

Precision Food Parenting

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Precision nutrition is an evolving field, but considers a person's health/disease status, genetics, metabolomics, microbiome, current food availability (e.g., grocery store, restaurant, home), and personal characteristics (e.g., previous food consumption that day, food preferences, etc.) to inform individualized guidance regarding the optimum nutrient intake to promote health for a child. Many factors influence child dietary intake, the most important of which need to be taken into consideration when making personalized dietary change prescriptions.

feeding style

child dietary intake

parenting practices

precision nutrition

1. Introduction

The most common causes of mortality in advanced economic countries are cardiovascular diseases (CVD) and cancers [1]. Diet substantially contributes to these illnesses [2]. Dietary preferences and practices are learned in childhood [3][4][5], thereby offering a strategically important opportunity to influence lifelong intake. Existing prescriptions for health are designed for groups of people, but there has been substantial variability in response to these group prescriptions [6]. Research and intervention to improve child health status are moving toward "precision nutrition" [7][8], i.e., the specification of nutrients, foods, or food patterns, most appropriate to promoting an individual's health (as opposed to generic dietary prescriptions which may not be relevant for a particular child). Precision nutrition is an evolving field, but considers a person's health/disease status, genetics, metabolomics, microbiome, current food availability (e.g., grocery store, restaurant, home), and personal characteristics (e.g., previous food consumption that day, food preferences, etc.) to inform individualized guidance regarding the optimum nutrient intake to promote health for that person, such as a child. Guidelines have been published for evaluating whether genotype-based dietary advice can be evaluated as more effective than population prescriptions; this is based on the number of published studies supporting the findings, and whether the relevant mechanism is understood [9]. How personalized nutrition interventions could best be delivered is still under investigation, but may involve web-based approaches [10] or the use of consumer technology to deliver content in real-time.

To keep pace with consumer expectations and the available science and technology, behavioral nutrition must move toward precision dietary behavior change [11][12], i.e., transitioning away from generic, one-size-fits-all dietary change procedures used to influence everyone (groups of people) to procedures tailored to most likely to be effective with a specific individual and the situations or environments they encounter. How to achieve this goal, however, is unclear.

Many factors influence child dietary intake [13][14][15], the most important of which need to be taken into consideration when making personalized dietary change prescriptions. High among these influences, especially for younger children, is parents [16]. Working with families to enhance the health of the child(ren) by way of dietary change has a long history [17]. Concerns exist about the effectiveness of family-based interventions for childhood obesity treatment [18] and dietary changes in particular [19]. Most studies attained minimal to no effects (in BMI or diet) despite incorporating a kitchen sink of behavior change techniques [18]. Inconsistent results were also reported in a review of family-based child dietary change interventions which assessed parent involvement [19]. Thus, while family-based interventions have become common, even popular [18][20], innovations are needed in how these interventions are designed, delivered, and evaluated.

Food parenting practices (FPP) (i.e., the specific behaviors parents use to influence their child's dietary intake [21]) provide a tool for individualizing dietary change prescriptions. While much progress has been made in specifying what food-related parenting practices exist [21][22][23], the circumstances in which they are most likely to be volitionally and effectively used need to be addressed. Which parenting practices are employed in any situation, however, reflects a selection by the parent from among diverse considerations and may change over time given the results of its use at a previous time (i.e., feedback).

Precision food parenting (PFP) attempts to enhance the health of a child by encouraging the child to consume healthier foods. Since the parent is a primary influence on what their child eats, PFP would specify whatever the parent can do either immediately at a meal or prior to a meal, or at snacking opportunities (i.e., FPP), taking into account contextual factors and child characteristics to increase the likelihood of the child selecting and consuming a healthier diet. PFP could take into account anticipation/understanding of more biological influences associated with precision medicine and nutrition, and social structure influences associated with precision public health [24]. Understanding how these variables inter-relate should facilitate more effective parenting change programs.

2. Feeding Styles

The overall parent-child relationship can be operationalized by Parenting Style, i.e., "a context that moderates the influence of specific parenting practices on the child" [25]. Parenting style is an emotion-laden construct concerning the longer-term relationship established by the way the parent treats or acts towards the child. Two constructs have been elucidated that characterize styles: the parent's demandingness or control of the child's behavior and their responsiveness to the child's concerns and behaviors [26]. Crossing the two parenting style dimensions (demandingness and responsiveness) results in four categories: authoritative (high demandingness and responsiveness), authoritarian (high demandingness, low responsiveness), indulgent/permisive (low demandingness, high responsiveness), and uninvolved (low demandingness and responsiveness). Feeding style is a similar construct, but more specifically relates parenting style to a meal context [27], i.e., demandingness, structure or control concerning eating or not eating specific foods or meals, and responsiveness to the child's response to food acceptance and satiety. As would be expected, children of permissive and uninvolved parents had the lowest intake of nutrient-rich foods [26].

Feeding style has been closely linked to child BMIz score. The indulgent feeding style has been consistently associated with higher child BMIz across multiple studies [28]. In addition, indulgent feeding style at 4–5 years of age was positively related to child BMIz at 7–9 years; and BMIz at 4–5 positively predicted indulgent feeding style and negatively predicted authoritarian feeding style at 7–9 years [27][28]. As would be expected, an authoritative parenting style involved a higher frequency of effective structure and responsive parenting practices [29]. Thus, feeding style provides an important contextual variable that should enhance understanding of the selection and use of FPP [29] (Table 1).

Table 1. Constructs, their relationship to precision food parenting, what is known, and priority research needs.

Construct	Relationship to PFP	What Is Known?	What Research Is Needed?
Feeding styles	The complex interplay between the parent and the child defined by two dimensions: the parents' demandingness and responsiveness, both in regard to the child's food behavior	Crossing the two dimensions yields four categories of relationship: authoritative, authoritarian, permissive, and uninvolved [29]. Indulgent practices lead to worse outcomes (diet, BMI) [30]. Authoritarian practices lead to the lowest BMI [31].	How consistently are the categories related to FPP, especially among goal-oriented FPP? Are there critical other dimensions of this relationship? Can we change feeding style and does that make a difference?
Habitual FPP	The specific behaviors that parents use without forethought with the intent to influence their child to eat specific foods, whether successful or not.	There are 17 proposed categories of FPP [23]. Some practices are likely to increase child intake of parent specified foods, and some are not [32][33].	To what extent do FPP reflect habit, and require a habit modification approach to change? Under what circumstances do FPP result in desired child intake? What are the longer term consequences of consistent or frequent use of FPP? What are the interrelationships among use of FPP?
Parent predisposition to select FPP	Diverse variables may predict a parent's use of FPP. Among these are personality characteristics and models of behavior, e.g., model of goal-directed behavior.	The model of goal-directed behavior predicted the use of categories of effective and ineffective FPP [34][35][36]. Little other research has addressed	Which variable or combinations of variables predict parent use of FPP? What are the limiting factors (e.g., stress, time constraints, depression, lack of financial resources) on the predictiveness of these variables?

Construct	Relationship to PFP	What Is Known?	What Research Is Needed?
Selection and use of FPP	Parents must select and use specific FPP in specific contexts/situations to influence child dietary intake	prediction of parent selection of FPP.	Under what circumstances do parents select to use specific FPP? How consistent are parents in the use of joint FPP and what are the implications of consistency/inconsistency for child intake?
Parent perception of eating event/context	Parents may vary in their perception of the context of an eating event (e.g., a special or usual event) and the extent to which the event dictates specific FPP.	Little research has addressed parent perception of eating events or FPP appropriate to the perception [37].	What are the most common categories of parents' perception of eating events? What do parents perceive as the most appropriate FPP for each category of eating event?
Child receptiveness	Some children are receptive to any/all/some FPP, and some are not	Children are not passive recipients of FPP [37][38].	Are there effective FPP to which children are universally receptive?
Child response predisposition	Children may be receptive to an FPP or not, based on appetitive, temperament, taste sensitivities, and other characteristics.	A large number of factors (e.g., child social/cultural, neighborhood) influence child dietary intake [39].	How do children with different response predispositions respond to different FPP in different situations?
Developmental characteristics	Influences on FPP and child intake vary by age and age-related characteristics of the child/adolescent.	Child temperament and appetitive and food avoidant characteristics were related to BMI [40]. Some child developmental characteristics, e.g., food neophobia or picky eating were not related to child BMI [41].	More precise definitions and operationalizations of developmental characteristics are needed. Under what circumstances are child developmental characteristics related to dietary intake and BMI, at what ages?
Child perception of eating event/context	Children may vary in their perception of the context of the eating event (e.g., a special or usual event) and the extent to which the event dictates specific behavior	Little research has addressed child perception of eating events or child behaviors appropriate to the perception.	What are the most common categories of child perception of eating events? What do children perceive as the most appropriate behavior for each category of eating event?
Child dietary intake	This objective of PFP is to enable children to consume	While many possible influences on child	Under what circumstances do FPP influence child dietary

Construct	Relationship to PFP	What Is Known?	What Research Is Needed?
What did the parent learn?	a healthier diet.	dietary intake have been proposed, and some supported, there are no consistent findings on the relation of FPP and child dietary intake [42].	intake?
What did the child learn?	As a result of the use of one or more FPP on a particular occasion, the parent will have learned one or more things, and this will serve to confirm or induce change in the parent predisposition to select and employ FPP. As a result of being on the receiving end of one or more FPP, the child could be oblivious, or adapt/modify some aspect of their receptiveness, including defensive behaviors for future attempts. Different children will likely respond to the same FPP in different ways.	Little research has addressed what parents learn from employing FPP or how it influences their predispositions to use FPP in the future.	How does use of FPP in interaction with their child, peers, or other sources of parenting information influence their predisposition to select, and how to employ FPP in the future?
Social determinants context	All parent and child behaviors and their interactions are performed in cultural and socioeconomic-demographic contexts.	Little research has addressed what children learn from receiving FPP or how the experience results in changes in their receptiveness.	Under what circumstances, what and how does a child learn from a parent's use of FPP, and how does this experience of related comments from peers and the media impact their future receptiveness.

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Behre, M.; Seghers, J.; McDonald, D.; Knight, R. **Food Selection Methods, Nutrition Interventions, and the Status of the Microbiome in Children**. *Ann. Rev. Nutr.* **2021**, *41*, 479–510. Categories differing across studies leading to limited clarity and confusion about what was measured.

8. Rodgers, G.P.; Collins, F.S. **Precision Nutrition—The Answer to “What to Eat to Stay Healthy”**. *JAMA* **2020**, *324*, 735–736.

The selection of FPP(s) in any situation likely reflects a habit, i.e., the mechanical non-conscious selection and consumption of food items [34]. Parental habit [34] and different food categories [34] were predicted. **Cross-Sectional, Cyclical Evaluation** [34]. To obtain proposed guidelines to evaluate scientific validity, vegetable (e.g., genotype-based dietary) and genetic [35] are not likely to have the parent intended influences on child intake) involved habit. The strongest positive predictor was the parent's habit of

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11. Chevance, G.; Perski, O.; Hekler, E.B. **Innovative methods for observing and changing complex scales**. *Respectively*. The two strongest predictors of the use of effective vegetable FPP were the habit of active child health behaviors: Four propositions. *Transl. Behav. Med.* **2021**, *11*, 676–685.

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A parent's own health, genetics, microbiome, metabolomics, and other variables will likely influence their own

14. Birch, L.H.; Dohd, A. **Early learning to eat: Birth to age 2 among children from low-income families**. *Birthweight* **2014**, *100*, 726–728. They make available at home). Parents will also have experiences with their child and other children learned from their

15. Thompson, D.; Callender, C.; Velazquez, D.; Adera, M.; Dave, J.M.; Olvera, N.; Chen, T.-A.; Goldsworthy, N. **Perspectives of Black/African American and Hispanic Parents and Children** other personal characteristics which predispose them to the selection of FPP [50].

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A model of goal-directed vegetable FPP has been proposed [51] which incorporates predisposing influences on a

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psychometrically validated scales [53] 2007, 35, 22–34, norms, perceived behavioral control, anticipated emotions, habit, competence/self-efficacy, relatedness, autonomy, perceived barriers, desire, and intentions toward

17. Nader, P.R.; Baranowski, T.; Vanderpool, N.A.; Dunn, K.; Dworkin, R.; Ray, L. **The Family Health** the use of vegetable FPP [50], the final predictive model accounted for almost 48.6% of the variance in the use of a

Project: Cardiovascular risk reduction education for children and parents. *J. Dev. Behav. Pediatr.*

composite of three effective vegetable FPP scales, incorporating several habit variables [36]. A model predicting a

1983, 4, 3–10. composite of three ineffective vegetable FPP scales accounted for 40.5% of the variance and included as

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directed behavior thereby provides a comprehensive set of variables that may predispose parents to use specific

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