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Research report

Prevalence of picky eating behaviour in Chinese school-age children and associations with anthropometric parameters and intelligence quotient. A cross-sectional study [☆]

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ABSTRACT

Previous studies have demonstrated the importance of eating behaviour regarding dietary variety and nutrient intake of children. However, the association between picky eating and growth of children is still a topic of debate. This study sought to estimate the prevalence of picky eating and to identify possible associations with the growth of school-age children in China. In this survey, 793 healthy children aged 7–12 years were recruited from nine cities and rural areas in China using a multi-stage cluster sampling method. Data collected included socio-demographic information and parents' perceptions of picky eating using a structured questionnaire, nutrient intake using 24-hour dietary recall, weight and height using body measurements, and intelligence using the Wechsler Intelligence Scale for Children. Blood samples were collected and analysed for minerals. The prevalence of picky eating reported by parents was 59.3% in children. Compared with non-picky eaters, picky eaters had a lower dietary intake of energy, protein, carbohydrates, most vitamins and minerals, and lower levels of magnesium, iron, and copper in the blood ($p < 0.05$), and also had a 0.184 z-score lower in height for age (95% CI: $-0.332, 0.036$; $p = 0.015$), a 0.385 z-score lower in weight for age (95% CI: $-0.533, -0.237$; $p < 0.001$), a 0.383 z-score lower in BMI for age (95% CI: $-0.563, -0.203$; $p < 0.001$), and scored 2.726 points higher on the intelligence test (95% CI: 0.809, 4.643; $p = 0.006$) when adjusted for children's birth weight and food allergy, mothers' education, and family income. Picky eating behaviour towards meat, eggs and vegetables showed negative associations with growth. Picky eating behaviour is prevalent in school-age children in China and may have a negative effect on growth.

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Abbreviations: α -TE, α -tocopherol equivalent; BAZ, body weight index for age Z-scores; BMI, body weight index; CI, confidence interval; EDTA, ethylene diamine tetraacetic acid; HAZ, height for age Z-scores; Hb, haemoglobin; IQ, intelligence quotient; MCV, mean corpuscular volume; NE, niacin equivalent; SD, standard deviation; SE, standard error; SEM, standard error of the mean; PIQ, performance intelligence quotient; RBC, red blood count; RE, retinol equivalent; VIQ, verbal intelligence quotient; WAZ, weight for age Z-scores; WISC-RC, The Chinese version of Wechsler Intelligence Scale for Children.

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1 Introduction

2 Picky eating is characterised by an unwillingness to try new foods,
3 a dislike of certain types of foods, and strong opinions about food
4 preparation (Galloway, Fiorito, Lee, & Birch, 2005; Jacobi, Schmitz,
5 & Agras, 2008; Shim, Kim, & Mathai, 2011), which result in eating
6 small quantities and a limited variety of food, potentially impact-
7 ing a child's growth (Goncalves, Moreira, Trindade, & Fiates, 2013;
8 Li, Shi, Wan, Hotta, & Ushijima, 2001; Steyn, Nel, Nantel, Kennedy,
9 & Labadarios, 2006). Further, it can result in long-term eating dis-
10 orders in adolescence and early adulthood (Needham, Dwyer,
11 Randall-Simpson, & Heeney, 2007; Woolston, 1983). Prevalence
12 studies (Goh & Jacob, 2012; Jacobi et al., 2008; Mascola, Bryson, &
13 Agras, 2010; Micali et al., 2011) of childhood picky eating have re-
14 ported conflicting results, possibly due to inconsistencies in
15 definitions and methods of assessment, as well as different age ranges
16 of children studied. Very young children will express their food pre-
17 ferences through body language or non-linguistic verbalisations, while
18 older children will become more autonomous towards food choices
19 and preferences during their time at school, so that the parent per-
20 ceives the rejection of food as being stronger as the child ages (Dovey,
21 Staples, Gibson, & Halford, 2008). Some picky eating behaviour in
22 very young children, from parents' subjective perceptions, may be
23 due to neophobia, which is different from pickiness in older chil-
24 dren. School-aged children are rapidly growing and have relatively
25 high nutrient requirements; therefore, their eating habits are crit-
26 ical for optimal development. However, picky eating behaviour is
27 relatively common during childhood while at school, with the pre-
28 valence ranging from 13% to 47% in developed countries (Goh & Jacob,
29 2012; Jacobi et al., 2008; Mascola et al., 2010). There is little infor-
30 mation on picky eating of school-aged children in China.

31 Picky eating in early childhood has been shown to continue into
32 mid-adolescence, which is associated with eating disorders, lasting
33 fussy eating, and limited dietary variety in adolescence and adult-
34 hood (Kotler, Cohen, Davies, Pine, & Walsh, 2001; McDermott et al.,
35 2010; Nicklaus, Boggio, Chabanet, & Issanchou, 2005). However, the
36 influence of picky eating on the growth of children is still a topic
37 of debate. One longitudinal study (Dubois, Farmer, Girard, Peterson,
38 & Tatone-Tokuda, 2007) following 1498 children aged 2.5, 3.5, and
39 4.5 years in Québec found that picky eaters were twice as likely to
40 be underweight at 4.5 years old than children who were never picky
41 eaters. Contradictory findings (Mascola et al., 2010) from another
42 longitudinal study with 120 children in the San Francisco Bay area
43 followed from 2 to 11 years of age suggested no significant effects
44 of picky eating behaviour on growth. These contradictory results
45 might be due to differences in definitions and assessments of picky
46 eating, and failing to adjust for various confounding factors includ-
47 ing age, gender, birth weight of the child, and socio-demographics.
48 At the same time, there is no study examining the correlations
49 between picky eating and Chinese children's growth. Therefore, it
50 would be of value to identify the correlation between picky eating
51 and growth of school-age children in China.

52 Intellectual status is of critical importance for schoolchildren, and
53 is often a major concern of parents. Previous studies (Benton, 2010;
54 McAfee et al., 2012) indicated that nutrition during early child-
55 hood had long-lasting impacts on the intelligence of children. As
56 the brain develops more quickly than the rest of the body, nutri-
57 ent deficiency, especially protein, iodine, iron, zinc, folic acid, and
58 vitamin B 12, at a critical stage of development may result in lasting
59 changes in brain structure and, thus, intelligence (Benton, 2010).
60 Picky eating characterised as the consumption of an inadequate
61 variety and amount of food(s) may result in a long-lasting lower
62 nutrient intake. However, nothing is known about the correlation
63 between picky eating and intelligence of school-age children.

64 Picky eaters usually have a limited dietary variety and consume
65 few fruits, vegetables, and meat rich in micronutrients (Shim et al.,
66

2011). In addition, their intake of fats, fibre, protein and sweets is
67 lower than that of non-picky eaters (Galloway et al., 2005). It is still
68 unclear whether the impact of picky eating on height and weight
69 depends on the types of food rejected by the picky eaters. A lower
70 intake of vitamin E and C, and fibre was found in picky nine-year-old
71 girls (Galloway et al., 2005); however, there is little information re-
72 garding the nutrient intake of Chinese school-aged picky eaters, not
73 just picky girls. Long-lasting lower nutrient intake may result in nu-
74 trient deficiency, but there is also a lack of knowledge regarding the
75 differences in micronutrients in the blood between picky eaters and
76 non-picky eaters.

77 Therefore, this study was performed to estimate the preva-
78 lence of picky eating behaviour in school-aged children in China;
79 to investigate possible associations between picky eating behaviour
80 and children's anthropometric parameters and intelligence quo-
81 tient, and to identify potential mechanisms from the viewpoint of
82 nutrient intake and micronutrients in whole blood.

83 Subjects and methods

84 Study sample

85 Data for this study were collected between November 2011 and
86 April 2012 from healthy school-age children in China. The study was
87 approved by the Ethical Committee in Health Science Center at
88 Peking University (NO.IRB00001052-11042). All participants gave
89 their written and informed consent signed by their legal guard-
90 ians. Using a multi-stage stratified cluster sampling method, 814
91 children aged 7–12 years were recruited. In the first stage, seven
92 major cities and two villages were selected representing various geo-
93 graphic locations and different levels of economic development:
94 Beijing, Guangzhou, Chengdu, Shenyang, Suzhou, Lanzhou, and
95 Zhengzhou, one village in the plains and one village in the moun-
96 tainous area in the suburb of Xingtai, Hebei province. In the second
97 stage, considering the size and representativeness of the samples,
98 one large primary school located in a semi-urban area within each
99 city/village was selected. In the last stage, one class of the second-
100 grade, and one class of the fourth-grade in each primary school was
101 selected randomly, and all children within the classes selected were
102 surveyed. The first and second stages were carried out with pur-
103 poseful sampling, and the third stage was carried out with random
104 sampling. Inclusion criteria were an age of 7–12 years, no re-
105 ported birth defects, such as congenital heart disease, hydrocephalus
106 or deformity at birth, no reported infantile paralysis or thalas-
107 semia, and no on-going acute health problems such as a common
108 cold or diarrhoea. Of the 814 children, 21 were excluded from the
109 analysis of data because of missing physical measurements (10),
110 blood samples (5), or a failure to complete the questionnaire (6).

111 Socio-demographics, anthropometry, intelligence and 112 blood measurement

113 After determining eligibility, a research assistant contacted fami-
114 lies and arranged a meeting with parents for a face-to-face interview.
115 The socio-demographic information was collected from the parents
116 with a structured questionnaire survey (mothers: 95.8% of parents),
117 and was administered by trained interviewers. Demographic data
118 included child's date of birth, gender, ethnicity, and birth weight,
119 and parents' educational level – 1) illiteracy; 2) primary school; 3)
120 middle school; 4) senior high school; 5) college; 6) graduate or above
121 – as well as family income (per capita monthly income) – 1) below
122 2000 Yuan; 2) 2000–4000 Yuan; 3) above 4000 Yuan; 4) unclear.
123 Data on child's food allergy history and parents' body weight and
124 height were also collected from the interview.

125 In every primary school, two well-trained researchers mea-
126 sured children's height and weight, respectively. The participants
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