01/09/2010 **Version 1**

Development and Evaluation of a New Infant Nutrition Screening Tool

(Infant Yorkhill Malnutrition Score)

Introduction

A large number of children experience undernutrition related to or resulting from their illness. Hospitalized children are at a high risk of developing malnutrition particularly children with underlying disease and clinical conditions (Joosten KF and Hulst JM, 2008, 2010). In addition malnutrition has been associated with an increase in length of hospital stay and consequently the cost of providing health care (Campanozzi A et al, 2009). Therefore, the identification of children at risk of undernutrition is an important part of any programme for providing optimal health and treating of hospitalized patients. Quality Improvement Scotland has recently published standards for Food Fluid and Nutritional Care, which state that all patients should be screened for undernutrition on admission and periodically during their stay at hospital (NHS QIS 2003).

Common methods of assessing nutritional status in children include a combination of dietary, anthropometric, biochemical measures and clinical signs. It is not possible for all admitted patients to have a complete nutritional assessment, but nutritional screening aims to identify those who are malnourished or at risk of becoming so to allow them to be assessed in more detail. In terms of anthropometric measures, the three most commonly used anthropometric indices are weight-for-height, height-for-age, and weight-for-age; According to WHO criteria, (WHO technical report, 1995) SD-scores<-2 for weight-for-height and height-for-age describe acute and chronic malnutrition respectively. BMI as a new indicator has been developed by WHO for the first time to assess (the thinness of a child and hence its probability to indicate malnutrition of children) the weight of children (De Onis M et al, 2006). Weight-for-height index has been suggested as valid criteria for the identification and treatment progress of severe acute malnutrition in children (Isanaka S et al, 2009). These indexes can be used for screening of chronic and acute malnutrition but their diagnostic value is limited when attempting to identify children at early stages of undernutrition or patients at risk of deterioration in nutritional status as the result of medical condition.

There is no agreement concerning the most appropriate criteria to be used. What is needed is a valid and accessible tool to establish the early identification and desirable management of nutritional risk in children. . There remains a great variation in the criteria used to define malnutrition, with each method having its own limitations.

Pre-existing paediatric nutrition screening tools

Recently a variety of nutritional screening tools have been developed for assessment of nutritional status of children in hospital setting, including; SGNA (Subjective Global Nutritional Assessment) (Secker and Jeejeebhoy, 2007), STAMP (Screening Tool for the Assessment of Malnutrition in Paediatric) (McCarthy H, et al. 2008 and More J, 2008),

STRONG kids (Screening Tool Risk on Nutritional Status and Growth) (Jessi M. Hulst et al., 2010), and PYMS (Paediatric Yourkhill Malnutrition Score). These all use the internationally recognized predictors of undernutrition: clinical assessment, dietary intake and anthropometric measurements. Each of these components bears a nutrition risk score, and overall score corresponds to the overall undernutrition risk of the patient.
Although, recent studies have attempted to develop appropriate nutritional screening tools for children on admission, they are not useful for infants as they have not been validated except of STRONG kids (Screening Too Risk on Nutritional Status and Growth) which has been developed for hospitalized children as well as infants.

Development of the infant Paediatric Yorkhill Malnutrition Score (iPYMS)

A project team, consisting of senior nursing, dietetic, research academic and medical staff have developed a preliminary tool that would be both simple and quick to use.
The infant nutritional screening tool will consist of four fields;

1. Weight centile (using admission weight)
2. Poor weight gain (by parental report)
3. Reduced intake
4. Effect on nutrition of current illness

On admission this tool would be completed by the nurse (researcher initially). A score of 0 or 1 classify patient at a low and median risk of undernutrition and a score of 2 or more reflects a high risk of undernutrition.

Purpose of the Study

The purpose of this study is to evaluate a proposed malnutrition screening scheme for infants - the infant Paediatric Yorkhill Malnutrition Screening(iPYMS)score to discover how well it distinguishes infants who are well-nourished from those undernourished or at risk of undernutrition (discriminant validity).
We also need to compare it with results of other reputable nutritional measurements (concurrent validity).

Hypotheses

1. Most infants with low fat levels or at high risk of undernutrition with Paediatric Global Nutritional Assessment (PGNA) will be identified by a high infant Yorkhill Malnutrition Score (sensitivity).
2. Infants with high infant Yorkhill Malnutrition Score will have lower fat levels than infants with low score (discriminant validity).
3. There will be a moderate to good agreement and concordance between infants who have been screened with iPYMS and STRONG kids.
4. Explore the utility of bioelectrical impedance and an infant eating behaviour scale in detecting infants with malnutrition
5. Relate the malnutrition risk to length of hospital stay

Method

The researcher will pilot the study and this will be the opportunity receive feedback on the study design. The researcher will first complete the iPYMS scoring sheet for each

child and then the questionnaires (SGNA and Infant EBQ) will be completed by the main carer of patient.

The Paediatric Yorkhill Malnutrition Score (PYMS) for infants must be able to distinguish those who are well-nourished from those malnourished or at risk of becoming so. It is based on internationally recognized predictors or symptoms of undernutrition (weight gain, reduced dietary intake), and therefore has face validity. However we need to compare it with results of other reputable nutritional measurements (concurrent validity), and its diagnostic value to screen the same patients with other currently used methods of undernutrition has to be tested (criterion validity). Accuracy is also important, considering how well the tool performs in detecting infants who really have problems and correctly identifying those who do not (sensitivity and specificity). So, we need further measurements to consider its sensitivity and the discriminant validity of the tool. We will study all screen positive and a sample of screen negative infants, using skinfolds and previous weight measurements and a parentally completed eating behaviour questionnaire. We will use this data to test the utility of PYMS score, growth trajectory, body mass index and behaviour questionnaire as predictors of low adiposity and stunting.

The discriminant validity of the screening tool will be tested using body composition measurement using triceps (TSF) and subscapular skinfold thickness and the mid upper arm circumference (MUAC) and SGNA (Subjective Global Nutritional Assessment). To test the concurrent validity, the results from the infant screening tool will be compared with the results of STRONG kids (Screening Tool Risk on Nutritional Status and Grow).

Reliability is also essential as the tool must produce similar results with repeat testing in the same circumstances and with different users where the patient's state has not changed. User-group may affect tool performance; for example, whether doctors, nurses or dieticians conducted the screening. Thus, the reliability of the tool needs to be tested in future.

Subjects

Participant of the study will be all patients newly admitted to selected wards (medical and general surgical wards) at the Royal Hospital for Sick Children (and possibly RAH Paisley). An average of 8 patients per day are admitted to the relevant wards and we will aim to recruit a total of 200 over a 4 month period, after an initial pilot with up to 20 patients. Children aged 1 -24 months are the subjects of this study because the purpose of this study is to develop a screening tool for infants.

Exclusions

- Patients in the short stay ward, intensive care or high dependency unit, Oncology unit, NICI and PICM, Cardiology (SA),
- Patient who have been transferred from neonatal units and PICM and NICM.

Sample Size- Power Calculation

Using the Altman monogram 45 subjects in each group (135 it total) would give 90% power to detect a difference of 0.66SD (1 centile space) in skinfolds between any two of the 3 groups. 70 subjects in each group (210) gives 80% power to detect a difference of 0.5SD in skinfolds between any two of the 3 groups.

It is likely that not all children will have complete measures so we will aim to recruit 200 subjects.

Sample Selection

Quota sampling will be used to obtain three equal groups of patients with different undernutrition scores (low, medium, high), until the desirable number of patients in each group is achieved. We will oversample high risk patients (expected to be only 10-20% of all patients) if necessary by screening all eligible patients using iPYMS and proceeding to full assessment for only those scoring high risk. In other word. a) The majority of patients screened at high risk of undernutrition. b) Every third child screened at medium risk of undernutrition. c) Every tenth child screened at low risk of undernutition (Gerasimidis K et al, 2010).

We expect that malnutrition will be identified in between 10-30% of infant studied. If previously unrecognised this means they can then be referred for further assessment.

Recruitment

The researcher will identify those patients eligible for screening by visiting the wards daily and obtaining details of new admissions from the nursing staff. She will then give an information leaflet to the patient's carer to read and answer any immediate questions. After at least one hour she will return to the ward and if the carer is happy to participate, the researcher will ask him/her to complete a consent form. A copy of the consent form will be given to the carers and another will be placed in the child's medical notes.

The material will be in written in a form suitable for anyone who can read English. We will not be able to include those infants where neither carer was able to read English.

Due to short admission periods usually most of the children will be discharged during the first day of stay. We aim to complete assessment on the next day after admission

Outcome Measurements

Parental questionnaires

1. Global Nutritional Assessment for infants (SGNA)

   The researcher will ask the main carers of patients to complete the eating behavior questionnaire about the infant's diet (type of milk. supplementary feeding and weaning diet), weight loss (poor weight gain), gastrointestinal symptoms, and daily activity. A rough visual assessment of the child's muscle stores and fat will be carried out by the researcher. This is a global nutritional assessment procedure recently validated in paediatric patients as a measure of current and future nutrition risk (Secker & Jeejeebhoy, 2007). A copy of the assessment form and the article that describes this method is attached for the ethics committee attention.

2. **Infant EBQ**

   This questionnaire has been developed using population data from a cohort study and is designed to identify infants at risk of weight faltering. This will be completed by the main carers of patients to assess the patient's general appetite and eating behaviour

Measurements

3. **Triceps (TSF) and subscapular skinfold thickness**

Measurement of the thickness of the skin of the arm (triceps) and shoulder blade (subscapular) will be done as a measure of fat store. Briefly the parent will take off their top clothing and the researcher will measure the skinfold thickness with Holtain calipers. This measurement will be to some extent inconvenient for patients particularly those who are <1 year of age.

4. **Weight and length**

Weight will have been measured on admission. The researcher will re weight and measure length using the ward scales and recumbents stadiometer or our own portable equipment.

5. **Mid upper arm circumference (MUAC)**

The researcher will measure the circumference of their mid upper arm using a simple measuring tape.

6. **Bioelectrical impedance (BIA)**

This has been developed for assessment of nutritional status in children based on indices of lean and fat adjusted for body size (Wright CM et al, 2008). We want to discover whether this method is practical and effective in this young age range and how it relates to nutrition score. Self adhesive electrodes are attached to the right wrist and ankle while the child lies on the bed. Three reading are taken, while, the electrodes are attached

The infants may become briefly upset by being measured. If they become very upset and uncooperative that measurement will be abandoned.

Additional elements

7. **STRONG kids (Screening Tool Risk on Nutritional Status and Growth)**

The researcher will extract equivalent items for SGNA about the child's food intake, diarrhoea, vomiting, weight loss or poor weight gain or no weight gain, during the few days before admission. An observational assessment of patients will be also carried out by researcher in terms of diminished subcutaneous fat, muscle mass and hollow face (subjective clinical assessment- the same as b). In addition, the researcher will use information recorded in the medical notes of the patient to assess patients' underlying illness with a risk of malnutrition (Anorexia nervosa, Celiac disease, Cystic fibrosis, cardiac disease, and trauma).

8. **Length of hospital stay (LOS)**

Length of hospital stay as a secondary outcome will also be collected from hospital admissions statistics or through the notes.

9. **Growth trajectory**

Patients' birth weight will be collected by the maternal report in order to calculate weight trajectory.

<u>Analysis-Statistics</u>

Data will be entered into the electronic database of SPSS v15. The paper data will have names and dates of birth recorded in order to allow linkage to hospital discharge data.The electronic data will have only enough personal information to link it uniquely with the paper record. The anonymised electronic data will be stored on the password protected university network.

The raw measurements of body composition, height, weight. Skinfolds and mid upper arm circumference will be converted into standard deviation scores.

- Height and weight will be converted into standard deviation scores according to the UK 1990 reference data.
- Skinfolds and mid upper arm circumference will be converted into standard deviation scores according to the World Health Organization reference values. A value less than -2 standard deviation scores denotes a patient at high risk of undernutrition.

Patient iPYMS outcome (nutrition risk), will be cross-tabulated with the respective nutrition risk from the Paediatric Subjective Global Nutrition Assessment or, body composition assessment. The proportion of patients at risk of undernutrition (according to body composition assessment and/or the Paediatric Subjective Global Nutrition Assessment) who were not identified by the iPYMS will be recorded as false negatives. On the contrary, the proportion of patients at low risk of undernutrition (according to body composition assessment and/or the Paediatric Subjective Global Nutrition Assessment) who were screened as at high risk of undernutrition by the iPYMS will be recorded as false positives.
The mean values per group compared using t-test and anova and the categorical data compared using chi squared and logistic regression analysis.
We will use this data to test the utility of PYMS score, growth trajectory, body mass index and behaviour questionnaire as predictors of low adiposity and stunting
K-statistics will be used for Agreement of the methods.

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