Prevalence of malnutrition at the time of admission among patients admitted to a Canadian tertiary-care paediatric hospital

Jo-Anna B Baxter MSc[1], Fatma Ibrahim Al-Madhaki MD AMBSP[1,2], Stanley H Zlotkin CM MD PhD FRCPC[1,3]

JB Baxter, FI Al-Madhaki, SH Zlotkin. Prevalence of malnutrition at the time of admission among patients admitted to a Canadian tertiary-care paediatric hospital. Paediatr Child Health 2014;19(8):413-417.

BACKGROUND: Malnutrition among hospitalized children is known to negatively influence their response to therapy and to prolong their admission. It also has short- and long-term consequences for growth, development and well-being. It is commonly regarded as a condition affecting children in low-income countries; however, malnutrition has been found to be variably prevalent among hospitalized children in higher-income countries. At the time the present study was conducted, it had been >30 years since the nutritional status of Canadian hospitalized children was last published.

OBJECTIVES: To determine and communicate the prevalence of malnutrition among children in a Canadian tertiary-care paediatric hospital at the time of their admission.

METHODS: In the present cross-sectional study, anthropometric measures were obtained from 322 children admitted to The Hospital for Sick Children in Toronto, Ontario. Nutritional indexes (BMI for age, weight for age, weight for length/height and length/height for age) were generated from anthropometric measures using the WHO igrowup software, and summarized according to WHO definitions.

RESULTS: The overall prevalence of malnutrition using BMI for age was 39.6% (95% CI 33% to 46%), of which 8.8% and 30.8% of participants were under- and overnourished, respectively. Furthermore, 6.9% (95% CI 3% to 13%) were determined to be acutely malnourished (weight for length/height <−2 SD) and 13.4% (95% CI 10% to 18%) chronically malnourished (length/height for age <−2 SD).

CONCLUSION: The high prevalence of overall malnutrition observed among study participants suggests that initial screening using simple anthropometric measures should be conducted on hospital admission so that patients can receive appropriate nutrition-specific care.

Key Words: *Anthropometry; Malnutrition; Overweight; Paediatrics; Prevalence; Undernutrition*

La prévalence de malnutrition à l'admission de patients dans un hôpital pédiatrique canadien de soins tertiaires

HISTORIQUE : On sait que la malnutrition chez les enfants hospitalisés nuit à leur réponse au traitement et prolonge leur hospitalisation. Elle a également des conséquences à court et à long terme sur la croissance, le développement et le bien-être. Elle est souvent considérée comme un problème chez les enfants de pays à faible revenu, mais sa prévalence est variable chez les enfants hospitalisés dans les pays à revenu élevé. Au moment de la présente étude, les dernières publications sur l'état nutritionnel des enfants canadiens hospitalisés remontaient à plus de 30 ans.

OBJECTIFS : Déterminer et communiquer la prévalence de malnutrition chez les enfants au moment de leur admission dans un hôpital pédiatrique canadien de soins tertiaires.

MÉTHODOLOGIE : Dans la présente étude transversale, les mesures anthropométriques ont été recensées auprès de 322 enfants admis à *The Hospital for Sick Children* de Toronto, en Ontario. Les indices nutritionnels (IMC par rapport à l'âge, poids par rapport à l'âge, poids par rapport à la taille et taille par rapport à l'âge) étaient tirés de mesures anthropométriques calculées au moyen du logiciel igrowup de l'OMS. Ces indices étaient résumés d'après les définitions de l'OMS.

RÉSULTATS : D'après l'IMC en fonction de l'âge, la prévalence globale de malnutrition s'élevait à 39,6 % (95 % IC 33 % à 46 %). Ainsi, 8,8 % et 30,8 % des participants étaient sous-alimentés et suralimentés, respectivement. De plus, il a été établi que 6,9 % (95 % IC 3 % à 13 %) souffraient de malnutrition aiguë (poids par rapport à la taille <−2 ÉT), et 13,4 % (95 % IC 10 % à 18 %), de malnutrition chronique (taille par rapport à l'âge <−2 ÉT).

CONCLUSION : D'après la forte prévalence de malnutrition globale chez les participants à l'étude, le dépistage initial faisant appel à des mesures anthropométriques simples devrait être effectué au moment de l'admission à l'hôpital, afin que les patients puissent recevoir des soins pertinents en matière de nutrition.

Malnutrition is defined as a state of poor nutrition characterized by insufficient, excessive or imbalanced consumption of nutrients. Children are considered to be malnourished if their dietary intake provides inadequate nutrients for growth and bodily maintenance, or if they are unable to fully utilize consumed nutrients due to illness or underlying disease. Childhood malnutrition has both short- and long-term consequences for growth, development, health and well-being. In its extreme form, it is associated with increased morbidity and mortality (1), as well as poor growth and reduced or delayed mental and psychomotor development (2,3).

While malnutrition is commonly regarded as a condition associated with low-income countries, the prevalence of malnutrition among hospitalized children in higher-income countries has been found to range from 6.1% to 35% (4-13). The reported prevalence of malnutrition among studies differs depending on the type of hospital, criteria used in calculating nutritional indexes and the reference population used for comparison. In a hospital-based setting, identification of children who are malnourished or at risk for malnutrition is important given the impact of nutrition on outcomes and the availability of resources to intervene (13,14).

[1]*The Hospital for Sick Children, Centre for Global Child Health, Toronto, Ontario;* [2]*Department of Pediatrics, Hamad Medical Corporation, Doha, State of Qatar;* [3]*Departments of Paediatrics, Nutritional Sciences, and Public Health, University of Toronto, Toronto, Ontario*

Correspondence: Dr Stanley H Zlotkin, The Hospital for Sick Children, Centre for Global Child Health, 555 University Avenue, Toronto, Ontario M5G 1X8. Telephone 416-813-8056, fax 416-813-5393, e-mail stanley.zlotkin@sickkids.ca

Accepted for publication July 25, 2014

TABLE 1
WHO nutrition indexes and relevant cut-offs

Index	Cut-off(s)	Age range, completed months
BMI for age*	Severe thinness: <−3 SD	0–228
	Thinness: <−2 SD	
	Overweight: >+1 SD	
	Obesity: >+2 SD	
Weight for age	Underweight: <−2 SD	0–120
Length/height for age	Stunting: <−2 SD	0–228
Weight for length/height (wasting)	Moderate acute malnutrition: <−2 SD	0–60
	Severe acute malnutrition: <−3 SD	

*Data adapted from references 19 and 20. *WHO Child Growth Standards include body mass index (BMI) for age starting at birth. In Canada, there is considered to be a lack of convincing evidence for the use of BMI for age <24 completed months; thus, BMI for age for participants <24 completed months were not included in any analyses presented*

However, malnutrition can go unrecognized in hospitals, as observed in a Belgian study that found that only one-third of children identified by trained study personnel as acutely malnourished on admission received nutritional support while in hospital (13). Identification of paediatric patients who are acutely or chronically undernourished is important because up to 50% experience longer hospital stays (13,14). As well, the likelihood of developing nutritional deficiencies increases when a child is hospitalized for a longer period of time (5,14), potentially leading to further adverse health outcomes.

At the time the present study was conducted, it had been >30 years since data on the nutritional status of hospitalized children in Canada had last been published (15). When last evaluated by Parsons et al (15) in 1980, at least one subnormal anthropometric measure had been found in 20% of the hospitalized study participants. Groleau et al (16) recently reported that of 173 children recruited from a general paediatric ward in a Quebec hospital, 13.3% of participants were acutely and/or chronically malnourished. We aimed to determine the prevalence of malnutrition among children recently admitted to The Hospital for Sick Children (SickKids), a large tertiary-care paediatric hospital located in Toronto, Ontario.

METHODS

Setting and subjects

The present study was conducted at SickKids from October 2009 through January 2010. SickKids is a tertiary-care paediatric teaching hospital associated with the University of Toronto (Toronto, Ontario). SickKids is dedicated to advancing children's health through the integration of patient care, research and education. From October 2009 to January 2010, there were 4500 admissions, which equated to an average of 40 new patient admissions per day. The average length of stay was approximately seven days (17).

A computer randomization program was used to identify 10 children admitted to SickKids within the past 24 h on weekdays. Exclusion criteria included patients <30 days of age; >19 years of age; clinically unstable patients (eg, admitted to the neonatal or paediatric intensive care); patients with postoperative immobility; and non-English speaking children and/or their legal guardian. Detailed records regarding patient ineligibility and refusals to participation were not maintained.

The study protocol was reviewed and approved by the Research Ethics Board at SickKids. Written informed consent was obtained from the parents or guardians of children <16 years of age, or directly from the patient for those ≥16 years of age.

Sample size

The sample size was calculated by estimating the number of individuals that would be needed to achieve sufficient power to perform comparisons of the prevalence of malnutrition with three possible covariates (age group, sex and diagnosis group) using a logistic regression model for evaluation. Using a logistic regression of a binary response variable for malnutrition on a binary independent variable for sex (assuming 50% male and 50% female) to detect a change in the probability of malnutrition from the baseline value of 0.3 to 0.1 (corresponding to an OR of 0.259) with an alpha level of 0.003 and 80% power, a total of 327 individuals were targeted for enrollment. An adjustment was made because multiple regression of the independent variable of interest on other independent variables in the logistic regression resulted in an R^2 of 0.3.

Study design and data collection

Basic demographic information (age, sex and diagnosis) and anthropometry (weight and length [or height for children ≥24 months]) data were collected. All anthropometric measures were administered by a single study research fellow using calibrated equipment and WHO standardized techniques, and were measured in duplicate, with the mean values being used in analyses (18).

Classification of study participants' growth

The WHO growth reference standards were used to classify study participants' growth by applying the publicly available WHO igrowup package for Stata (Stata Corporation, USA) to participant anthropometric data to determine *z*-scores for nutrition indexes using the WHO Child Growth Standards (children up to 60 completed months of age) and WHO Child Growth References (children 61 to 228 completed months of age). All nutrition indexes were defined according to the WHO criteria: body mass index (BMI) for age; weight for age (WFA); weight for length/height (WFL; indicative of acute malnutrition); and height for age (HFA; indicative of chronic malnutrition) (Table 1) (19,20). Although the WHO Child Growth Standards include BMI for age starting at birth, certain countries, including Canada, consider there to be a lack of convincing evidence for the use of BMI for age in infants and young children <24 months of age (21). As such, BMI-for-age values for participants <24 months of age were not included. WFA was only determined for participants ≤120 completed months of age because the WHO growth standards and references for this index have not been calculated beyond 120 completed months of age. WFL was only determined for participants ≤60 completed months of age, as the WHO growth references and standards for this index have not been determined beyond this age cut-off.

Determining the prevalence of malnutrition

The prevalence of malnutrition overall was determined by dividing the number of malnourished cases identified using BMI for age (inclusive of severe thinness, thinness, overweight and obesity) by the number of subjects for which BMI for age was calculated. The prevalence of each specific nutrition index (WFA, WFL and HFA) was also determined by dividing the number of cases by the number of subjects, while taking into consideration the corresponding age range for the index.

Statistical analyses

Descriptive statistics were used to describe the study population, with continuous outcomes summarized as a mean and range, and categorical outcomes presented as a percent. Participant medical diagnoses were classified into three categories: acute medical or

surgical presentation, with no pre-existing (chronic) disease; acute medical or surgical presentation, with pre-existing (chronic) disease; elective medical or surgical presentation, with or without pre-existing (chronic) disease. Chronic disease was defined in the context of the present study as a pre-existing condition >6 months duration. Age was transformed into a categorical variable using four categories: <24 months; 24 to 60 months; 61 to 143 months; and ≥144 months. The χ^2 test was used to determine whether there was an association between positive identification of individuals for the different nutrition indexes ('cases') with categorical covariates of interest (sex, age and diagnosis). Given the assumptions of the χ^2 test, the Fisher exact test was alternatively used when the frequency of cases was ≤5. Data were analyzed using Stata/IC 12.0 (Stata Corporation, USA). The experiment-wise error rate was controlled at 0.05 by applying a Bonferroni correction to account for multiple testing; therefore, P<0.004 from independent tests were considered to be statistically significant.

RESULTS

Enrollment and exclusion

In total, 327 children were enrolled in the study. Of those enrolled, data from five participants were excluded from the analyses: two because although they met the inclusion criteria, their measurement values were implausible (range −5 SD to −7 SD) and could not be verified; and three due to height measurement error on verification with hospital records. Of the 322 participants included in the analyses, 53% were male, and the mean age was 92.5 months (range 1.25 to 216 months) (Table 2). The majority of participants were admitted for an elective medical or surgical indication, with or without a pre-existing (chronic) disease.

Prevalence of malnutrition

Using BMI for age (among children 24 to 228 completed months of age), the prevalence of malnutrition was determined to be 39.6% (99 of 250; 95% CI 33 to 46%). Within the 39.6% of participants identified as malnourished, 30.8% were overnourished (17.2% overweight and 13.6% obese) and 8.8% were undernourished (6.0% thinness and 2.8% severe thinness) (Table 3). Using the nutritional status indexes WFA (applicable up to 120 completed months), WFL (up to 60 completed months) and HFA (up to 228 completed months), 9.4% of participants were found to be underweight (19 of 203; 95% CI 6 to 14%), 6.9% acutely malnourished (nine of 130 [five of 130 moderately and four of 130 severely]; 95% CI 3% to 13%) and 13.4% chronically malnourished (43 of 322; 95% CI 10% to 18%), respectively (Table 3).

Associations between malnutrition using BMI for age and covariates of interest

There was no significant association between malnutrition overall (ie, a bivariate variable for all participants identified as malnourished using the BMI-for-age indicators) and covariates of interest. When each BMI-for-age indicator was considered individually with the covariates, no significant associations were observed. Given the absence of significant associations between BMI-for-age indicators and the covariates in the univariate analyses, multiple logistic analyses were not conducted.

Associations between other nutritional status indicators and covariates of interest

Patients <24 completed months of age were more likely to be associated with being identified as chronically malnourished (HFA <−2 SD) compared with the other age groups (P=0.0001). No other significant associations were observed between nutritional status indicators and covariates of interest.

TABLE 2
Baseline demographics

Characteristic	Participants (n=322)
Age, months, mean ± SD (range)	92.5±67.5 (1.25–216)
Age categories, n (%)	
1–23 months	72 (22)
24–60 months	60 (19)
61–143 months	106 (33)
≥144 months	84 (26)
Sex, male:female, n:n (% male)	170:152 (53)
Diagnosis, n (%)	
Acute medical or surgical presentation, without pre-existing disease	88 (27)
Acute medical or surgical presentation, with pre-existing disease	99 (31)
Elective medical or surgical presentation, with or without pre-existing disease	135 (42)

DISCUSSION

Because there is limited published information pertaining to the nutritional status of hospitalized Canadian children, we aimed to assess the prevalence of malnutrition among recently admitted patients at a tertiary-care hospital using simple, standard anthropometric measures. We found that more than one-third of the patients studied were either under- or overnourished according to the WHO nutrition status indicator BMI for age. Of particular importance, 6.9% (nine of 130 participants zero to 60 completed months of age) and 13.4% (43 of 322 participants zero to 228 completed months of age) of participants were determined to be acutely and chronically malnourished (undernourished), respectively.

We observed that 30.8% of all study participants ≥24 months of age were overweight or obese (17.2% and 13.6%, respectively) using BMI-for-age cut-offs. Data obtained using direct measurements from the 2004 Canadian Community Health Survey similarly suggests that 26% of (nonhospitalized) Canadian children were overweight or obese (18 and 8%, respectively) among those two to 17 years of age using BMI (22). Data from the 2009 to 2011 Canadian Health Measures Survey, which used WHO cut-offs for BMI to height and weight measures, found that among children five to 17 years of age, 31.5% were overweight or obese (19.8% and 11.7%, respectively) (23). In considering children identified as thin or severely thin using BMI for age <−2 SD, we identified 9.3% of participants as undernourished. We do not know of any reliable published literature using the Canadian Community Health Survey, Canadian Health Measures Survey or other Canadian data reporting on thinness; however, European studies using BMI <−2 SD have reported the prevalence of thinness in similarly aged children to be between 9.8% to 12% (9,13,24).

Our finding of a prevalence of 6.9% of acutely malnourished hospitalized children was similar to other non-Canadian studies using the same cut-off (WFH <−2 SD), which ranged from 7% to 11% (5,6,13,14). A study involving Canadian children hospitalized in a general paediatric unit recently published by Groleau et al (16) found that 11% of participants were acutely malnourished. We identified 13.4% of children as being chronically malnourished, compared with 6.3% reported by Groleau et al (16). An important difference between these two Canadian hospital-based studies is the type of hospital: the present study samples from a tertiary-care paediatric hospital where children are likely to be sicker. Both study findings are consistent with other studies in

TABLE 3
Spectrum of observed cases for nutrition status indexes among participants

Index	Observed cases, n (%)	95% CI	Sex (male:female)	P	Age*	P	Diagnosis†	P
BFA (n=250)								
Extreme thinness: BFA ≤−3 SD	7 (2.8)	1–6	5:2	0.452	B: 1 C: 4 D: 2	0.701	A: 1 B: 4 C: 2	0.496
Thinness: −3 SD < BFA ≤−2 SD	15 (6.0)	3–10	10:5	0.267	B: 1 C: 11 D: 3	0.032	A: 3 B: 7 C: 5	0.663
Overweight: 1 SD ≤ BFA <2 SD	43 (17.2)	13–22	21:22	0.567	B: 10 C: 14 D: 19	0.475	A: 10 B: 16 C: 17	0.874
Obesity: BFA ≥2 SD	34 (13.6)	10–18	22:12	0.135	B: 11 C: 11 D: 12	0.364	A: 11 B: 10 C: 13	0.633
Weight for age (n=203)								
WFA ≤−2 SD	19 (9.4)	6–14	9:10	0.444	A: 11 B: 2 C: 6	0.072	A: 2 B: 9 C: 8	0.040
Weight for length/height (n=130)								
MAM: −3 SD < WFL ≤−2 SD	5 (3.8)	1–9	3:2	1.000	A: 5 B: 0	0.297	A: 1 B: 1 C: 3	0.149
SAM: WFL ≤−3 SD	4 (3.1)	0–8	2:2		A: 2 B: 2		A: 0 B: 3 C: 1	
Height for age (n=322)								
HFA ≤−2 SD	43 (13.4)	10–18	21:22	0.591	A: 21 B: 6 C: 10 D: 6	0.0001	A: 7 B: 20 C: 16	0.035

**Age categories included A: <24 completed months; B: 24 to 60 completed months; C: 61 to 143 completed months; and D: ≥144 completed months. †Diagnosis categories included A: acute medical or surgical presentation, with no pre-existing (chronic) disease; B: acute medical or surgical presentation with pre-existing (chronic) disease; and C: elective medical or surgical presentation, with or without pre-existing (chronic) disease. BFA Body mass index for age; BMI Body mass index; HFA Height for age; MAM Moderate acute malnutrition; SAM Severe acute malnutrition; WFA Weight for age; WFL Weight for length*

which chronic malnutrition in hospitalized children was found to range between 2.5% to 18% (6,11,13,14). The variation in the prevalence of chronic malnutrition between studies could be attributed to the use of different references and/or cut-off values, which can lead to varying classification. Additionally, the type of facility could lead to variability because patients with more serious underlying diseases are more likely to present at tertiary care facilities (13,14).

Identification of acute and chronic malnutrition is important given the documented association with length of hospital stay and weight loss during hospitalization. Belgian children identified as chronically undernourished were found to have 50% longer hospital stays (13); in the Netherlands, acutely malnourished children had 45% longer hospital stays (14). Additionally, approximately 30% to 65% of children were found to have lost weight while hospitalized (13,25), which can aggravate a pre-existing condition. Collectively, these data demonstrate the importance of a child's nutritional status on admission to hospital. Initial assessment of a child's nutritional status on hospital admission using simple anthropometric measures is important because in most children's hospitals, nutrition-related interventions for patients and resources for caregivers are readily available.

A strength of the present study was that one researcher facilitated and conducted all anthropometric measures, which eliminated interobserver measurement variability. However, because data were not captured detailing ineligibility and refusals to participate, there is the potential for selection bias because we do not know whether those not recruited to participate in the study were of better nutritional status. This could affect the generalizability and representativeness of the results. Although Canada does not have nationally representative growth reference data, a benefit of the present study was using the WHO growth standards, in which the data from zero to 60 completed months of age represent 'optimal' growth based on longitudinal data originating from an international population selected for optimal child-rearing practices. This enhances its worldwide applicability. However, the WHO growth reference values for children >60 completed months of age are extrapolated from all existing United States studies. These data are not optimal, but are the current 'gold' standard for growth measurements.

CONCLUSION

Although the methods used to identify children with malnutrition have changed over the past 30 years, results from the current study compared with previous studies suggest that rates of malnutrition of children admitted to a tertiary children's hospital remain high. Early assessment and classification of malnutrition in children admitted to hospital provides an opportunity for

intervention, which could lead to better clinical outcomes and shorter hospital stays. This may translate into lower hospitalization costs. We have demonstrated that the use of standard screening techniques as a means of initial nutritional assessment can identify children with malnutrition. Future research assessing the impact of early and focused nutritional interventions, specifically among malnourished hospitalized patients, to prevent hospital-based complications and delayed discharge would be of value.

DISCLOSURES: Funding was provided by The Hospital for Sick Children Foundation.

INSTITUTION WHERE WORK ORIGINATED: The Hospital for Sick Children.

ETHICS BOARD THAT APPROVED STUDY: Research Ethics Board at The Hospital for Sick Children.

REFERENCES

1. Pollack MM, Ruttimann UE, Wiley JS. Nutritional depletions in critically ill children: Associations with physiologic instability and increased quantity of care. J Parenter Enteral Nutr 1985;9:309-13.
2. Lucas A, Morley R, Cole TJ. Randomised trial of early diet in preterm babies and later intelligence quotient. BMJ 1998;317:1481-7.
3. Klein PS, Forbes GB, Nader PR. Effects of starvation in infancy (pyloric stenosis) on subsequent learning abilities. J Pediatr 1975;87:8-15.
4. Pawellek I, Dokoupil K, Koletzko B. Prevalence of malnutrition in paediatric hospital patients. Clin Nutr 2008;27:72-6.
5. Rocha GA, Rocha EJ, Martins CV. The effects of hospitalization on the nutritional status of children. J Pediatr (Rio J) 2006;82:70-4.
6. Marteletti O, Caldari D, Guimber D, Mention K, Michaud L, Gottrand F. [Malnutrition screening in hospitalized children: Influence of the hospital unit on its management]. Arch Pediatr 2005;12:1226-31.
7. Dogan Y, Erkan T, Yalvac S, et al. Nutritional status of patients hospitalized in pediatric clinic. Turk J Gastroenterol 2005;16:212-6.
8. Ozturk Y, Buyukgebiz B, Arslan N, Ellidokuz H. Effects of hospital stay on nutritional anthropometric data in Turkish children. J Trop Pediatr 2003;49:189-90.
9. Hankard R, Bloch J, Martin P, et al. Nutritional status and risk in hospitalized children. Arch Pediatr 2001;8:1203-8.
10. Hendricks KM, Duggan C, Gallagher L, et al. Malnutrition in hospitalized pediatric patients. Current prevalence. Arch Pediatr Adolesc Med 1995;149:1118-22.
11. Hendrikse WH, Reilly JJ, Weaver LT. Malnutrition in a children's hospital. Clin Nutr 1997;16:13-8.
12. Moy RJD, Smallman S, Booth IW. Malnutrition in a UK children's hospital. J Hum Nutr Diet 1990;3:93-100.
13. Huysentruyt K, Alliet P, Muyshont L, Devreker T, Bontems P, Vandenplas Y. Hospital-related undernutrition in children: Still an often unrecognized and undertreated problem. Acta Paediatr 2013;102:e460-6.
14. Joosten KF, Hulst JM. Prevalence of malnutrition in pediatric hospital patients. Curr Opin Pediatr 2008;20:590-6.
15. Parsons HG, Francoeur TE, Howland P, Spengler RF, Pencharz PB. The nutritional status of hospitalized children. Am J Clin Nutr 1980;33:1140-6.
16. Groleau V, Thibault M, Roy CC, Doyon M, Brochu EE, Babakissa C. Malnutrition in hospitalized children: Prevalence, impact, and management. Can J Diet Pract Res 2014;75:29-34.
17. Hospital for Sick Children. SickKids Annual Report 2010-2011. Toronto: Hospital for Sick Children, 2011.
18. WHO. Training Course on Child Growth Assessment. Geneva, 2008.
19. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatr Suppl 2006;450:76-85.
20. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ 2007;85:660-7.
21. Dietitians of Canada, Canadian Paediatric Society, The College of Family Physicians of Canada. Promoting optimal monitoring of child growth in Canada: Using the new World Health Organization growth charts 2010.
22. Shields M. Overweight and obesity among children and youth. Health Rep 2006;17:27-42.
23. Roberts KC, Shields M, de Groh M, Aziz A, Gilbert JA. Overweight and obesity in children and adolescents: Results from the 2009 to 2011 Canadian Health Measures Survey. Statistics Canada, Health Reports 2012;23:3-7.
24. Campanozzi A, Russo M, Catucci A, et al. Hospital-acquired malnutrition in children with mild clinical conditions. Nutrition 2009;25:540-7.
25. Sermet-Gaudelus I, Poisson-Salomon AS, Colomb V, et al. Simple pediatric nutritional risk score to identify children at risk of malnutrition. Am J Clin Nutr 2000;72:64-70.