

Addressing Knowledge Gaps in Adolescent Nutrition: Toward Advancing Public Health and Sustainable Development

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ABSTRACT

Adolescence marks a critical period of growth in the life course. Malnutrition among adolescents includes suboptimal dietary intake of macronutrients and micronutrients as well as overweight and obesity linked to poor dietary quality. We discuss adolescent nutrition and outline 3 knowledge gaps toward advancing adolescent health. First, micronutrient and macronutrient supplements have significant potential to improve nutritional status, but information on the most effective implementation strategies is lacking. Second, food system interventions offer a promising avenue to improve access to healthy foods, and school settings may be an important entry point for improving diets. Third, nutrition programs should be combined with delayed pregnancy interventions for greatest impact given the adverse effects of early pregnancy on maternal and infant health and nutrition outcomes. Evidence-based solutions for adolescent nutritional supplementation, food system and dietary intake interventions, and integration with sexual and reproductive health strategies present crucial opportunities for improving adolescent health and well-being. *Curr Dev Nutr* 2019;3:nzz062.

Adolescence—a time of profound changes in physical, cognitive, and social development—marks a critical period of growth in the life course. Adolescent health is affected by childhood well-being and establishes a trajectory for maternal and adult health status. Health behaviors adopted in adolescence have implications that can persist throughout the life course, such as noncommunicable diseases resulting from poor diet and limited physical activity. The burden of disease for adolescents is greatest in the African region, where 45% of the world's 1.2 million adolescent deaths occurred in 2015 (1). Young people 10–19 y of age face health challenges ranging from infectious disease to mental health and injuries. Key among the health challenges for adolescents is malnutrition. Here we discuss adolescent nutrition and outline 3 knowledge gaps that need to be addressed to advance adolescent health.

Adolescent malnutrition includes suboptimal dietary intake of macronutrients and micronutrients. Improving and correcting nutritional deficiencies persisting from childhood may promote catch-up growth during the critical period of adolescence (2). Given increased linear growth during puberty, the period of adolescence may provide a second window of opportunity to address stunted growth resulting from undernutrition and micronutrient deficiencies in childhood. Iron deficiency is the most common micronutrient deficiency among adolescents, contributing the greatest burden of disease in terms of disability-adjusted life years (DALYs) (3). Iron-deficiency anemia is the largest cause of DALYs lost globally among females aged 10–19 y and males aged 10–14 y (1). Improving dietary quality among adolescents will help to reduce anemia and micronutrient deficiencies and improve physical and cognitive growth. In addition, there is evidence that improved nutritional status may increase the school attendance and educational performance of adolescents (4).

At the same time, overweight and obesity are linked to poor dietary quality and affect one-third of adolescents globally (3). In addition to dietary interventions, promoting physical activity



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is an important approach to preventing overweight and obesity. In Africa, overweight and obesity disproportionately affect girls (5). Inadequate fruit and vegetable intake, as well as intake of high-fat and calorie-dense foods, contribute to the burden of overweight, especially among younger adolescent girls (6). Fifteen percent of adolescents in Africa are overweight or obese and at increased risk for diabetes and other related noncommunicable diseases later in life (3).

Malnutrition among adolescents also has important consequences for maternal and newborn health. Complications from pregnancy and childbirth are the leading cause of death for adolescent girls aged 15–19 y (1). Improved nutrition during pregnancy is associated with optimal birth outcomes and maternal health status (7). Correcting nutritional deficiencies and improving diets for adolescents allows them to enter pregnancy in a healthier state, leading to improved maternal health and birth outcomes (8). Identifying the most effective strategies for improving dietary quality and nutritional status are priorities for adolescent health.

There are several knowledge gaps in adolescent nutrition that offer promising avenues for improving health and development in this age group. First, both micronutrient and macronutrient supplements targeted at adolescents have significant potential to improve nutritional status. Iron and folic acid supplements have been given to address micronutrient deficiencies and anemia among pregnant women (9, 10). Although iron is recommended in pregnancy to prevent and reduce anemia, folic acid needs to be given by the first month of pregnancy—before most women present to a clinic—to have the intended benefit of preventing neural tube defects (11). The WHO therefore recommends weekly iron and folic acid supplementation for all menstruating adolescent girls and women where the prevalence of anemia among women of reproductive age is >20%, and daily iron supplementation where the prevalence is >40% (12, 13). Future research should focus on implementation strategies for these guidelines to examine the acceptability and effectiveness of supplementation dose, delivery, and duration. In addition, macronutrient protein and calorie-dense supplements among pregnant women to address a high prevalence of undernutrition have been associated with improvements in birth outcomes (14). Macronutrient supplements may also have positive effects on catch-up growth during adolescence, although evidence in this area is lacking (2). Macronutrient interventions can help manage prevalent adolescent undernutrition, and although they could be provided to all adolescents to promote optimal nutrition during a critical window of growth, it is imperative to consider adverse consequences for adolescents who are overweight or obese.

Second, food system interventions offer a promising avenue to improve the availability and access of healthy foods for adolescents. One-third of adolescents globally are food insecure, with higher prevalence in the African region (15, 16). Globally, poor dietary quality is the leading risk factor for poor health (17). Adolescents have a higher energy requirement than other age groups (3). Average fruit and vegetable intake is below the WHO-recommended 400 g/d for adults in all regions of the world with the exception of East Asia; the average global intake of vegetables is ~200 g and has not shifted much over the past 2 decades (17). Low vegetable and fruit intake is an important risk factor for the global burden of disease (18). Increasing food security and improving dietary quality for 10–19 y olds may have positive implications for dietary habits into adulthood. There are

multiple opportunities to intervene in food systems and environments, such as increasing production of fruits and vegetables, reducing waste, strengthening food value chains, and introducing innovative market approaches (e.g., community-supported agriculture programs). More evidence is needed on how food environments shape the food preferences and food-related behaviors of adolescent populations and affect their food security and dietary quality (19).

School settings offer one possibility for improving adolescent food security and dietary quality. School garden programs can increase fruit and vegetable access and may be useful strategies to increase dietary diversity and awareness of healthy diets among adolescent students. School gardens have been effective at improving knowledge, but when introduced as a sole intervention have not been as successful at increasing dietary diversity among students (20). Coupling school gardens with nutrition education and linking programs to community- and household-level approaches may be more effective for increasing dietary diversity and nutritional status. In addition, offering nutritious meals at schools (including through use of produce from school gardens) may also help to improve school retention and enrollment. Working with food vendors both within and surrounding primary and secondary schools to restrict or incentivize access to certain foods may also help to reduce unhealthy food options and increase healthy alternatives (21). Approaches may include limitations on marketing and advertising of nutrient-poor and energy-dense products, elimination of sugar-sweetened beverages within and around schools, and increased access to nutritious school meals and healthy snacks (19).

Third, nutrition programs should be integrated with sexual and reproductive health interventions aimed at delaying pregnancies. Globally, the adolescent fertility rate is 43.9 per 1000 women aged 15–19 y (22). Every year, ~23 million adolescent girls in developing countries become pregnant (23). Almost 20% of women in developing countries have a live birth by the age of 18. This increases to 25–28% in sub-Saharan Africa, and up to 40% in Bangladesh (24). Young mothers have higher nutritional requirements associated with fetal needs at a time when the mothers themselves are growing, resulting in intergenerational nutritional deficits (25). Delayed pregnancy offers a complementary strategy for improving adolescent nutrition and health. Delaying marriage and pregnancy improves maternal health and birth outcomes (26), and could also help improve retention in school and educational attainment. Potential interventions should combine empowerment approaches that help adolescents advocate for their well-being by increasing awareness and knowledge among both males and females, with community- and school-based approaches. Effective strategies include policies that prohibit child marriage and improve sexual and reproductive health education and services, and programs to retain girls in school (21, 27).

Closing these knowledge gaps will require sustained effort from multiple sectors including health, agriculture, and education, as well as engagement of adolescents, their parents, and communities. Importantly, adolescents should be included in the design of research programs in order to ensure youth-friendly interventions. Data collection platforms at national and subnational levels, including demographic and health surveys as well as health and demographic surveillance systems, will need to be enhanced to track nutrition and health indicators across the full age range of adolescence. Evidence-based solutions for adolescent nutrient supplements, food system and dietary quality interventions,

and integration with delayed pregnancy strategies present crucial opportunities for improving adolescent health and well-being. Greater investment in advancing adolescent nutrition is critical to promote their health and development now, and has lifelong implications for them and their future families.

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