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Contribution of Calories and Fats to Nutritional Outcomes

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Overview and Methodology

This memo addresses the question of caloric and fat/lipid deficiencies and their contribution to nutritional outcomes. Where possible, it provides evidence for the role of food in nutrition measures. The following questions are key for both calories and fats:

- Are calories and/or fats deficient in the diets of the poor (particularly in target regions of SSA and SEA)? What is the evidence for this deficiency?
- Is there any evidence that deficiencies in calories or fats impact nutrition measures?

Furthermore, key studies and pieces of literature are identified that may be helpful in understanding the responses to above questions.

Methodologies include Google Scholar, University of Washington Library, and PubMed searches. Search terms include: caloric/e deficiency, caloric/e intake, diet deficiency, nutrition measures, calorie impact on nutrition measures, fats/lipid deficiency, undernourished, malnourished, in combination with Sub-Saharan Africa (SSA) and nutrition. Despite the fairly extensive search, a limited number of articles were found that discuss either calorie/fats/lipid deficiencies or their impact on measures of nutrition. A majority of the literature on protein calorie malnutrition was written in the 1960s and 70s. A total of 23 articles and studies were reviewed. Below is a summary of the relevant points.

Calories: Contribution to Nutritional Outcomes

<u>Calorie deficiency in the diets of the poor</u>

Numerous random design studies have found that calorie deficiency reduces work capacity. Furthermore, observational studies have found that quality of diet and energy intake may be linked to increased income.[1] One study in particular, on school children in Guatemala, showed the positive impact of increased calorie intake on productivity. Children performed better in school, were healthier, and had a greater work capacity in adulthood than the control group.[2]

Van Wesenbeeck, Keyzer, and Nubé (2009) determined that in SSA, approximately 17.3% of the population suffers from undernutrition,[3] which they calculated from the anthropometric data for women and children available through the Demographic and Health Surveys.[4] They also estimated the average daily per capita calorie intake to be 2098 Kcal.[5] According to international standards this estimate should allow for a healthy lifestyle on average, but the geographical spread, both within SSA and within individual countries, of the prevalence of undernourishment and calorie intake is considerable.[6]

Honfoga and van den Boom's (2003) study of food consumption patterns in Central West Africa between the years 1961-2000 found that while calorie and protein availability has increased during that time period, intake levels are still below recommended amounts. The study also found that calorie and protein intake is still mainly from cereals. This raises policy questions about food security and import dependency,[7] which is a result of the yield growth lagging behind the population growth.[8]

Bridge et al (2006) conducted a study in Uganda in which they compared nutritional status and food consumption of children between the ages of 12 and 72 months and found that the children between the ages of 12-35 months suffered from a daily deficit in calorie intake. However, the deficiency was in carbohydrate intake, as they did appear to consume the recommended amount of protein, fats, iron, and vitamin A.[9]

Calorie impact on nutrition measures

Commonly used nutrition measures include underweight, stunting and wasting. Many researchers use anthropometric measures such as height or weigh-for-height (z-scores), because nutrient intake is so difficult to measure. Nevertheless anthropometric data is scarce and different measurements are used for adults and children.[10] The relationship between height and undernutrition is also contested. According to Thomas and Frankenberg (2002), height is a key determinant of economic success.[11] However, another study shows that calorie intake during childhood is not significantly related to adult population height.[12] Yet another study shows that, since the 18th century caloric intake in Europe has increased by more than a third and adult height by 10 cm or more, suggesting a positive relationship between the two.[13]

Bhutta et al (2008) conducted a study of six programs in Latin America that showed micronutrient fortified food supplements, combined with conditional cash payments and nutritional education, resulted in a 10% reduction in stunting in children ages 12-36 months.[14] Some of the literature has suggested that while volume of breast milk may not be affected by malnutrition, the nutrient content is. A study done in Zambia by Hautvast et al (1999) showed that mothers of stunted children had more frequent energy deficiency than mothers of non-stunted children.[15]

Bridge et al's (2006) study in Uganda on children ages 12-72 months found that stunting was most severe in children ages 12-35 months, most likely due to chronic insufficient calorie intake. The authors suspect this to be due to the weaning process, low energy diets, and frequent disease episodes.[16]

Observational studies have found that nutrition measures, such as height and body mass index (BMI) may also be linked to economic success, although it is difficult to determine causal pathways.[17]

Fats and Lipids: Contribution to Nutritional Outcomes

Fat and lipid deficiency in the diets of the poor

Most of the discussion in the literature of fat intake and nutrition has to do with obesity and overweight. Dangour and Uauy (2007) discuss the lack of a particular omega-3 fatty acid, DHA (Docosahexaenoic acid) as possibly linked to a deficit in cognitive function in aging adults, but as evidence for this is just beginning to emerge, there is not yet significant information.[18]

Another study, by Popkins et al (2001) on the dietary transition in India found undernutrition is being reduced as incomes increase. Over the last half century, fat intake for all income groups has risen and energy intake has risen for the poor.[19]

A longitudinal study conducted in 2000 and 2003 by MacKeown, Pedro, and Norris (2007) in Johannesburg, South Africa on children at the age of 10, with follow-up at the age of 13, showed that while these children showed low intake of fat (±30%), there was an increase in the percentage of energy from fat between 2000 and 2003.[20]

A study on both rural and urban subjects in Tanzania by Mazengo et al (1997), found that fat intake was extremely low for all groups and rural subjects consumed very little saturated fatty acids.[21] On average, fat intake was only 12.5% of energy intake (compared to 35% in industrialized countries). This is important because as the proportion of calories derived from fat decreases, so does the energy density of food consumed.[22]

A review article by Smit, Muskiet, and Boersma (2004) found that essential fatty acid (EFA) deficiency is often prevalent in protein energy malnutrition (PEM). However, they conclude that there is insufficient evidence to make a recommendation on appropriate EFA intake for malnourished children and they highlight the need for more research on the relationship between EFA deficiency and PEM.[23]

Fat and lipid impact on nutrition measures

Dangour and Uauy (2007) raise two nutritional concerns in the 21st century related to fat impact: the first is changing patterns of food consumption and the second relates to the need for quality over quantity. The former is concerned with the amount of fatty foods consumed in times of over abundance by sedentary societies. The latter refers to the need for more nutritious food in the developing world, as opposed to the more common increase in cereal production.[24]

Recommended literature

Bhutta et al (2008): Discusses interventions to improve nutrient intake for maternal and child undernutrition. There are also several other pieces of literature on maternal and child malnutrition and proposed interventions, which may abate the problem of undernourishment.[25]

Dangour, A. D., & Uauy, R. (2008): This piece raises nutrition challenges in the 21st century, several of which discuss overconsumption of food and the quality of food.

Kishore, G. M., & Shewmaker, C. (1999): This article discusses the creation of two new types of grain: one that increases the calorie density and the second that increases the nutrient density. They argue that these types of improvements will be instrumental in meeting food demands of the growing population.[26]

Petrou, S., & Kupek, E. (2010): This article provides an updated discussion of the relationship between undernutrition and poverty.

Strauss, J., & Thomas, D. (1995): See Part 2 for an interesting discussion on the nutrition-income relationship.

Subramanian, S., & Deaton, A. (1996): A study done in India on the elasticity of calories.

Thomas, D., & Frankenberg, E. (2002): This article gives a brief overview of the links between nutrient intake, nutrition measures, and productivity.

van Wesenbeeck, C., Keyzer, M. A., & Nubé, M. (2009): This paper estimates the number of people in Sub-Saharan Africa suffering from undernutrition and the mean calorie intake on a sub-national level.

Please direct comments or questions about this research to Leigh Anderson, at eparx@u.washington.edu.

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[1] Thomas & Frankenberg, 2002, p 106
[2] Ibid, p 108
[3] van Wesenbeeck, Keyzer, & Nubé, 2009, p 7
[4] Ibid, p 2
[5] Ibid, p 7
[6] Ibid, p 8
[7] Honfoga & van den Boom, 2003, p 180
[8] Ibid, p 167
[9] Bridge et al, 2006, p 622
[10] van Wesenbeeck, C., Keyzer, M. A., & Nubé, M., 2009, p 17
[11] Thomas & Frankenberg, 2002, p 108
[12] Akachi, 2007, p 405
[13] Cutler et al, 2006, p 101
[14] Bhutta et al, 2008, p 429-430
[15] Hautvast et al, 1999, p 57
[16] Bridge et al, 2006, p 624
[17] Thomas & Frankenberg, 2002, p 106
[18] Dangour & Uauy, 2007, p S4-S5
[19] Popkins et al, 2001, p 380
[20] MacKeown et al, 2007, p 641
[21] Mazengo et al, 1997, p 317
[22] Ibid, p 323
[23] Smit et al, 2004, p 247
[24] Dangour & Uauy, 2007, p S3
[25] Bhutta et al, 2008; Black et al, 2008; Bryce et al, 2008; Matilsky et al, 2009; Victora et al, 2008
[26] Kishore & Shewmaker, 1999, p 5970