
| Santos et al. 2016 (25) | 7 | "Fruits and vegetables", "Milk", "Rice and beans", "Carbohydrates" | "Snacks and treats", "Coffee and bread", "Cheese and processed meats", |
| Camara et al. 2015 (26) | 2 | "Guidelines" | "Processed, fast-foods" |
| Wall et al. 2012 (27) | 3 | "Traditional", "Healthy" | "Junk" |
| Jansen et al. 2019 (28) | 3 | "Vegetables, healthy proteins and sides" | "Breads and spreads", "Processed and fried" |
| Shin et al. 2007 (29) | 3 | "Korean healthy" | "Animal foods", "Sweets" |
| Rashid et al. 2018 (30) | 4 | "Healthy" | "Snacking", "Full-fat", "Meat" |

## Factors associated with dietary pattern

Table III shows the associations between the identified dietary patterns and sociodemographic, socioeconomic and lifestyle factors among preschool children.

## Sociodemographic factors

All studies included in this review have investigated the influence of sociodemographic factors such as age, gender, ethnicity, parents' characteristics, and family structure on dietary pattern. Among the six studies that investigated the relationship between age and dietary pattern, three studies have found a significant positive association between age with unhealthy patterns (20,23,29) whilst another three studies revealed no significant relationship (21,22,28). Two of the included studies have reported an association between sex and dietary pattern (20,25). Three studies have revealed a significant association between ethnicity with dietary pattern (19,28,30). The presence of older siblings (21,26) and number of siblings (21,23) were also associated with children's dietary pattern. Four studies have reported an inversed association between parents' age with adherence to unhealthy dietary patterns (23,25-27). Six studies have included parents' weight status as sociodemographic data in their studies in which three studies indicated a significant association with dietary pattern (21,22,27). However, the association was absent in the remaining studies (20,23,24).

**Table III: Sociodemographic, socioeconomic and lifestyle factors associated with dietary patterns among preschool children**

| Authors, Year of Publication | Study Location | Sample Size, Age | Dietary Assessment | Dietary Patterns | Sociodemographic, Socioeconomic and Lifestyle Factors Assessed | Factors Associated with Dietary Patterns |
|---|---|---|---|---|---|---|
| Sugianto et al. 2022 (19) | Singapore | 808, 5 years | Food frequency questionnaire | "Healthy", "Unhealthy" | Gender, ethnicity, birth order, maternal age during pregnancy, household income, maternal education level | Lower maternal education level, Malay and Indian ethnic groups were associated with "unhealthy" cluster. |
| Nasreddine et al. 2019 (20) | Lebanon | 525, 2–5 years | 24-hour dietary recall | "Fast food and sweets", "Traditional Lebanese" | Age, gender, maternal body mass index, maternal education level | Age was positively associated with "fast food and sweets" pattern. Girls and maternal education level were inversely associated with "fast food and sweets" pattern. Maternal education level was positively associated with "Traditional Lebanese" pattern. |
| Leventakou et al. 2016 (21) | Crete, Greece | 1061, 4 years | Food frequency questionnaire | "Mediterranean", "Snacky", "Western" | Gender, age, number of siblings, time spent watching television, time spent outside home, passive smoking at home, maternal age, parental education level, maternal pre-pregnancy body mass index | Number of siblings was positively associated "Mediterranean" pattern. Time spent watching television was inversely associated with "Mediterranean" pattern. Number of older siblings was associated with "snacky" pattern. Maternal age, maternal pre-pregnancy body mass index and parental education level were inversely associated with "snacky" pattern. Number of siblings, exposure to passive smoking, and time spent watching television were positively associated with "Western" pattern. |

CONTINUE

**Table III: Sociodemographic, socioeconomic and lifestyle factors associated with dietary patterns among preschool children (Cont.)**

| Authors, Year of Publication | Study Location | Sample Size, Age | Dietary Assessment | Dietary Patterns | Sociodemographic, Socioeconomic and Lifestyle Factors Assessed | Factors Associated with Dietary Patterns |
|---|---|---|---|---|---|---|
| Min et al. 2021 (22) | Beijing, China | 3373, 3–6 years | Food frequency questionnaire | "Sugar-sweetened beverage and snack", "Chinese traditional", "Health conscious", "Snack" | Age, gender, maternal and paternal socioeconomic status, maternal and paternal weight status | Increasing age, lower maternal and paternal socioeconomic status were associated with "sugar-sweetened beverage and snack" pattern.<br>Maternal weight status of normal or underweight was associated with "health conscious" pattern. |
| Rutayisire et al. 2018 (23) | Anhui and Jiangsu, China | 8900, 3–6 years | Food frequency questionnaire | "Traditional Chinese", "Modern" | Age, gender, number of siblings, maternal and paternal age, maternal and paternal education level, maternal and paternal smoking habits, household income, maternal and paternal weight status | Maternal and paternal education level and paternal smoking habits were associated with "traditional Chinese" pattern. Household income and paternal age were inversely associated with "traditional Chinese" pattern.<br>Age and number of siblings were positively associated with "modern" pattern. Maternal and paternal age, maternal and paternal education level, and paternal smoking habits were inversely associated with "modern" pattern. |
| Nobre et al. 2012 (24) | Minas Gerais, Brazil | 232, 5 years | Food frequency questionnaire | "Mixed diet, "Snack", "Unhealthy" | Gender, time spent watching television, maternal weight status, maternal years of schooling, household income, household size | Maternal years of schooling was negatively associated with "mixed diet" pattern.<br>Maternal years of schooling was positively associated with "snack" pattern.<br>Household income was positively associated with "unhealthy" pattern. |
| Santos et al. 2016 (25) | Pelotas, Brazil | 3427, 6 years | Food frequency questionnaire | "Fruits and vegetables", "Snacks and treats", "Coffee and bread", "Milk", "Cheese and processed meats", "Rice and beans", "Carbohydrates" | Gender, maternal age at birth, socioeconomic status | Girls were associated with "fruits and vegetables" pattern.<br>Socioeconomic status was inversely associated with "snacks and treats" pattern.<br>Socioeconomic status was negatively associated with "coffee and bread" pattern.<br>Socioeconomic status was positively associated with "milk" pattern. Girls were inversely associated with "milk" pattern.<br>Socioeconomic status was positively associated with "cheese and processed meats" pattern. Maternal age at child's birth was negatively associated with "cheese and processed meats" pattern.<br>Girls, maternal age at child's birth, socioeconomic status were inversely associated with "rice and beans" pattern. |
| Camara et al. 2015 (26) | France | 974, 2-5 years | Food frequency questionnaire (multiple time point, collected at the age of 2, 3 and 5-6 years) | "Guidelines", "Processed, fast foods" | Maternal and paternal age at child's birth, maternal and paternal education level, socioeconomic status, presence of older siblings. | Maternal and paternal education level were associated with "guidelines" pattern.<br>Maternal age at child's birth, maternal education level, socioeconomic status, and presence of older siblings were inversely associated with "processed, fast foods" pattern. |
| Wall et al. 2012 (27) | Auckland, New Zealand | 550, 3.5 years | Food frequency questionnaire | "Junk", "Traditional", "Healthy" | Gender, socioeconomic status, maternal education level, maternal smoking in pregnancy, maternal body weight status, maternal age during pregnancy | Young maternal age during pregnancy, maternal weight status, maternal smoking in pregnancy were associated with "junk" pattern. |

CONTINUE

**Table III: Sociodemographic, socioeconomic and lifestyle factors associated with dietary patterns among preschool children (Cont.)**

| Authors, Year of Publication | Study Location | Sample Size, Age | Dietary Assessment | Dietary Patterns | Sociodemographic, Socioeconomic and Lifestyle Factors Assessed | Factors Associated with Dietary Patterns |
|---|---|---|---|---|---|---|
| Jansen et al. 2019 (28) | Michigan, the United States | 355, 3–5 years | Food frequency questionnaire | "Vegetables, healthy proteins and sides", "Breads and spreads", "Processed and fried" | Age, gender, ethnicity, maternal and paternal education level, socioeconomic status, sleeping pattern | Bedtime on weekdays, duration of night sleep on weekends and difference in total sleep time between weekends and weekdays were inversely associated with "vegetables, healthy proteins and sides" pattern.<br>Maternal and paternal education level were associated with "breads and spreads" pattern.<br>Black, non-hispanic/Latino or other ethnicities, bedtime on weekends and difference in bedtime between weekends and weekdays were associated with "processed and fried" pattern. |
| Shin et al. 2007 (29) | Seoul and Uijeongbu, South Korea | 1441, 5 years | Food frequency questionnaire | "Korean healthy", "Animal foods", "Sweets" | Age, gender, household income, household food expenditure | Household income and household food expenditure were associated with "Korean healthy" pattern.<br>Age and household food expenditure were associated with "animal foods" pattern.<br>Household food expenditure was associated with "sweets" pattern. |
| Rashid et al. 2018 (30) | Amsterdam, the Netherlands | 2769, 5 years | Food frequency questionnaire | "Snacking", "Full-fat", "Meat", "Healthy" | Ethnicity, socioeconomic status (maternal educational level) | Turkish ethnic group and low socioeconomic status were associated with higher score of "snacking" pattern.<br>Turkish ethnic group and high socioeconomic status were associated with higher score of "full-fat" pattern.<br>Surinamese ethnic group and low socioeconomic status were associated with higher score of "meat" pattern.<br>Moroccan and Turkish ethnic groups were associated with higher score of "healthy" pattern. |

### Socioeconomic factors

Eight out of nine studies discovered a significant influence of parental educational level with dietary pattern of children (19-21,23,24,26,28,30) and one study reported no significant association (27). There are six studies that reported household income has a significant association on dietary pattern among preschool children (22-26,29).

### Lifestyle factors

The relationship between lifestyle factors, such as children's sleeping habits, screen time and parents' smoking habit, with dietary pattern was also being investigated by six studies included in this review. One study has revealed a significant association between the timing of bedtime with dietary pattern (28). One out of two studies has reported a significant association between time spent watching television with dietary pattern (21) however, another study did not indicate any significant relationship (24). Besides that, there are three studies that have also explored the relationship between smoking habits of parents with dietary patterns of children (21,23,27).

## DISCUSSION

The current narrative review outlined factors associated with dietary pattern among preschool children aged two to six years, based on an analysis of 12 studies. The associated factors were identified within three main themes: sociodemographic, socioeconomic, and lifestyle factors.

### Sociodemographic factors

Several sociodemographic characteristics have been linked with children's dietary patterns. Overall, studies suggested that diet quality tends to decline with increasing age (31,32). From our review, several studies have found a significant association between older age with such unhealthy patterns as "fast food and sweets" (20), "modern" (23) and "animal foods" (29) among preschool children. Consistent to the previous findings, a recent study among preschool children in China also discovered that older children were more likely to adhere to pattern named "sugar-sweetened beverage and snacks" (22). This may be attributed by as children get older, they become more independent, and parents may gradually become less strict in controlling their food intakes, in addition to the exposure from older siblings or peers (33). Subsequently, children are more likely to choose food based on their preferences.

In this review, differences in dietary patterns between sex are observed. One study has indicated that compared to boys, girls were less likely to follow "fast food and sweets" pattern (20). Similarly, Santos and colleagues also observed that girls exhibited lower adherence to unhealthy pattern termed as "cheese and processed meats", instead they were found to have greater adherence to the "fruits and vegetables" pattern (25). Boys' preferences over energy-dense foods such as meat and fast foods may be related to the higher energy requirement as compared to girls (34). Moreover, gender differences in dietary patterns among children may also

be driven by parents' feeding practices (35). Studies have indicated that parents typically express more concern on their daughters' weight status compared to their sons. This concern may lead parents to control or restrict their daughters' food intake while sons are often being encouraged to eat more foods.

Racial or ethnic background which is part of social identities is one of the determinants of individual dietary patterns. Every racial or ethnic group possess its own set of belief and cultural practices which significantly influence their daily food intakes, spanning from purchase and preparation of food to its consumption (36). Findings from an Asian cohort study in Singapore revealed that preschool children of Indian and Malay ethnicity showed higher adherence to "unhealthy" cluster consisting of fries, processed meat, biscuits, and ice cream compared to their Chinese counterparts (19). Other studies in the United States (28) and the Netherlands (30) also found variations in children's dietary patterns based on their ethnic backgrounds. Children of black, non-Hispanic/Latino ethnicity showed significantly higher intake of "processed and fried" pattern than their white, non-Hispanic/Latino counterparts (28). Children of main ethnic group in the Netherlands, the Dutch ethnicity showed lower adherence towards "snacking" pattern compared to other ethnic groups (30). Children from other ethnicities such as Turkish exhibited with higher intake of "full-fat", "healthy" and "snacking" patterns. In contrast, Surinamese children were found to have higher adherence towards "meat" pattern whilst Moroccan children showed higher intake of "healthy" pattern (30). Moreover, the results of this review also indicate that ethnic minorities tend to adopt unhealthy dietary patterns. This may be attributed by factors such as limited food availability and lower socioeconomic status, including lower income and educational level which constrain their access to healthy and diverse food options thereby influence their dietary choices (37). Hence, it is also important to address the socioeconomic inequalities besides improving food accessibility among ethnically diverse populations to improve their dietary quality thereby reducing nutrition-health related problems in future.

Besides that, sociodemographic factors, such as household size and number of siblings, play an important role in predicting children's dietary patterns. The presence of older siblings, has been found to be associated with the practise of "processed, fast-foods" patterns among children aged two to five years (26). Other studies have associated the adherence to such unhealthy patterns as "snacky", "Western" and "modern" among children with older siblings (21) or those with higher number of siblings (21,23). Apart from the influence of older siblings who are often considered as role models in shaping their younger siblings' food intake, having many siblings can also lead parents to choose less healthy foods, such as easily and quickly prepared processed foods, due to increased childcare responsibilities (26,38).

Characteristics of parents, such as their age, have been linked with children's dietary pattern in which having older parents are associated with lower adherence to such an unhealthy pattern as "modern" pattern (23). In this current review, few studies have also observed that children of young mothers were more likely to follow such unhealthy patterns as "cheese and processed meats" (25), "processed, fast-foods" (26) and "junk" (27). Compared to older parents, younger parents have been linked with lower nutrition knowledge, thereby exposing their children to unhealthy and poor eating habits (14). Hence, it is crucial to provide young parents with nutrition education to increase their knowledge and to enhance their attitude and practices as an effort to support healthier eating habits (39).

In this review, there are few studies that examined the relationship between parents' weight status with children's dietary pattern. A study has demonstrated that the adherence to "health conscious" pattern consisting of milk, legumes, fish products, wheat products and high protein foods was higher among children whose mothers who were not overweight (22). Conversely, mothers' overweight and obesity status has been identified as a determinant to higher adherence to "junk" pattern consisting of soft drinks, sweets bar, chips, white bread and cordials (27). Besides that, it has been suggested that lower pre-pregnancy body mass index of mother has also been linked to higher score of "snacky" pattern among preschool children (21).

Mothers with poor lifestyle including those with unhealthy body weight are less likely to concern about the nutritional value of their children's foods intake (40). Furthermore, poor feeding practices, such as less use of healthy eating guidelines and less monitoring on their children's food intake, have also been observed among mother with higher body mass index (41). In addition, unhealthy weight status has also been associated with unhealthy eating behaviour, in which it can indirectly affect children's food intake through parents' food modelling and feeding practices (42,43).

**Socioeconomic factors**

Parental education attainments, type of occupation as well as household income are among the characteristics that are usually used as indicators of socioeconomic status. Studies have ascertained that children's dietary patterns are closely related to the socioeconomic status in which highly educated and high-income parents resulting in better nutrition quality among children (31,44). Adherence to unhealthy dietary patterns termed as "unhealthy" (19), "fast food and sweets" (20), "snacky" (21), "modern" (23) and "snacking" (30) are observed among children of parents with lower education level.

A study conducted by Camara et al. (26) revealed that adherence to the "guidelines" pattern consisting of vegetables, fruits and fish was greater among children from highly educated mothers and fathers. Conversely, children whose mothers with lower education level exhibited greater consumption of "processed, fast-foods" pattern. This clearly highlights the importance of high education level among mothers and fathers, as it implies that they may have better health literacy and ability to understand and use food labels thereby are more likely to prepare nutritious foods for their children (45,46).

However, contradicting to findings of other studies, Nobre and colleagues (24) found that children of mothers with lower education level were less likely to follow "snack" pattern. Instead, they exhibited with greater intake of "mixed diet" pattern consisting of typical local foods. Lower education level has been associated with lower household income. This may cause mothers to use local staples such as rice, root vegetables, and flour that are much cheaper in their daily food preparation compared to processed foods which are more likely to cost more.

The income of the household is seen as an important predictor of dietary patterns. It is well acknowledged that compared to high-income households, children from low-income households are usually linked to the adoption of unhealthy dietary patterns (22,25,26). However, the relationships between household income and children's dietary patterns show inconsistencies. In this present review, there are few studies that reported the contradicting findings with children from high-income households were more likely to adhere to unhealthy patterns consisting of processed meat, snacks, and sugary beverages (23-25). Simultaneously, these richer children also showed less adherence to healthy pattern such as "traditional Chinese" made up of wheat, legumes, poultry, meat, fruits, and vegetables (23). On the other hand, Shin et al. (29) also revealed that the consumption of "Korean healthy" pattern was higher among children from high-income households and adherence this dietary pattern is also related to increased household expenses.

A systematic review on association between socioeconomic factors with dietary patterns suggested that these discrepancies may be attributed to the fact that in developed and high-incomes countries, processed foods and fast-food restaurants are usually easy to find and have lower price compared to healthy foods, causing low-income groups to purchase less nutritious choices (47). On the contrary, in middle- or low-income countries, high-income households have been associated with high consumption of processed foods. This may be because the price of processed foods is expensive in middle- and low-income countries due to the lack of access to it, causing poorer households to opt for staple or traditional local foods that are lower in cost (48).

**Lifestyle factors**

Adequate sleeping hour has an important role in the growth and development of children (49). Sleeping habits, including bedtime and total duration of night sleep have been found to influence dietary patterns among children. A study has reported that children who went to bed late on weekends were linked with higher intake of "processed and fried" pattern, whilst children who had late bedtime on weekdays were associated with lower intake of the "vegetables, healthy proteins, and sides" pattern (28). Children who had shorter night sleep duration, especially on weekdays were also presented with lower intake of the "vegetables, healthy proteins, and side dishes" pattern.

Shorter sleep duration can result in prolonged wakefulness, creating a window of opportunities for increased food intake which is influenced by taste and smell (50). Moreover, inadequate sleeping hour can cause disruption to hormone regulation. Changes in appetite-regulating hormone, such as ghrelin, cortisol, and leptin, can enhance the feeling of hunger (51). In addition, unhealthy sleep habits can also cause emotional disturbances such as fatigue and lethargy, subsequently contributing to a tendency to choose high-energy foods like snacks, fast food or sweets as a means in coping with these issues (52). Consequently, engaging in unhealthy sleeping habits can expose children to increase in fat composition and risk of overweight in children (50,53). Therefore, complying to the recommendation by the American Academy of Sleep Medicine which is to get ten to 13 hours of sleep for children aged three to five years, is important for cognitive, motor skills development and overall quality of life (2,54).

The amount of time spent on watching television can influence the dietary patterns of children. In this present review, longer time spent on watching television has been linked with adherence to "Western" dietary pattern (21) although another study did not see any significant relationship (24). Apart from being associated with a sedentary behaviour, children who spend a lot of time watching television are also exposed to unhealthy food advertisements, including fast food and snacks, which are broadcasted on television, thereby influencing their food intake (55). A study involving 22 countries has revealed that beverages (including flavoured drinks and carbonated beverages), chocolate and confectionery, breakfast cereals, ready-made foods, and baked products such as cakes, biscuits and pastries which are primarily comprised of food groups that are not permitted to be advertised to children, are the top five food categories that are frequently advertised on television, particularly during peak viewing hours (56). Therefore, parents need to limit children's screen time in addition to encourage their children to engage in physical activity. Besides that, reinforcement of policy for unhealthy food

advertisements on media platforms by the authorities is also crucial in promoting a healthier eating pattern among children.

There are few studies that explored the relationship between smoking habits of parents with dietary patterns of children (21,23,27). Children of parents with smoking habits or children who were exposed to second-hand smoke at home have been associated with unhealthy dietary pattern such as "junk" (27) and "Western" patterns (21). Apart from having lower awareness of health risks, smoking habits have been linked with socioeconomic disadvantages including lower household income and lower education attainment (57-59). Moreover, poor dietary quality has also been observed among adults with smoking habits (60). This may suggest that the unhealthy dietary patterns observed in children may be related to the limited health knowledge and poor dietary quality among smoking parents.

Despite the valuable insights provided by the reviewed studies, it is important to acknowledge the limitations of the current review, which is the absence of quality assessment for the included studies that could introduce to the potential bias in the interpretation of findings and limitations in the reliability of the synthesised evidence. Besides that, this review only focussed on English-language articles, which may limit the generalisability of the findings. Future research in this area should aim to address these limitations by incorporating rigorous methodological assessments and including a broader range of languages and regions to ensure a more representative understanding of childhood dietary patterns.

## CONCLUSION

This review emphasizes that sociodemographic, socioeconomic and lifestyle factors, such as age, ethnicity, sex, number of siblings, maternal weight status, maternal education level, household income, time spent watching television, sleeping behaviours and parental smoking habits, are linked with dietary patterns among preschool children aged two to six years. In addition, this review also highlights that there are complex and inconsistent findings on the influence of ethnic groups and socioeconomic status on dietary pattern among preschool children. The commonly identified dietary patterns also include less healthy or lower diet quality foods, indicating that preschool children may be exposed to the risk of poor nutritional status. Taken together, the development of programs or interventions aiming at establishing healthy eating styles at early age should consider the sociodemographic, socioeconomic and lifestyle factors so that the effectiveness of the program can be achieved, thereby reducing the health implications and healthcare burden in the future.

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