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Canon: Animal Source Foods and Adolescent Nutrition

ANIMAL SOURCE FOODS AND ADOLESCENT NUTRITION

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Due to a variety of production, processing, or preservation limitations, or because of household economic, cultural or religious factors, many children, especially those in developing countries, do not consume an adequate amount of animal source foods (ASF). While little to no animal products are consumed in many developing countries, they are nonetheless essential to a healthy diet, especially for a growing child. The majority of low income households in developing countries base their diets on cereal grains or starchy tubers. These typical diets pose many threats to the nutritional health of children. Grains and starches lack many essential micronutrients, and the starchy foods often result in poor absorption of these essential micronutrients. Animal source foods, however, are particularly high in iron, zinc, vitamin B12, riboflavin, calcium, and vitamin A (Ruel, 2003). While meat and muscle products, specifically, offer high amounts of heme iron, zinc, riboflavin, vitamin B12, niacin, and vitamin B6, it has relatively low amounts of vitamin A and folate. Milk, on the other hand, is significantly high in vitamin A, calcium, phosphorous, vitamin B12, riboflavin, and folate, but is low in zinc and iron (Grillenberger et al., 2003). It is also recognized that ASF offers a complete set of the amino acids essential to the human diet, in addition to a high bioavailability of the aforementioned micronutrients (Harris and Neumann, 1999).

Various micronutrient deficiencies may result in devastating health problems, in both the areas of physical and cognitive growth. Health problems can develop into immediate ailments such as anemia, night blindness, and diminished work capacity, or result in more long-term effects like rickets, permanent blindness, neuromuscular deficits, psychiatric disorders, and ultimately death (Black, 2003).

Iron deficiencies are widespread in all parts of the world, but extensively in developing countries. According to Harris and Neuman's 1999 study, in developing countries, it is estimated that 26% of men, 42% of women, 46% of school age children, and 56% of children less than four years of age suffer from iron deficiency anemia.

Iron deficiencies affect an individual's overall health in many different ways. Because a lack of iron reduces the blood's oxygen carrying capacity, symptoms of iron deficiencies include tiredness or fatigue and general weakness. This can directly affect the work performance of an adult or adolescent, and can indirectly affect tests scores or other cognitive measurements (Scrimshaw, 1996). In a NHANES III survey in the United States, 5,398 children, ranging from six to sixteen years were given mathematics tests. The results of an iron deficient group were compared with the results of a normal group; the iron deficient group's scores were significantly lower than those of the normal group (Black, 2003).

Iron deficiencies also have an effect on growth and immunity. A low amount of iron increases morbidity from mild infections, particularly because it interferes with the human body's ability to regulate temperature. Finally, iron deficiencies pose an increased risk to maternal mortality, premature births, and pre and peri-natal loss (Scrimshaw, 1996).

Iron is by no means the only, nor the most important micronutrient that most children in developing countries lack. Vitamin B12 deficiencies are often due to malabsorption as a result from intestinal parasites, but it is additionally rarely included in the diet, as animal source foods are likely left out of a child's feeding program. A shortage of vitamin B12 has extremely harmful effects on the hematological, immune, and nervous systems. It may also present irreparable effects to a pregnant mother or her developing fetus (Harris and Neumann, 1999). A study in the Netherlands identified delayed motor and language development due to a scarcity of vitamin B12 in the diet. In Guatemala, cognitive defects were evidenced by slow reaction times on tests of perception, memory, and reasoning, as well as decreased academic performance, poorer teacher ratings, and a higher rate of delinquent behavior (Black, 2003).

Another common micronutrient deficiency found particularly in those whose diets lack ASF is a zinc deficiency. Zinc deficiencies are especially harmful to young women of reproductive age as well as developing fetuses and young children. A lack of zinc in the body interferes with gene expression, cell division and differentiation, and DNA and RNA synthesis. Additionally, a diet high in fiber tends to lower zinc absorption (Harris and Neumann, 1999).

As important as the aforementioned micronutrients are to the human diet, ASF consumption varies widely throughout the world. Several generalized factors, however, play an important role in determining who consumes what in most societies. First of all, it is important to note that food classifications vary between geographical regions and cultural communities. Residents of a certain area may group hot and cold foods, light and heavy meals, non-nutritious and healthy snacks, or pure and impure rations differently. These classifications may in turn affect the appropriateness of a certain food to be consumed (Gittelsohn and Vastine, 2003).

Another important factor to be considered within a community is food prohibitions. For various reasons, certain foods or food types may be forbidden. A permanent prohibition, the most widespread type of prohibition, is often due to religious beliefs. The most common permanent prohibitions are for beef and pork consumption. A permanent prohibition is generally non-negotiable; those within a society who go against such prohibitions may be ostracized by the entire community, group, or even religion. The second type of food proscriptions, transitory prohibitions, revolves around certain phases of, in most cases, an individual. At times of illness, pregnancy, lactation, menstruation, etc., individuals may be barred from consuming certain foods or food groups, as defined by the local culture. While there are two types of food prohibitions, animal source foods are the most common foods to be banned (Gittelsohn and Vastine, 2003).

Deeper than the community's cultural beliefs, individual household patterns are also important in determining ASF consumption. Household food allocations often favor males over females or adults over children. While most staple foods are usually divided evenly, it is the luxury foods, commonly ASF, that are allocated according to status. Additionally, this practice may be used to reinforce individual rank within a household (Gittelsohn and Vastine, 2003).

Child care practices within a household also affect the amount of ASF a child

Canon: Animal Source Foods and Adolescent Nutrition consumes. The feeding styles and the involvement of the caregiver play the most important role in determining a child's food intake, but knowledge and application of hygiene and sanitation, as well as the quality and amount of supervision a child receives, play a substantially important part in the child's diet. An active feeding program from an involved caregiver generally results in higher quality diets for children (Gittelsohn and Vastine, 2003).

Although generally known but all too important to omit, economic factors are usually the main reason given for lack of diversity or ASF in a diet. The income of a household normally is the key dynamic for access to ASF (Gittelsohn and Vastine, 2003).

The purpose of this paper is to review literature on the epidemiologic relationship between the lack of animal source foods and child malnutrition (or the protective exposure of animal source foods).

REVIEW OF STUDIES

COMBINED REVIEW FOR FIVE ARTICLES:

School Snacks Containing Animal Source Foods Improve Dietary Quality for Children in rural Kenya; Animal Source Foods Improve Dietary Quality, Micronutrient Status, Growth and Cognitive Function in Kenyan School Children: Background, Study Design and Baseline Findings; Kenyan School Children Have Multiple Micronutrient Deficiencies, but Increased Plasma Vitamin B-12 Is the Only Detectable Micronutrient Response to Meat or Milk Supplementation; The Impact of Dietary Intervention on the Cognitive Development of Kenyan School Children; Food Supplements Have a Positive Impact on Weight Gain and the Addition of Animal Source Foods Increases Lean Body Mass of Kenyan Schoolchildren

STUDY TYPE: INTERVENTION STUDY

This study conducted in Kenya was a controlled feeding trial. To form four feeding trials, twelve rural schools were randomized into four groups. The four groups were fed either 1) plant based local Githeri (control), 2) Githeri with oil for energy, 3) Githeri with milk, or 4) Githeri with meat. After baseline data was collected, the feeding trial lasted from 1998 to 2001.

Sample Size: Two cohorts, n=554 and n=550

CONTROLLING FOR CONFOUNDING VARIABLES AND BIASES:

In selecting participants, children with mental retardation, chronic handicaps, those that switched schools during the study, and those with prolonged absences were excluded from the results, but were fed with their classmates.

The authors recognize that it was impossible, during this particular study, to control the feeding program at home for each child. They also acknowledge that food in the home may have been redirected, even though parents were told to continue the normal routine.

Concerning the actual energy requirement, the authors state that even though children were receiving the recommended caloric intake prior to the trial, it may not have accurately reflected the true required calories because of variables such as malaria and other infections, as well as 'catch-up' growth. The authors also realize that activity

levels were also not accounted for in determining caloric requirements.

Additionally, the authors state that a diet similar to the trial snack, if carried out throughout the day, may increase or decrease the bioavailability of other minerals, depending on the snack content.

This study was, for the most part, very well designed and carried out. First of all, the study employed over 100 previously trained and experienced local field analysts. Secondly, most of the methods for this study had previously been used in this locale in the 1980's, making it less of a burden for researchers and participants. Finally, the local residents were very cooperative and had a good relationship with the analysts and research team.

There are other variables that perhaps should have been addressed. For example, each home feeding program could have varied greatly. While the authors acknowledged that parents may have reallocated food, they did not address the normal diet variations that each home may have had. Children were chosen from schools in rural districts, where the primary occupation was farming. It is likely that the everyday diets were similar, but it was not addressed.

Additionally, the definition of meat was not included in the study. Chicken, pork, beef, and fish have different nutrient compositions.

Finally, eating habits were based on a twenty-four hour recall. The authors did not distinguish if this was a parent or caretaker recall, or a child recall. Of course this may involve recall bias, especially with children. Caretakers may also have fabricated information provided for the recall.

Experiences of a Community-Based Dietary Intervention to Enhance Micronutrient Adequacy of Diets Low in Animal Source Foods and High in Phytate: A Case Study in Rural Malawian Children

STUDY TYPE: INTERVENTION TRIAL AND CASE STUDY

Households that had children in the appropriate age range in two intervention and two control villages were identified. Children were not selected based on a random sample. The control groups consisted of a maize-based diet, while the intervention groups were fed a diet consisting of more animal source foods. The point of this study was to increase the bioavailability and enhance the micronutrient content of primarily maize-based diets provided to children, ages 30 to 90 months, in southern Malawi.

Sample Size: Intervention n=200, Control n=81

CONTROLLING FOR CONFOUNDING VARIABLES AND BIASES:

This article did not directly address many confounding variables or biases. The authors did acknowledge the reasons why it was not possible to conduct a randomized trial. Based on the experimental design, they only used willing participants. They also mentioned that other infections, such as malaria, may contribute to the findings.

Although the information is valuable, there is a lack of variables and biases that were addressed. There could be many that were important in this study. For example, because this is a participant based study, many children that were at the highest risk for malnutrition (those that could have benefited most from the study), may not have

Canon: Animal Source Foods and Adolescent Nutrition
been involved for a variety of reasons. Perhaps they were too weak or sick to attend the feedings, the caretakers were embarrassed, or the caretakers were not available to take children to the feeding.

Saliva Composition in Indian Children with Chronic Protein-Energy Malnutrition

STUDY TYPE: CASE-CONTROL

Children from low socio-economic, low education rural areas in India were selected for a case-control study. Saliva was collected from the children, ages eight to twelve, and analyzed to assess the effects of protein-energy malnutrition on saliva contents. The authors found that children with moderate to severe protein-energy malnutrition had significantly reduced secretion rate, buffering capacity, and lower protein and calcium secretions in their stimulated saliva. These children also had impaired immunologic and agglutinating defense factors in unstimulated saliva.

Sample Size: Case n=34, Control n=34

CONTROLLING FOR CONFOUNDING VARIABLES AND BIASES:

Because of perceived benefits to caretaker's and their families, there may have been an increased level of participation. Due to this, children were only selected for the study if they had a known birth date. This reduced age variables if children outside of the study's age limits were to participate.

In selecting the participants, the authors state that they selected the "consecutive" participants that were within the right age category. This is a source of selection bias that was not addressed in the study. Additionally, while the study focused on protein-energy malnutrition, there was little said about the diet or nutrient source for subjects. Protein-energy malnutrition was simply classified as being under the normal height for age, in addition to the normal weight for age categories.

SUMMARY AND CONCLUSIONS

As evidenced by these epidemiologic studies, as well as many other observational studies and literature reviews, including animal source foods in children's diets is a protective exposure against malnutrition. Millions of children in developing countries suffer from malnourishment. Animal source foods are a critical component to the diets of growing children and could prevent countless health problems due to malnourishment. They provide numerous micronutrients that plants lack, are easily digestible, and carry a complete set of the essential amino acids. In many developing countries, however, children do not have access to such foods for a variety of reasons. Financial constraints, caregiver knowledge, location, and storage techniques are just a few of the reasons given for a lack of animal source foods in the diet.

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