RESEARCH



Assessing family influence on adolescent healthy eating: insights from knowledge, attitudes, and practices in a cross-sectional survey in Hong Kong

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Abstract

Background Poor dietary habits in adolescents contribute to the development of non-communicable diseases in adulthood. While family influence by parenting style, food parenting practice and household income on adolescent eating habits has been well-established, other family factors such as parental health conditions as well as the impact on dietary knowledge and attitudes in adolescents are underexplored. This study aimed to evaluate the relative importance of family factors on adolescent healthy eating using the knowledge, attitudes, and practices (KAP) model.

Methods A cross-sectional online survey was conducted among parent-adolescent dyads recruited from a previous cohort study and secondary schools in Hong Kong. Adolescent healthy eating was assessed by a locally developed and validated KAP of Healthy Eating Questionnaire (KAP-HEQ). It evaluated knowledge on dietary recommendations, health outcomes and food choice; attitudes on outcome expectation, food preference, and self-efficacy; and practices on meal pattern and healthy/unhealthy food consumption. Parents reported on family factors including their KAP of healthy eating (KAP-HEQ), parenting style (Parenting Style and Dimensions Questionnaire), attitudes towards adolescent eating habit, food parenting practices, and family demographic characteristics such as employment status and household income. Multivariable linear regression was used to estimate the family influence on adolescent healthy eating.

Results Two hundred seven dyads of parents (mean age = 46.14 years, 85.02% mothers, 80.19% married, 60.87% attained senior secondary education or above) and adolescents (mean age = 15.21 years, 48.31% female) completed the survey. Positive associations were found between dyad knowledge (β = 0.28, *p* < 0.001), dyad attitudes (β = 0.22, *p* < 0.001), and between adolescent practices and food parenting practices (β = 0.18, *p* < 0.001) and parental employment status (part-time vs unemployed: β = 4.08, *p* < 0.05). Negative associations were identified between adolescent attitudes and authoritative parenting style (β = -0.11, *p* < 0.05) and household size (β = -3.19, *p* < 0.05), and between adolescent practices and higher parental education levels (senior secondary or above vs primary or below: β = -2.86, *p* < 0.05).

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Discussion The study found positive effects of parental dietary knowledge, attitudes, and food parenting practices on adolescent KAP of healthy eating. Interventions to enhance these three family facilitators should be included in strategies for promoting KAP of healthy eating among adolescents.

Keywords Adolescents, Healthy eating, Family influence, KAP, Food parenting practices

Background

In recent decades, modern food patterns have shifted to the consumption of highly processed and calorie-dense foods [1]. Unhealthy dietary habits, characterized by a low consumption of fruit and vegetables (FV) and high intake of oil, salt and sugar, are widely recognized as a significant risk factor in the development of various noncommunicable diseases (NCDs) [2], which have created tremendous burden on healthcare systems and economies worldwide [3].

An unhealthy diet is linked to poorer mental health [4] and increased risk of obesity [5] in adolescents, and progression to developing various NCDs later in adulthood [6]. However, the local Population Health Survey 2020/22 reported that 98.7% of the respondents aged 15 to 24 did not meet the dietary recommendations on consuming at least 5 servings of FV per day and 83.9% had daily salt intake of 5 g or above [7]. It is essential to establish a balanced and nutritious diet during adolescence and lay the foundation for a healthier life in the future.

Based on the socio-ecological model, individual dietary habits are influenced by the surrounding environment [8]. Family plays a vital role to assist children in acquiring healthy eating behaviors. Existing evidence has shown the facilitating roles of food parenting practices (nutrition education, role modeling, and food availability), authoritative parenting style, and socioeconomic status on food consumption of adolescents [9, 10]. A growing number of studies suggested that parental health conditions and dietary knowledge promote nutrition knowledge, healthy food consumption and meal pattern in adolescents [11, 12].

The Knowledge, Attitudes and Practices (KAP) model is recommended by the World Health Organization to identify gaps in the understanding, cultural beliefs and behaviors to map out the needs for planning behavior change interventions [13]. People with a firm comprehension of health knowledge and positive attitudes tend to practice healthy habits [14]. Recognizing the family influence on dietary KAP in adolescents is crucial for designing effective interventions to promote healthy eating in family setting.

Existing research mainly focuses on the direct influence of family on the eating practices of adolescents but not their dietary knowledge and attitudes. A few recent studies have explored family influence on adolescent KAP of healthy eating in diverse contexts [11, 15–17], and demonstrated positive associations between parentadolescent attitudes in terms of autonomy motivation and consumption of FV [15] and of healthy beverages [16], between food parenting practices and adolescent nutrition knowledge and less unhealthy food consumption [17], and between dietary knowledge in parents and adolescents [11]. However, most studies focused on a few specific family factors with a limited exploration of the impact of parental KAP of healthy eating, as well as the relative importance of various family factors on all the dietary KAP in adolescents. Most studies were conducted in Western countries and the results might not be applicable to the Chinese population which has a different eating culture. An earlier local study identified a positive association between mothers' FV-related knowledge, attitudes, and practices and FV consumption among children aged 9 to 11 [18], but none in adolescents. Our previous qualitative study showed that, apart from the family factors identified in the literature, parental attitudes towards adolescent eating habit, such as perceived susceptibility to health outcomes and priority of obligations in adolescents, have positive impacts on the KAP of healthy eating in adolescents [19]. This study aimed to examine the relative importance of family factors on the KAP of healthy eating in Chinese adolescents in Hong Kong.

Methods

Participants

It is a cross-sectional survey study involving adolescents aged 12 to 19 and their primary parents. Participants were partly drawn from the "Trekkers Family Enhancement Scheme" (TFES) cohort study which targeted the low-income working families [20], and partly recruited from secondary schools in middle- and high-income districts in Hong Kong. Families were included if the adolescents were 12 to 19 years old with a parent as the primary caregivers. Those who could not read Chinese nor use WhatsApp messenger and those who participated in the field-test of the survey were excluded. A total of 302 families were invited to the study by a WhatsApp message and an e-pamphlet with a brief introduction on the study aim, criteria (age of adolescent and parent being the primary caregiver) and procedures, and a link for online registration. Fifty-six families (18.5%) completed online registration and they referred another 30 families to participate. Of those 86 families, 68 (79.1%) completed the questionnaires. Additionally, 169 families were recruited from seven schools by the distribution of printed pamphlet or posting of e-pamphlet on the school intranet platform, and 139 of them (82.2%) completed the survey. A final sample of 207 parent-adolescent dyads was recruited in this study. A flow diagram of subject recruitment is presented in the Supplementary Material 1. It met the minimum requirement of 113 dyads as estimated by detecting a correlation of 0.3 [21] with 90% power and 5% level of significance [22], and 90 dyads for multivariable regression with 14 independent variables and 4 confounding variables based on the sample-to-variable ratio of 5:1 [23]. Each family received an incentive of HK\$200 supermarket coupons as a token of appreciation.

Data collection

Quantitative data were collected from October 2022 to June 2023 using Qualtrics, an online survey platform with secure data storage in the server of the University. Each dyad received a link to parent- or adolescent-specific survey and a unique family reference code. Parents provided consent for themselves and their adolescent children, while adolescents consented individually, on the first page of the survey link before proceeding to the questionnaire survey. Parents completed a series of questionnaires, including the Knowledge, Attitudes and Practices of Healthy Eating Questionnaire (KAP-HEQ), the Parenting Styles and Dimensions Questionnaire (PSDQ), the questionnaires on Parent Attitudes towards Adolescent Eating Habit (PAAEH) and the Food Parenting Practices (FPP), as well as demographic information on parental and household characteristics. Adolescents completed the KAP-HEQ along with information on their age and gender. They survey was completed by the participants on their own.

The study was approved by the Institutional Review Board of the University/Hospital Authority Hong Kong West Cluster (UW 22–289).

Measures

KAP of Healthy Eating Questionnaire (KAP-HEQ)

KAP-HEQ consists of three constructs measuring knowledge, attitudes and practices of healthy eating [24] (Supplementary Material 2). *Knowledge* includes 14 items on dietary recommendations (4 items), health outcomes (5 items), and food choice (5 items). Correct answers score 1 point whereas incorrect or "not sure" responses receive no points. One item has three correct answers, yielding a maximum knowledge scale score of 16. *Attitudes* includes 15 items across three sub-constructs: outcome expectations for healthy and unhealthy eating (5 items), preference towards certain food types and priorities in food choice (5 items), and self-efficacy to adopt healthy eating (5 items). A 5-point Likert scale is used to assess agreement with each statement (1 - Strongly disagree to 5 - Strongly agree), with reverse coding for negative attributes. Practices consists of 15 items on meal patterns (2 items), healthy food consumption (6 items), and unhealthy food consumption (7 items), with a 5-point Likert scale for frequency and reverse coding for unhealthy practices. Both Attitudes and Practices have a total score between 15 and 75. The KAP scores were transformed to scales with a range from 0 to 100, with higher scores indicating better knowledge, more positive attitudes, or healthier practices of healthy eating, respectively. The KAP-HEQ has demonstrated modest to good internal consistency and test-retest reliability in a local validation study with Cronbach's alpha (α) of 0.54–0.84 and intraclass correlation coefficient (ICC) of 0.58–0.84 [24].

Parenting Style and Dimensions Questionnaire (PSDQ)

The 32-item Chinese version of the PSDQ adopted in Project CARE [25] was used in this study. It differentiates parenting styles into authoritative, authoritarian and permissive subscales using a 5-point Likert scale (1 - Never to 5 - Always) [26]. Authoritative subscale has 15 items on connection, regulation, and autonomy granting, with a total score ranging from 15 to 75. Authoritarian subscale has 12 items on physical coercion, verbal hostility, and non-reasoning, with a total score of 12–60. Permissive subscale includes 5 items on indulgence, with a total score of 5–25. The three subscales had an Cronbach's alpha of 0.85, 0.71, and 0.66, respectively, in the Project CARE involving parents of 8 to 17-year-old children [25], indicating an acceptable level of internal consistency.

Parent Attitudes towards Adolescent Eating Habit (PAAEH)

The 10-item PAAEH questionnaire assesses the parental attitudes towards perceived susceptibility to the risk of unhealthy eating, priority of health amidst other obligations in adolescents, efficacy in preparing tasty and healthy meals, and responsibility for fostering food choices in adolescents (Supplementary Material 3). The 5-point Likert scale measures the level of agreement for each question in the PAAEH, with a total score ranging from 0 to 50. Reverse coding is applied to responses of items on negative attributes. The PAAEH was found to have modest internal consistency and good test–retest reliability in a pilot study of 30 adults ($\alpha = 0.59$, ICC =0.84) [27].

Food Parenting Practices (FPP)

The 10-item FPP questionnaire evaluates the structure and autonomy support constructs of food parenting practice, encompassing aspects of home food availability, family discussions on food-related topics, parental supervision, and varying food choices and recipes in home cooking (Supplementary Material 4). A 5-point Likert scale is used to assess the frequency of these practices, with a total score of 5–50 and reverse coding for items on negative attributes. The FPP had good reliability among 30 adults in a pilot study ($\alpha = 0.79$, ICC = 0.92) [27].

Demographic characteristics

Both parents and adolescents reported their age and gender. Parents also provided information on marital status, education, employment status, working hours, history of chronic conditions, monthly household income, and family size (Supplementary Material 5).

Statistical analysis

Descriptive analyses were computed using t-test for continuous variables and chi-square test for categorical variables. Spearman correlation was conducted to assess the associations between parent KAP and adolescent KAP of healthy eating. Multivariable linear regression was performed to examine the effects of family factors on adolescent KAP of healthy eating adjusted by dyad age and gender and the other two KAP scale scores of adolescents. R-squared (R2) was used to assess the proportion of variance explained by the variables in the model, and a value of ≤ 0.1 is considered acceptable in studies on human behaviors [28]. We adopted backward elimination method in regression analysis to select the most significant factors with *p*-value < 0.1 from the full set of family factors. Results were presented by unstandardized coefficients(B) in two models: the "initial" model included all potential variables and the "final" model included variables selected from backward elimination process. All tests were two-tailed, and a significance level of <0.05 was considered statistically significant. All analyses were completed using Stata 16.

Results

Sample characteristics

A total of 207 parent-adolescent dyads completed the survey. The mean ages of adolescents and parents were 15.21 years and 46.14 years, respectively (Table 1). The majority of the parents were mothers (85.02%) and married (80.19%). Most had completed senior secondary school or above (60.87%) and had employment (62.90%), with a majority holding full-time positions. Moreover, around a fifth of parents reported having at

Table 1 Characteristics of adolescents and parents

	Adolescent	Parent
	N = 207	N = 207
Age (Years), Mean ± SD	15.21 ± 1.93	46.14 ± 5.89
Female, N (%)	100 (48.31)	176 (85.02)
Parental characteristic		
Married, N (%)		166 (80.19)
Education, N (%)		
Junior secondary or below		81 (39.13)
Senior secondary or above		126 (60.87)
Employment status, N (%)		
None		77 (37.20)
Part-time		39 (18.84)
Full-time		91 (43.96)
With chronic disease, N (%)		43 (20.77)
Household characteristics		
Household income		
< HK\$20,000		114 (55.07)
≥ HK\$20,000		93 (44.93)
Household size, N (%)		
< 4		92 (44.44)
≥ 4		115 (55.56)
KAP of Healthy Eating scores, Mean \pm SD		
Knowledge	60.27 ± 14.28	63.19 ± 12.70
Attitude	59.31 ± 13.25	65.02 ± 13.82
Practice	59.33 ± 11.69	67.28 ± 12.63
PSDQ Authoritative subscale scores, Mean \pm SD		69.62 ± 14.75
Connection Dimension		72.80 ± 15.85
Regulation Dimension		68.09 ± 16.75
Autonomy Granting Dimension		67.97 ± 16.32
PSDQ Authoritarian subscale scores, Mean \pm SD		25.33 ± 14.73
Physical Coercion Dimension		15.22 ± 15.10
Verbal Hostility Dimension		37.08 ± 19.30
Non-Reasoning Dimension		23.70 ± 16.66
PSDQ Permissive subscale scores, Mean \pm SD		38.04 ± 14.29
PAAEH score, Mean ± SD		60.17 ± 11.33
FPP score, Mean ±SD		63.12 ± 13.19

All scores were transformed to scales with a range from 0 to 100

PSDQ Parenting Style Dimensions Questionnaire, PAAEH Parent Attitudes towards Adolescent Eating Habit, FPP Food Parenting Practice

least one chronic disease (20.77%), and around half of the households reported a monthly household income of less than HK\$20,000 (55.07%) and consisted of at least four family members (55.56%). The scores for Knowledge, Attitudes and Practices of healthy eating among adolescents (60.27, 59.31, and 59.33, respectively) were lower than those among parents (63.19, 65.02, and 67.28, respectively).

Correlations between parent KAP and adolescent KAP of healthy eating scores

Significant correlations were observed between corresponding parent and adolescent KAP scale scores (Table 2): knowledge (r = 0.26, p < 0.001), attitudes (r = 0.24, p < 0.001), and practices (r = 0.26, p < 0.001). Additionally, positive correlations were found between adolescent attitudes and parental practices (r = 0.22, p < 0.01),

Table 2 Associations between KAP of Healthy Eating Scale scores in adolescents and parents (N = 207)

Parent KAP scores	Adolescent KAP scores				
	Knowledge	Attitude	Practice		
Knowledge	0.26***	0.09	0.02		
Attitude	0.09	0.24***	0.19**		
Practice	0.1	0.22**	0.26***		

Spearman correlation was used

: *p* < 0.01; **: *p* < 0.001

as well as between adolescent practices and parental attitudes (r = 0.19, p < 0.001).

Adjusted effects of family factors on adolescent KAP of healthy eating scores

Table 3 presents the adjusted associations between family factors and adolescent KAP of healthy eating. Positive associations were found between dyad knowledge (B = 0.28, p < 0.001), between dyad attitudes (B = 0.22, p < 0.001), and between adolescent practices and FPP (B = 0.18, p < 0.001) as well as parental part-time employment (compared to unemployed: B = 4.08, p < 0.05). On the other hand, authoritative parenting style (B = -0.11, p < 0.05) and households with four or more family members (B = -3.19, p < 0.05) had negative effects on adolescent attitudes, while adolescents whose parents attained senior secondary education had worse practices of healthy eating (B = -2.86, p < 0.05). No significant associations between any adolescent KAP and parental dietary practices, authoritarian/permissive parenting style,

Table 3 Adjusted effect of family factors on adolescent KAP (subscales of PSDQ) (N = 207)

	Adolescent KAP scale scores					
	Knowledge		Attitudes		Practices	
	Initial ^a	Final ^a	Initial ^a	Final ^a	Initial ^a	Final ^a
Parent KAP scale scores						
Knowledge	0.25**	0.28***	0.05		-0.05	
Attitudes	-0.05		0.14	0.22***	-0.05	
Practices	0.10		0.00		0.09	
PSDQ subscale scores						
Authoritative	0.03		-0.14*	-0.11*	0.06	
Authoritarian	0.04		0.08		0.09	
Permissive	0.15	0.13	-0.08		-0.06	
PAAEH score	0.14		0.10		0.05	
FPP score	-0.07		0.07		0.11	0.18***
Parental characteristics						
Married	-0.48		1.05		1.46	
Senior secondary or above	2.00		0.79		-3.34*	-2.86*
Employed						
Part-time	-4.13		-3.70	-3.61	4.81*	4.08*
Full-time	-4.43		0.86		1.16	
With chronic disease	-4.07	-4.62	3.05		-2.26	
Household characteristics						
Household income (≥ HK\$20,000)	2.09		-2.45		0.50	
Household size (≥ 4)	-2.21		-3.53*	-3.19*	1.06	
R ²	0.15	0.09	0.38	0.34	0.39	0.35

FPP Food Parenting Practice, PAAEH Parent Attitudes towards Adolescent Eating Habit, PSDQ Parenting Styles and Dimensions Questionnaire, R² R-squared

* *p*-value < 0.05; ***p*-value < 0.01; ****p*-value < 0.001 by multivariable linear regression

^a Unstandardized coefficients (B) of the multivariable linear regression are shown. Dyad age, gender and adolescent KAP scale scores (excluding the construct being examined) were adjusted in the initial models; final models were selected by backward elimination until the *p*-values of all remaining variables were < 0.1

presence of parental chronic disease nor household income (p > 0.05).

Further regression analysis of individual dimensions of the PSDQ subscales on adolescent KAP scale scores found that the regulation dimension had a weak positive association with adolescent Practice score (B = 0.09, p < 0.05), and no significant associations between the dimensions of authoritative subscale and adolescent attitudes (Table 4).

Discussion

This study demonstrated that parental dietary knowledge, attitudes, and food parenting practices were facilitators of respective KAP of healthy eating in adolescents. Parental part-time employment and regulation, a dimension of the authoritative parenting style measured by PSDQ, also had positive associations with healthy eating practices in adolescents. Larger family size and more educated parents were possible barriers to adolescent attitudes and practices, respectively. These findings underscore the complex interplay of family factors in shaping adolescent eating habits and highlight the need to consider specific family influences when promoting different KAP constructs of healthy eating.

We found the strongest facilitator on adolescent healthy eating practices was FPP. FPP involves the behaviors (e.g. food availability, setting rules, and child involvement) that parents employ to influence their children's dietary habits and preferences for specific food choices [29]. Its positive influence on adolescent eating practices

Table 4 Adju	usted effect of family	/ factors on adolescent KAP ((dimensions of PSDQ) (N=	= 207)
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	Adolescent					
	Knowledge		Attitudes		Practices	
	Initial ^a	Final ^a	Initial ^a	Final ^a	Initial ^a	Final ^a
Parental KAP scores						
Knowledge	0.26**	0.29***	0.04		-0.03	
Attitudes	-0.06		0.14	0.21***	-0.07	
Practices	0.11		0.00		0.11	
PSDQ Authoritative subscale scores						
Connection Dimension	-0.14		-0.04		-0.09	
Regulation Dimension	0.19		-0.08	-0.09	0.14*	0.09*
Autonomy Granting Dimension	-0.03		-0.03		-0.00	
PSDQ Authoritarian subscale scores						
Physical Coercion Dimension	0.12		-0.00		0.05	
Verbal Hostility Dimension	-0.05		0.05		0.01	
Non-Reasoning/Punitive Dimension	-0.03		0.02		0.01	
PSDQ Permissive subscale scores	0.14	0.12	-0.08		-0.07	
PAAEH score	0.13		0.10		0.05	
FPP score	-0.07		0.08		0.10	0.14**
Parental characteristics						
Married	0.42		0.87		1.85	
Senior secondary or above	1.59		0.89		-3.70*	-3.68*
Employed						
Part-time	-3.95		-3.75	-3.52	4.66*	4.29*
Full-time	-4.47		0.84		1.06	
With chronic disease	-3.22		2.90		-1.93	
Household characteristics						
Household income (≥ HK\$20,000)	2.37		-2.55		0.67	
Household size (≥ 4)	-3.11		-3.26	-2.90	0.44	
R ²	0.17	0.10	0.38	0.34	0.40	0.36

FPP Food Parenting Practice, PAAEH Parent Attitudes towards Adolescent Eating Habit, PSDQ Parenting Styles and Dimensions Questionnaire

* *p*-value < 0.05; ***p*-value < 0.01; ****p*-value < 0.001 by multivariable linear regression

^a Unstandardized coefficients (B) of the multivariable regression models are shown. Dyad age, gender and adolescent KAP scale scores (excluding the construct being examined) were adjusted in the initial models; final models were selected by backward elimination until the *p*-values of all remaining variables were < 0.1

was highlighted in previous reviews [9, 30, 31]. For instance, setting clear rules and routines around eating, such as regular mealtimes and restrictions on snacking, has been linked to enhanced child diet quality [29]. As a result, FPP could function as a direct and effective strategy for promoting healthy dietary habits among adolescents.

Parental knowledge and attitudes of healthy eating can positively impact corresponding adolescent KAP scales. A prior study showed that children of parents who possessed more nutrition knowledge tend to exhibit better recognition of healthy food [32]. To the best of our knowledge, prior research has not adequately explored the direct relationship between attitudes towards healthy eating among parents and adolescents. Several reviews suggested that parents who perceived the importance of healthy eating for themselves were likely to prioritize health concern in food affairs and adopt healthier practices and FPP, while parents also serve as role models to adolescents in dietary practices [9, 31, 33]. Empowering parents with dietary knowledge and positive attitudes are essential to enhance adolescent cognition of healthy eating.

It was unexpected to find that the authoritative parenting style had no significant effect on adolescent practices of healthy eating but a weak negative effect on their Attitudes adjusting for other family factors. The findings differ from those reported in the literature showing a facilitating role of authoritative parenting style on healthy eating practices in adolescents [34, 35]. Our further analysis using the individual dimensions of PSDQ subscale showed a weak positive association between regulation dimension of the authoritative parenting style and adolescent practices, which could be the effective element among the other two dimensions (connection and autonomy granting). On the other hand, a review [33] and four later studies also showed no association between parenting styles and FV/snack intake in preschoolers [36] and young adolescents [37–39]. One explanation for the insignificant association could be the inclusion of FPP factors such as food availability [37], mealtime structure [39], and rule setting [38] in the regression analysis, which could be the mediators between parenting style and adolescent dietary practice. The influence of various parenting styles on the KAP of healthy eating in adolescents needs further exploration.

We observed healthier eating practices in adolescents of part-time working parents compared to counterparts of unemployed parents, regardless of household income. Working parents were often linked to less frequent family meals and an increased intake of fast food [19, 40, 41], resulting in poorer diet quality. However, part-time employment might impose less time pressure on home cooking. Another possible explanation may be the lower intake of unhealthy snacks in the absence of parents. A recent review presented mixed results regarding the dietary habits of children with employed mothers. It pointed towards unfavorable impacts on certain dietary patterns (e.g., family meals and FV consumption), but the findings on unhealthy food intake (e.g., fast food, junk food, and sugary drinks) were inconsistent [41]. Future studies should explore in greater depth on how parental employment, particularly of mothers, can influence the different aspects of eating habits in adolescents.

Interestingly, we found that adolescents whose parents had senior secondary or higher education were less likely to practice healthy eating. An early longitudinal study conducted in China demonstrated that children aged 6–13 years with more educated mothers tended to consume a high-fat diet but low in fruit and vegetables adjusted for family income [42]. It could be explained by the less participation in childcare chores among parents with higher education levels as revealed in a local study [43]. Further research on the association between parental education and adolescent healthy eating should consider cultural contexts.

Household size was found to have a negative association with adolescent attitudes towards healthy eating in our study. This finding could be explained by the resource dilution model [44], which suggests that as the number of children increases, parental resources are likely to decrease. Competition among siblings for parents' time, energy, and financial resources [45] could hamper parents' ability to provide personalized guidance and attention to each child. This might lead to less effective communication about the importance of healthy eating habits among parents and children. It is worth exploring the unique challenges faced by larger families in fostering healthy eating habits.

Interventions promoting healthy eating should target not only adolescents but also their parents. Enhancing parental nutrition knowledge, attitudes and food parenting practices could improve dietary habits in adolescents. Practical strategies could be public education of dietary recommendations and health outcomes, provision of simple recipes for healthy and tasty cooking, and encouraging the adoption of food availability and rule setting for eating habits ay home. More in-depth studies are needed to investigate the effect of parenting style, parental educational level, and employment status on adolescent healthy eating. An intervention study should be carried out to evaluate the effectiveness of a family approach to promote adolescent healthy eating.

The current study has several strengths. Firstly, it is more comprehensive than previous research as it considers multiple family factors that could influence healthy

eating in adolescents. Secondly, the study used the KAP-HEQ, a culturally tailored questionnaire for Chinese adolescents and adults, which has proven to be reliable and sensitive [24]. Thirdly, the study recruited parent-child dyads from two sampling populations to enhance the representativeness of the results. However, several limitations should also be acknowledged. The cross-sectional design limits our ability to establish causality of findings. The data were self-reported imposing reporting bias. The relatively small sample size may not have sufficient power to detect small associations. The majority of the study families had household incomes below the population median, limiting the generalizability of our findings to richer families. The recruitment of families who could read Chinese may limit the interpretation of the findings to the Chinese culture.

Conclusion

Parental dietary knowledge, attitudes, and food parenting practices are key facilitators of adolescent KAP of healthy eating. The association between parental part-time employment and healthy eating practices in adolescents deserves further investigation. A higher education level in the parent and a larger household size could be barriers to the development of KAP of healthy eating in adolescents, which needs to be confirmed by future research. Inventions on adolescent healthy eating should empower the parents by education of dietary recommendations and health outcomes, provision of simple healthy recipes, and promoting healthy food availability and rule setting at home.

Abbreviations

KAP	Knowledge, attitudes, and practices
KAP-HEQ	KAP of Healthy Eating Questionnaire
NCD	Non-communicable diseases
TFES	Trekkers Family Enhancement Scheme
PSDQ	Parenting Styles and Dimensions Questionnaire
PAAEH	Parent Attitudes towards Adolescent Eating Habit
FPP	Food Parenting Practices
ICC	Intraclass correlation coefficient

Supplementary Information

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- Supplementary Material 1. Supplementary Material 2. Supplementary Material 3. Supplementary Material 4.
- Supplementary Material 5.

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Authors' contributions

KL (Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing—original draft, Writing review & editing), CL (Funding acquisition, Conceptualization, Supervision), QK (Formal analysis, Methodology, Writing—original draft), all co-authors (Writing—review & editing).

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of the University/ Hospital Authority Hong Kong West Cluster (UW 22–289). Parents provided informed consent for themselves and their children, while adolescents consented individually before enrolling in the study.

Consent for publication

Not applicable.

Competing interests

CW was employed by the Laboratory of Data Discovery for Health Limited (D24H). The remaining authors declare that no conflicts of interest exist.

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