Diet Quality and Feelings of Worry, Sadness or Unhappiness in Canadian Children

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ABSTRACT

OBJECTIVE: To examine the association between diet quality and feelings of worry, sadness or unhappiness in Canadian children.

METHODS: Responses to the Harvard Food Frequency Questionnaire of 6,528 grade 5 students were used to calculate a composite score of diet quality, and its components: variety, adequacy, moderation and balance. Responses to the question on "feelings of worry, sadness or unhappiness" from the EuroQoL 5 Dimension questions for Youth (EQ-5D-Y), a validated Health Related Quality of Life questionnaire, constitute the outcome of interest. Multilevel logistic regression methods were used to examine the association between diet quality and feelings of worry, sadness or unhappiness. All analyses were adjusted for gender, household income, parental education, energy intake, weight status, physical activity level, geographic area and year of data collection.

RESULTS: Diet quality was inversely associated with children's feelings of worried, sad or unhappy (Odds ratio (95% confidence interval): 0.90 (0.85-0.97)). Dietary variety and dietary adequacy were also statistically significantly associated with lower odds of feeling worried, sad or unhappy. When the results were stratified by gender, the effect of diet on feeling worried, sad or unhappy was more pronounced in girls than boys.

CONCLUSION: These findings suggest that diet quality plays a role in feelings of worry, sadness or unhappiness and complement other studies that have suggested the link between diet and mental health. We recommend consideration of diet quality in public health strategies that aim to reduce the burden of poor mental health in children and youth.

KEY WORDS: Nutrition; mental health; mood; children; public health; quality of life

La traduction du résumé se trouve à la fin de l'article.

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Mood disorders constitute an important public health concern because they are prevalent, affect quality of life, are an established risk factor for suicide, and are a source of substantive economic costs to society.[1] Diet quality is an established public health concern that contributes to excess body weight and consequent chronic diseases.[2-4] Although some research points to a link between nutrition and mental health, most of the extant literature has focused on adult populations.[5-8] Studies examining the relationship between diet quality and mental health in early adolescence found that children consuming lower quality diets were more likely to have poor mental health outcomes.[9-11] A prospective study from Nova Scotia found that greater variety in the diet was significantly associated with a lower rate of being diagnosed with internalizing disorder during the three years of follow-up.[10] A study among Australian adolescents found lower diet quality to be associated with poorer mental health outcomes both cross-sectionally and prospectively.[9] Regional dietary differences and distinct national regulations regarding food fortification policies limit generalizations related to the importance of diet for mental health. Broader evidence from more studies and local evidence will allow to better tailor public health initiatives to promote healthy eating and to improve mental health.

Studies have indicated that children suffering from depressive symptoms that do not meet diagnostic criteria have higher rates of depression and other mental health disorders in adulthood.[12,13] Therefore, feelings of worry, sadness or unhappiness may represent an early marker for poor mental well-being later in life. Given that other studies have identified the longitudinal relationships of diet and mental health, we sought to understand the importance of diet quality for early markers of mental well-being, specifically feelings of worry, sadness or unhappiness. This understanding is important to policy makers to develop strategies for early public health interventions.

METHODS

Sample

This study used data from the Raising healthy Eating and Active Living Kids in Alberta study (REAL Kids Alberta), a cross-sectional, province-wide survey examining diet quality, physical activity and

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wellness of grade 5 students (aged 10-11 years) across Alberta, Canada. The study, including data collection and parental informed consent forms, was approved by the Health Research Ethics Board of the University of Alberta. Details regarding the questionnaires used are available through the project's website: www.REALKidsAlberta.ca. The data collection procedures have been described in detail elsewhere.[14] In brief, surveys were administered in 2008 and in 2010. In 2008, 5,321 grade 5 students received a parent survey and parental consent form. Of these students, 3,704 received parental consent to participate, 3,421 of whom completed the surveys (64% participation rate). In 2010, 3,687 of 5,597 grade 5 students received parental consent to participate, 3,398 of whom completed the surveys (61% participation rate). In concordance with established recommendations for the analysis of food frequency data, we excluded subjects with calorie intakes of less than 500, and of more than 5,000 kilocalories per day,[15] leaving a total sample of 6,528 students.

Exposure of interest: Diet quality

Nutrient intake and dietary habits were examined using the Harvard Food Frequency Youth/Adolescent Questionnaire (YAQ).[16] This self-administered questionnaire is used to assess usual dietary intake over the previous twelve months. The YAQ is designed for children and youth aged 9 to 18 years, and has been validated among this age group.[16]

On the basis of students' responses to the YAQ and Canadian Nutrient Files,[17] we assessed nutrient intake, energy intake, and daily servings of vegetables and fruit. On the basis of these quantities, we calculated the Diet Quality Index-International (DQI-I), a commonly used index of diet quality that incorporates several dietary characteristics.[18,19] The DQI-I score ranges from 0 to 100, with higher scores indicating a higher diet quality. The DQI-I consists of four component scores: 1) variety, 2) adequacy, 3) moderation, and 4) balance.[18]

Outcome of interest: Feelings of worry, sadness or unhappiness

The EuroQoL for youth (EQ-5D-Y) is a modified version of the adult EQ-5D instrument that measures health-related quality of life.[20] The EQ-5D-Y is a widely used and validated instrument, and is translated in 25 languages.[20] Students are asked to describe the degree to which they are currently feeling "worried, sad or unhappy", with three response options: "you are not worried, sad or unhappy," "you are a bit worried, sad or unhappy" and "you are very worried, sad or unhappy". For the purpose of this study, responses to this question were dichotomized into two groups: "not worried, sad or unhappy" and "a bit and very worried, sad or unhappy" due to the small number of children indicating they were very worried, sad or unhappy. For the sake of brevity, we refer to feelings of worry and sadness, or mood, throughout this paper.

Covariates

A parent survey provided information on socio-demographic characteristics, including household income and parental education. Student height and weight were measured by a trained evaluation assistant to determine weight status. Weight status (normal weight, overweight, obese) was defined using cut-offs established for children and youth by the International Obesity Task Force.[21] Physical activity level was determined from the student and parent surveys, based on questions from the Physical Activity Questionnaire for Children (PAQ-C), a valid and reliable tool for assessing physical activity level.[22] These questions formed a composite score from 1 (least active) to 6 (most active).

Table 1. Socio-demographic and Self-reported Feelings of Worry, Sadness and Unhappiness Among Grade 5 Students in Alberta

	% of Grade 5 Students	% Reporting Feeling Worried, Sad or Unhappy		
		No	A Bit	Very
Sex				
Female	51	58	38	4
Male	49	71	27	2
Household income ($)				
<50,000	16	62	34	4
50,001-75,000	12	63	33	4
75,001-100,000	14	66	31	3
>100,001	25	66	31	3
Not reported	33			
Parental education				
Secondary school or less	24	62	34	4
College	37	64	32	3
University	33	66	31	2
Not reported	5			
Residence				
Metropolitan area	47	64	33	3
City	39	65	32	4
Rural/town	14	64	32	3
Year of data collection				
2008	50	62	35	3
2010	50	66	30	4
Physical activity level				
Low level	3	53	44	4
Medium	87	63	33	3
High level	10	76	22	2
Body weight status				
Normal weight	72	65	32	3
Overweight, not obese	20	64	32	4
Obese	8	58	38	4

Statistical analysis

Multilevel logistic regression methods were used to examine the association of diet quality with feelings of worry, sadness or unhappiness. These regression methods generated odds ratios for a 10% change in diet quality score. All analyses were adjusted for energy intake and seven categorical variables: gender, household income, parental education, weight status, physical activity level, area of residence and year of data collection. Total energy intake (kcal/day) was controlled for in all analyses as per recommendations for food frequency data.[23] Missing values for these variables were considered as separate covariate categories in the regression models, but their estimates are not presented. Population weights were applied to yield provincial population estimates. Analyses were performed using Stata Statistical Software (Release 11).

RESULTS

Table 1 shows that 32% of students reported feeling a bit worried or sad and 3% of students reported feeling very worried or sad. In univariate analysis, feelings of being worried, sad or unhappy were more prevalent among girls than boys (42% vs. 29%), among children with low as compared to high physical activity (48% vs. 24%), and among obese as compared to normal weight children (42% vs. 35%).

Table 2 presents odds ratios adjusted for energy intake (Model 1), energy intake and socio-demographic characteristics (Model 2), and additionally adjusted for physical activity and body weight (Model 3),

Table 2. Odds Ratios (OR) With 95% Confidence Intervals for the Association Between Indicators of Diet Quality and Feeling a Bit/Very Worried, Sad or Unhappy

	Model 1* OR (95% CI)	Model 2 † OR (95% CI)	Model 3 ‡ OR (95% CI)		
			All Students	Boys	Girls
Diet quality	0.92 (0.86-0.98)	0.89 (0.84-0.96)	0.90 (0.85-0.97)	0.94 (0.86-1.03)	0.89 (0.80-0.98)
Variety	0.95 (0.92-0.99)	0.94 (0.91-0.98)	0.95 (0.91-0.98)	0.93 (0.88-0.99)	0.96 (0.91-1.02)
Adequacy	0.90 (0.84-0.96)	0.87 (0.82-0.93)	0.89 (0.83-0.95)	0.91 (0.83-1.00)	0.87 (0.80-0.95)
Moderation	0.96 (0.92-1.01)	0.95 (0.91-1.00)	0.96 (0.91-1.00)	0.99 (0.94-1.05)	0.93 (0.87-0.99)
Balance	1.06 (1.02-1.09)	1.05 (1.02-1.09)	1.05 (1.02-1.09)	1.06 (1.01-1.11)	1.04 (1.00-1.09)

OR: odds rate ratio; CI: confidence interval.
All analyses weighted to yield provincial population estimates.
* Adjusted for energy intake.
† Adjusted for energy intake, gender, household income, parental education, geographic area, and year of data collection.
‡ Adjusted for energy intake, gender, household income, parental education, geographic area, year of data collection, body weight status and physical activity level.

for the association of diet quality with feeling worried, sad or unhappy. Diet quality was significantly associated with these feelings: for a 10% increase in diet quality score, the odds of feeling worried, sad or unhappy decreased by approximately 10% (Model 3 (all students): 1 – 0.90 times 100%). Students with more varied and more adequate diets had significantly lower odds of having these feelings. Greater dietary balance was significantly associated with increased odds of feeling worried, sad or unhappy.

Gender-stratified results (Table 2) showed that better overall diet quality was significantly associated with lower odds of feeling worried, sad or unhappy in girls only. Moreover, the importance of dietary adequacy and moderation for these feelings was more pronounced in girls than in boys. Finally, for both boys and girls, greater dietary balance was associated with increased odds of feeling worried, sad or unhappy.

DISCUSSION

The current study is one of only a few that investigated the relationship between diet and mood in children. The findings are consistent with work that suggested a relationship between poor diet quality and mental health problems in children.[9-11,24]

Many youngsters experience depressive symptoms that do not meet criteria for a diagnosis,[13] that may in fact represent early markers for mental health problems in adulthood.[12,13] Ravens-Sieberer et al.[25] confirmed this by revealing a strong correlation of EQ-5D-Y responses with borderline and abnormal mental health problems using the same survey instrument (EQ-5D-Y) as was used in the current study. Our observation that 42% of girls and 29% of boys report some degree of feelings of being worried, sad or unhappy adds to the concern that subclinical markers for future mental health problems are very prevalent.

Two particular aspects of diet – variety and adequacy – were significantly associated with decreased feelings of worry or sadness in the current study. This suggests that exposing children to a variety of foods – particularly foods that provide the essential nutrients required for healthy development – can play an important role in reducing some of the negative feelings experienced by children. In our earlier work, better dietary variety was shown to reduce the probability of developing internalizing disorders in subsequent years,[10] which draws further attention to the importance of dietary variety. These findings are therefore important to public health decision makers tasked with improving mental well-being of youngsters and with preventing mental disorders. Dietary moderation captures excess consumption of fat, saturated fat, cholesterol and sodium, and was found to have no substantial or statistically significant associations with feelings of worry or sadness.[18] Dietary balance captures the balance in energy originating from carbohydrates, fat or protein and the balance in the fatty acid composition of the diet.[18] Contrary to expectations, a better dietary balance was significantly associated with increased odds of feeling worried, sad or unhappy. Further nutritional research is needed to clarify the importance of dietary balance for mental health and well-being.

The study revealed that girls reported more feelings of worry, sadness or unhappiness than boys, and the existence of gender differences in the relationship of diet quality with mood. Various factors may contribute to the gender differentials in the relationship between diet and mood. These include the effect of diet on maturation,[26] the fact that girls mature earlier than boys and that the prevalence of mood disorders increases once girls enter puberty.[27-29] In addition, female adolescents and adults are on average more likely to under-report dietary intake than their male counterparts, which may contribute to explaining the observed relationships between diet and mood.[30-34]

There are several plausible biological mechanisms linking nutrition and mental well-being. Some studies have revealed that diets low in magnesium or high in glycemic load may lead to higher plasma C-reactive protein levels. C-reactive protein is a marker of low-grade inflammation and inflammation is considered to facilitate the development of depression.[35,36] A western diet typically has a high glycemic index[37] and a low magnesium content.[38] Other studies have suggested the involvement of oxidative stress in several mental illnesses, including schizophrenia, bipolar disorder, depression and autism.[39] Oxidative stress may induce neuronal damage, modulates intracellular signaling and ultimately leads to neuronal death.[39] Regular consumption of foods rich in antioxidants, for example blueberries, grapes, apples, and spinach, is demonstrated to have an inverse association with age-associated pathophysiological and cognitive changes.[40] There is evidence from animal studies that supplementation with extracts from these foods reduces or blocks neuronal death, which further suggests that interventions that promote healthy eating may reduce the public health burden of mental health disorders.[39]

Limitations to this study should be noted. The cross-sectional study design does not rule out the potential for reverse causality. It may be that children feeling worried, sad or unhappy eat less healthy foods. Both diet quality and feelings of worry, sadness and unhappiness were self-reported, which is prone to error. In addition, the outcome for this study was a single question about feeling worried, sad, or unhappy, drawn from the EQ-5D-Y. However, other studies using one or two questions have shown to be effective

at identifying depression.[41-43] Also the EQ-5D-Y has been shown to be adequate for identifying individuals with depression and anxiety,[44] but EQ-5D-Y is not considered a diagnostic tool. Future studies examining diet and mental health may benefit from using a more sophisticated questionnaire in the assessment of depression and anxiety.

Despite these limitations, this study had several methodological strengths. For instance, this was a population-based study with a relatively high response rate, as well as a large sample size. Also, several socio-demographic and other factors were controlled for in the analysis, allowing for a clearer interpretation of the role of diet quality for the children's feelings, although we cannot exclude the presence of residual confounding and influences of unmeasured confounders. For example, children in settings that are not ideal for diet or mental health have both poor diet and mental health.

Mental health disorders result in substantial economic costs to society in addition to personal costs. Depression costs the Canadian economy more than $14 billion per year.[45] The findings from the current study suggest that diet quality plays an important role for mental health in addition to physical health. We recommend that consideration be given to diet quality as a preventive strategy to improve both mental and physical health.

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RÉSUMÉ

OBJECTIF : Examiner l'association entre la qualité du régime et les sentiments d'inquiétude, de tristesse ou de mécontentement chez les enfants canadiens.

MÉTHODE : Nous avons étudié les réponses de 6 528 élèves de 5e année au Questionnaire de fréquence de consommation des produits alimentaires de Harvard pour calculer un indice combiné de qualité du régime, et ses composantes : variété, adéquation, modération et équilibre. Les réponses à la question sur les « sentiments d'inquiétude, de tristesse ou de mécontentement » dans le questionnaire EuroQoL 5-Dimension s'adressant jeunes (EQ-5D-Y), un outil validé pour mesurer la qualité de vie liée à la santé, constituaient nos résultats d'intérêt. Au moyen d'analyses de régression logistique multiniveaux, nous avons examiné l'association entre la qualité du régime et les sentiments d'inquiétude, de tristesse ou de mécontentement. Nos analyses ont été ajustées pour tenir compte du sexe, du revenu du ménage, de l'instruction parentale, de l'apport énergétique, du statut pondéral, des niveaux d'activité physique, de la zone géographique et de l'année de collecte des données.

RÉSULTATS : La qualité du régime était inversement associée aux sentiments d'inquiétude, de tristesse ou de mécontentement des enfants (rapport de cotes (intervalle de confiance de 95 %) : 0,90 (0,85-0,97)). La variété et l'adéquation du régime présentaient aussi une corrélation significative avec une probabilité inférieure de se sentir inquiet, triste ou mécontent. Quand les résultats étaient stratifiés selon le sexe, l'effet du régime sur les sentiments d'inquiétude, de tristesse ou de mécontentement était plus prononcé chez les filles que chez les garçons.

CONCLUSIONS : Ces constatations montrent que la qualité du régime contribue aux sentiments d'inquiétude, de tristesse ou de mécontentement, ce qui confirme les résultats d'études faisant état d'un lien entre le régime et la santé mentale. Nous recommandons que l'on tienne compte de la qualité du régime dans les stratégies de santé publique qui visent à réduire le fardeau des problèmes de santé mentale chez les enfants et les jeunes.

MOTS CLÉS : nutrition; santé mentale; humeur; enfant; santé publique; qualité de vie