CATECHOLAMINE METABOLITE IN SCHOOL CHILDREN WITH DELAYED SCHOLASTIC ACHIEVEMENT

Thesis

Submitted for Partial fulfillment
of Master Degree in ***Pediatric***

By

Khaled Fahmy Mohamed
(M.B.B.Ch, Ain Shams University)

Under Supervision of

Prof. Dr. Sanaa Youssef Shaaban
Professor of Pediatrics
Faculty of Medicine
Ain Shams University

Prof. Dr. May Fouad Nassar
Professor of Pediatrics
Faculty of Medicine
Ain Shams University

Prof. Dr. Eman Saleh El Hadidi
Assistant Professor of Pediatrics
Faculty of Medicine
Ain Shams University

Faculty of Medicine
Ain Shams University
2011

INTRODUCTION

Malnutrition disorders affect more than 30% of school children in Egypt. This problem appears to be largely attributable to poor dietary quality and micronutrient deficiencies, such as iron and vitamin A. inadequate nutrition intake has important implications because malnutrition has been shown to negatively affect the cognitive development of primary school children *(Galal, 2005).*

Correlation studies provide some support to the idea that sugar intake could play a role in hyperactivity *(Prinz et al., 1980).*

Thiamin is a vitamin for which body stores are relatively small and can be depleted within a few weeks of inadequate intake. Behavioral problems have been reported in thiamin – deficient adolescents whose diet consists largely of high calorie "junk food" *(Benton et al., 1977).*

The symptoms of hyperactivity, impulsivity and concentration deficits associated with attention deficit disorder may be related, in part, to alterations in dopaminergic and noradrenergic function *(Rogeness et al., 1989).*

AIM OF THE WORK

The aim of the study is to highlight the effect of different dietary patterns of children on their delayed scholastic achievement. The study will also correlate any detected problems to the level of catecholamine metabolites in urine.

NUTRITION

Definition

Nutrition described as the sum of the processes by which the living organism receives materials from the environment and uses them to promote the vital activities. Such materials are known as nutrients. Nutrients are commonly applied to many substances which are digested, absorbed and used to promote body function. These nutrients include protein, fat, carbo-hydrate, mineral, vitamins and water i.e. Nutrition is the state resulting from balance between nutrients intake and nutrients expenditure *(Harris, 2004).*

Nutritional status reflects the degree to which physiological needs for nutrients are being met. The balance between nutrient intake and nutrient requirements is essential for optimal health. Nutrients intake is dependant on actual food consumption which is influenced by many factors. These factors include economic situation, eating behavior, emotional, climate, cultural influences and the effects of various disease state on appetite and the ability to consume and absorb adequate nutrition *(Mahan, 2002).*

Over the last 20 years, there has been an increasing interest in the central role of nutrition in growth and development *(Harris, 2004).*

Child nutrition is one of basics of pediatrics. Its objective is mainly to study the growth and development of the child, the analysis of child needs, the form in which the mother feeds her child and the immediate and long term consequence of nutrition *(Mubarak, 2004).*

Today we know more about pediatric nutrition and types of food children should eat for optimal growth and development, as well as future health than ever before *(Mc Bean and Miller, 1999).*

Providing adequate energy and nutrients to ensure adequate growth and development remains the most important consideration in the nutrition of the children. Small frequent feedings play a significant role in providing energy in diets of children *(Roy et al., 2005).*

For every society, nutritional assessment in the community is essential for accurate planning and implementation of intervention programs to reduce morbidity and mortality associated with under-nutrition *(Mahan, 2002).*

Evidences show that infancy, toddler years, and early childhood (ages 0-6) are perhaps the most important developmental stages for establishing healthy eating and exercise patterns. These patterns can provide

optimal growth and cognitive development, and prevent a life time of nutrition related diseases. If children do not eat the appropriate nutrients and engage in physical activity during these early years, by the time they enter school, they may already show signs of cognitive impairment, and have established eating patterns that results in lifetime of insufficient intake of milk, fruits, vegetables and key nutrients like iron and calcium *(Boyle and Kavanagh, 2000).*

Recommended intake of nutrients:

Recommended dietary allowance is defined as "the levels of intake of essential nutrients that judged to be adequate to meet the known nutrient needs of practically all healthy persons" *(Mubarak, 2004).*

The recommended intakes of nutrients are related to specific communities and depend upon feeding habits, physical activity of the community and the climates *(Lasheen et al., 2004).*

There is wide range of actual needs based on individual characteristics. The Dietary Reference Intakes (DRI), which includes Recommended Dietary Allowance (RDI) and Adequate Intake (AI), serve as a guide to prevent deficiency and/or to provide positive health benefits *(Betty, 2004).*

The Food Guide Pyramid is an outline of what we should eat each day. It is not a rigid prescription, but a general guide that lets you choose and plane a healthful diet that is right for you and your family. The overall message of the Food Guide Pyramid is to select foods that together give you all the nutrients you need to maintain health without eating too many calories or too much fat *(Kendal and Puck, 2004).*

In preschool children, growth pattern and energy needs during this stage are highly variable *(Roy et al., 2005).*

Using the Food Guide Pyramid in planning meals for preschool children will help ensure that they are getting a variety of foods and the right amounts from each food group. It also helps to ensure that foods high in fat and sugars are kept in moderation *(Kendal and Puck, 2004).*

The RDAs provides an average energy allowance, based on reference weight for each group. However, studies show that weight is a limited standard because of over- or under-weight status. Height, however, is a useful reference in determining appropriate energy intake for individual children. Use of kilocalories per centimeter of height (kcal/cm) is a good clinical tool for both assessing and estimating energy needs *(Betty, 2004).*

The diet should provide energy consistent with the maintenance of body weight within the recommended range. It should include:

- Essential nutrients in the amount recommended.
- Not more than 30% of energy as fat (33g/1000kcal) and not more than 10% as saturated fat (11g/1000 kcal).
- 55% of energy as carbohydrate 138g/1000kcal) from a variety of sources.
- The sodium content of the diet should be reduced.
- Community water supplies containing less than 1 mg/liter fluoride, so it should be fluorinated to that level.

(Roy et al., 2005)

Breakfast

Breakfast is an important and necessary for the optimal performance and well-being of a school child *(Gorman, 1995).*

The evidence that nutritional supplementation will improve both physical and mental development in children suffering from more severe nutrient deficiencies such as protein-energy malnutrition, iron deficiency anemia, and zinc and iodine deficiencies as well as others *(Pollitt, 1995).*

The acute effects of missing breakfast have been examined both in studies examining the effects of glucose delivery on physiology and function following an overnight fast, as well as in studies examining the effects of breakfast consumption on standard cognitive tests. The longer-term effects of breakfast omission have been examined in studies that were conducted over school terms and examined cognition as well as attendance and tardiness (Papamandjaris ,2000*).*

In well nourished American children, breakfast consumption resulted in improved but not consistently significant performance in arithmetic, continuos performance tasks, and problem solving, yet worse outcomes in short-term memory *(Conners & Blouin, 1982).*

Lower energy consumption at breakfast resulted in poorer performance in creativity testing and voluntary endurance, and energy was negatively correlated with errors in number checking *(Wyon et al., 1997).*

The timing of breakfast consumption may affect a childs capacity to perform during testing throughout the morning, with consumption closer to testing time yielding better results *(Vaisman et al., 1996).*

Longer-term studies are important in that they examine the effect of repeated episodes of breakfast omission on cognition and school performance and as such they more directly represent the classroom experience (Papamandjaris ,2000*).*

The differential effects of breakfast omission on adequately nourished versus malnourished children. In three studies, the cognitive performance of under-nourished and wasted children was negatively affected by the omission of breakfast, whereas the performance of the well nourished controls was not affected *(Grantham-McGregor et al., 1998).*

School Breakfast Program

The introduction of the SBP (School Breakfast Program) positively impacted the academic performance of low-income school children *(Meyers et al., 1989).*

Conversion of the targeted SBP available to needy children to a universal SBP available to all children resulted in an increase in composite math and reading percentile scores over a three year period *(Minnesota Department of Children, Families, and Learning 1998)*

In Jamaica, students who received a full breakfast over a school year had improved attendance

and nutritional status compared to those who received a placebo *(Powell et al., 1998).*

Students who received breakfast showed improvements in arithmetic and higher attendance rates; the gains in arithmetic were independent of attendance *(Simeon, 1998).*

Students receiving breakfast over a one month period demonstrated improvements in attendance and vocabulary *(Pollitt et al., 1996).*

In inner-city schools with a predominantly African-American population, children who participated in the SBP had lower levels of hyperactivity as well as improvements in depression and anxiety *(Murphy et al., 1998).*

Parents and teachers of students in a universal breakfast program in elementary schools reported improved student performance and behaviour following introduction of the program *(Minnesota Department of Children, Families, and Learning, 1998).*

In an evaluation of the School Food Nutrition Program of Toronto, 45% of teachers reported a change in student behaviour, including calmer, more focused students with more energy *(Brown, 1993).*

Studies have shown positive effects of breakfast in well nourished and malnourished students on classroom performance and behaviours, both over the short- and long-term. Indeed, researchers in the field, point to a link between breakfast and cognition which cannot be ignored *(Kanarek, 1997).*

Reduced energy intake negatively affected creative thinking and voluntary physical endurance. Additionally, children who ate more of the nutritionally inadequate breakfast made fewer addition mistakes *(Wayon et al., 1997).*

The brain is sensitive to drops in short-term availability of nutrients and that omission of breakfast may affect brain functioning, particularly working memory. This effect may be most pronounced in nutritionally at-risk children *(Pollitt et al., 1996).*

Under-nourished children performed significantly better following consumption of breakfast. Changes in classroom behaviour depended on the school. Better organized schools saw improved attention with breakfast whereas in poorly organized schools the behaviour deteriorated. Omission of breakfast has a greater detrimental effect in undernourished as compared to adequately nourished children *(Grantham et al., 1998).*

The National Institute of Nutrition states that school-based feeding programs aim to alleviate a child's hunger and as such can improve a child's scholastic performance while at the same time contributing to the nutritional status of the child *(National Institute of Nutrition, 1993).*

For parents and educators, a stated goal of alleviation of hunger is often synonymous with the goal of improved cognition and performance, whether or not the concept is explicitly outlined *(Brown, 1993).*

Depending on their make-up, breakfast programs may provide an opportunity for socialization and exploration of cultural diversity as well as nutrition education. Programs that incorporate such holistic goals are most likely positively affecting the well-being of the students and volunteers (Papamandjaris ,2000*).*

With respect to scholastic performance, much of the evidence is qualitative. In Toronto, 45% of school staff reported a change in student behaviour as a result of the program, including calmer, more focused students with greater energy *(Brown, 1993).* Similar reports of better behaviour are reported from studies in Ottawa, where teachers also report improved academic performance *(Ryan, 1996).*

Children who miss breakfast may suffer from very mild malnutrition that may still be chronic yet present real clinical symptoms that are normally associated with malnutrition *(Wachs, 1995).*

This level of malnutrition is hypothesized to result in changes in metabolism and reduce the child s interaction with the environment, thereby affecting cognition *(Wachs, 1995).*

Picky eating or eating disorders

Both for the boys and for the girls the top foods in order of priority were chips and/or crisps, white bread, confectionery, meat, biscuits, cakes, buns and soft drinks *(Doyle et al., 1994).*

The diets on which the school children existed seem to be so low in essential nutrients, vitamins and minerals that it may not be inappropriate to suggest that most of these children were also suffering from a sub-clinical malnutrition, which in turn has been directly linked with behavioural disorders and scholastic failures, as well as with antisocial and criminal behaviour *(Bryce-Smith, 1994).*

Food additives:

A food additive is any substance not commonly regarded or used as food, which is added to, or used in

or on, food at any stage to affect its keeping quality, texture, consistency, taste, color, alkalinity or acidity, or to serve any other technological function in relation to food, and includes processing aids in so far as they are added to or used in or on food *(The Food Labelling Regulations, 1980).*

The growth in the use of food additives has increased enormously in the past 30 years, totalling now over 200,000 tonnes per year.(Tuula E. Tuormaa, 1994)

With the great increase in the use of food additives, there also has emerged considerable scientific data linking food additive intolerance with various physical and mental disorders, particularly with childhood hyperactivity *(Smith, 1991).*

A recent study examined the nutritional status of 65 inner city school children. The results showed that 63% of the children obtained more than 35% of their calorie intake from foods as fat and 88% of the children consumed more than 11% of their calories from added sucrose. A third of the children had nothing to eat for breakfast before going to school and the remainder consumed only confectionery and/or crisps. 40% of the girls and 34% of the boys ate no fresh fruit during the week they kept the diary .(Tuula E. Tuormaa, 1994)