

Evaluation of school-based obesity prevention model

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Abstract. Obesity is a prevalent disease found among adolescents in the United States. The rising incidence in recent years has raised concerns among the public, for obesity is known as the risk factor for several chronic and severe diseases. Programs aimed at treating and preventing childhood obesity are therefore in high demand. Since the enrollment of American youth—who are between 5 and 17 years old—in schools is higher than in any other institution in the United States, schools can implant effective obesity-targeted programs by providing cheap, convenient, and accessible settings for treating and preventing obesity for the student population. This article will review and analyze the success of primary preventive initiatives implemented in schools by comparing the effectiveness of four out of eight components of an integrated comprehensive model for school-based prevention of obesity: physical education courses, food service and nutrition environment, school-site health promotion, and health service. At the end of this article, a future research plan will be introduced. A sample of 154 residential students from a local high school located in Fryeburg, Maine will be observed and surveyed to test the effectiveness of the school-based primary prevention model for obesity.

Keywords: obesity, school, prevention model.

1. Introduction

Adolescent obesity is a common problem in the United States. The incidence of adolescent obesity has almost tripled within the last 30 years [1]. According to the Youth Risk Behavior Surveillance System (YRBSS), among the 15,624 high school participants in the Youth Risk Behavior Survey in 2015, 14.8% were obese and 15.6% were overweight [2]. Childhood obesity is responsible for a series of health concerns, among which some can even exert long-term effects on the rest of a child's life. For example, adolescents with obesity are 5 times more prone to develop obesity in their adulthood [3]. Insulin resistance, which usually comes along with the presence of obesity, leads to type 2 diabetes in childhood—a significant societal health issue that lasts to adulthood [4]. Since it is proven to be hard to treat adult obesity, programs aimed at treating and preventing childhood obesity exhibit a higher success rate and therefore are in high demand. The refractory nature of obesity as well determines the high effectiveness of childhood obesity prevention [5].

Schools provide an alternate setting for childhood obesity prevention and treatment besides clinics and hospitals. Since the enrollment of American adolescents—who are aged 5-17 y—in schools is higher than in any other institution in the United States, schools can extensively contact the children during the first 20 years of their lives [5]. Such contact gives schools a great opportunity to offer students and their families accessible and convenient resources at low or no cost.

School-based treatments or preventative measures for obesity can be divided into primary or secondary interventions. Whereas primary intervention is a broader approach that provides obesity prevention to all children, secondary intervention provides obesity interventions only to children and adolescents with risk status such as being overweight. This article will review and evaluate the effectiveness of school-based primary prevention efforts by comparing the effectiveness of four out of eight components of the integrated comprehensive model for school-based obesity prevention. This model is invented by Allensworth DD and Kolbe LJ. and its eight components include physical education classes, health instruction (curriculum), school counseling, and psychology programs, school-site health promotion for faculty and staff, family and community linkages, nutrition environment of the school, school health services, and school food service [6]. The components to be studied in this article are physical education courses, food service and nutrition environment, school-site health promotion, and health service.

2. Physical education courses

Regular physical activities can lower the risk of getting hypertension, diabetes, and obesity [7]. According to Janssen and Leblanc's findings, physical activity is strongly related to health, especially in high-risk youth [8]. Moreover, Hu, Ramachandran, Bhattacharya, and Nunna's assessment of the relationship between obesity and modifiable risk factors reveals that the lack of physical activity is the most contributing risk factor to adolescent obesity since both "not being on a sports team" –a PAF of 16.57%– and "watching television for 3 hours or more per day"–a PAF of 7.13 %– displayed a significant correlation with obesity [9]. The Guidelines for School and Community Programs to Promote Lifelong Physical Activity Among Young People, recently published by the CDC, suggested comprehensive, daily physical education for children in grades K–12. [10]. Unfortunately, quality physical education– 50 percent of your daily activity should be moderate to vigorous [MVPA]–in schools is marginalized in practice [11]. Less than two-thirds of high school pupils take physical education classes. whereas merely 25% of them take PE classes daily [12].

Adolescents who are obese are likely to be unintentionally discouraged from engaging in regular physical activities [10]. Therefore, physical education in schools is essential in inducing motivation among the students, especially those who already present obesity, to frequently and regularly participate in physical exercise.

In 2014, Dr. Kahan and Dr. McKenzie estimated the energy expenditure (EE) from national recommendations and data collected from 19 states in the U.S. with PE duration guidelines, under 3 scenarios: potential (standard quality PE: MVPA=50%), reality (MVPA=35%), and classroom instruction only. In comparison to students who only got classroom training, they discovered that students in schools that adhere to the nationally prescribed PE standards from grades 1 through 10 could burn between 35,000 and 90,000 more calories [11]. The result indicates the importance to strengthen schools' enforcement of quality physical education in treating and preventing adolescent obesity since the consumption of calories is directly related to weight management.

The goal of physical education in schools is to help students develop a habit of regularly involve in physical activity. As it was inferred from a study, habitual physical activity can significantly contribute to longitudinal weight change and therefore long-term weight control. Participants who completed a 3-month education in a health-related fitness program and continued involve in recommended physical activity levels for a minimum of 2 years displayed a remarkable increase in their mean NAS (Nasa Activity Scale) and a notable reduction in follow-up weight values [13].

3. Food service and nutrition environment

Based on the documentation from the National School Nutrition Dietary Assessment Study in 1993, it was concluded that School lunches contained a lot of fat., which contributed to 38% of the calorie intake [12]. Though new legislation that required National School Lunch Program (NSLP) and National School Breakfast Program (NSBP) to meet the guidelines for fat and saturated fat was passed in 1994, it does not entirely apply to junior and senior high schools' food service. The students are still offered lunch

options that were rich in fat and sugar. Those options, for example, school stores, à la carte food in the cafeteria, and vending machines are still easily accessible, and branded fast foods have been more often served à la carte in the school cafeterias since they have been the best-selling items among students [14]. School stores and vending machines are especially common to provide unhealthy food options for students. A study performed in 1996 shows that healthy food choices, specifically those that contained lower fat, were often unavailable or less frequently seen [15]. Table 1 attached below summarized the findings.

Table 1. Comparison between the prevalence of healthy and unhealthy food choices in school stores and vending machines.

Healthy Option	Prevalence Among Schools	Unhealthy Option	Prevalence
Potato, Corn, or Taco chips	>50%	Pretzels	25%
Fruit	8%	Candy and Candy Bar	Almost 80%

A study led by Dr. Shanthy A. Bowman compared children who ate fast food and those who didn't on a typical day. Those who ate fast food consumed more total energy (by +187 kcal), more carbohydrates (by +24g), and more sugar-sweetened beverages (by +228g) but less fiber, milk, and other beneficial diets [16]. The study then concluded that without control, children in the U.S. will be increasingly exposed to the adverse effect of poor dietary quality in ways that possibly could increase their risks for obesity.

The nutrition environment of a school isn't strictly referring to the food service. It's a cohesive concept that as well incorporates classroom curricula, school stores, snack bars, vending machines, fundraisings, food-reward disciplines, in-school advertisements, and nutrition education materials [17]. However, the nutrition environment in schools nowadays is not even close to being organized. According to Wolfe and Campbell's findings, the nutrition environment in schools presents as fragmented, inconsistent even conflicted, and lacks planning [15].

A group of scientists has attempted an experiment that examined how the alteration of school food environments and practices affected the dietary behaviors of US Public School children [18]. The statistical analysis disclosed that efforts could be done by schools to positively impact the dietary habits of students. Table 2 attached below summarizes the findings.

Table 2. How specific dietary alterations in school settings can affect the dietary habits of middle school students and high school students.

Object to experiment on	Alterations	Effect on elementary students	P value	Effect on middle school students	P value	Effect on high school students	P value
Sugar-sweetened beverage consumption	Without stores or snack bars			Reduced consumption by 22 kcal	P<0.01	Reduced consumption by 28 kcal	P<0.01
Intake of beverages with sugar	Absence a pouring rights contract					Reduced consumption by 16 kcal	P<0.05

Table 2. (continued).

Intake of beverages with sugar	No à la carte offerings			Reduced consumption by 52 kcal	P<0,001
Intake of foods high in energy but low in nutrients	French fries are not offered in the school meal program.	Reduced consumption by 43 kcal	P<0.01	Reduced consumption by 41 kcal	P<0.001

4. School-site health promotion

Health promotion program benefits a variety of people in schools, not only students but also the teachers, staff, coaches, and food service workers [17]. The materials taught by the program include but are not limited to recommendations for healthy diets, regular physical activity, and techniques that help manage weight and prevent obesity.

Recent years have witnessed the development of worksite health promotion, which focuses majorly on the education of the value of teachers and staff members [17]. According to the 1992 USDA national survey, 78% of large worksites (those with more than 750 employees) and 22% of small worksites (less than 100 employees) provided nutrition education, among which ¼ of them offered weight control techniques [13]. By educating the teachers and staff, typically staff who are food service workers, the students can be indirectly benefited from the healthy environment established by the consistent efforts of the members of the schools, among which the school administration can play the greatest role in improving the school health policies.

On the other hand, health promotion for students is crucial in promoting physical activity – a factor that is later explained significantly correlates with obesity. As stated by a randomized controlled trial conducted in Iran, the experimental group that received Health Promotion Model-based Training (HPM Model) for two months was found a significant increase in physical activity rate ($p<0.05$) [19].

5. Health service

Though it was expected that school health services should include overweight screening, preventive counseling, weight management assessment, and treatment or referral, data collected by the School Health Policies and Programs Study (SHPPS) from a nationally representative sample revealed that many if not most schools lack the commitment to reaching such expectations [17]. According to SHPPS, only 27% of junior and senior high schools require height and weight screening whereas merely 47% of all states require follow-up if a potential problem is detected from the screening. More than half (54%) of them don't even offer height and weight screening programs while 63% of them provide no nutrition or weight management services [20].

School nurses take a critical role in coordinating the health services in schools and connecting students' families with health care providers. They are a major component in school-based clinics to provide prevention services for overweight students and just students in general. Nurses' support for conducting health services is just as important as the level of dedication from the school's administration. Fortunately, a study in 2005 found that a considerable number of nurses (76% of them, $p=0.009$), among those that participated in the study, endorsed efforts to prevent obesity in schools and expressed interest in providing primary and secondary preventive care in educational settings. Additionally, it was discovered that nurses who supported school-based height, weight, and BMI screening were more than three times as likely to support school health services for obesity prevention ($p=0.005$) and twice as likely to offer obesity prevention services ($p=0.021$) [21]. However, 21 licensed elementary school

nurses were interviewed for another study, and all expressed their frustrations that despite feeling well-positioned to offer services for obesity prevention, they were constrained by time restraints, staffing, and resources. [22].

School counselors are also placed strategically in the multi-disciplinary team of school-based health services. They are equipped to provide supportive counseling for students dealing with health and/or psychological concerns related to childhood obesity so that the student's academic performance, personal-social relations, and career development can be improved or least negatively impacted. They are also responsible for communicating with the student's parents, teachers, administrators, medical professionals, and other stakeholders in the journey of the students' obesity prevention. School counselors can practice within a framework provided by the ASCA National Model and appropriately approach students who need obesity prevention or treatment [23].

6. Conclusion

Schools play an important role in providing students with health resources that are affordable and accessible. School-based health program has the potential to improve students' health habits and prevent their health conditions from deteriorating, especially for those who struggle with obesity. Allensworth DD and Kolbe LJ's model for school-based obesity prevention lays a framework for schools to establish effective health programs. Four out of eight components of the model are evaluated for their respective impact on students, each is a critical contributor to the overall success of the model.

Engaging in physical activities regularly can lower the risk of getting a series of chronic and severe diseases – including obesity. Enforcing quality physical education – characterized as a minimum of 50% of moderate-to-vigorous physical activity (MVPA) – can increase students' calorie consumption and help students develop a habit of regularly involved in physical activity, which can significantly contribute to longitudinal weight change and long-term weight control.

Substituting or limiting unhealthy food choices in school cafeterias, school stores, and school vending machines can reduce carbohydrate and fat intake, helping to lower the risk of obesity. It can also positively impact the dietary habits of students, guiding them to pick healthy food choices over unhealthy ones.

School-site health promotion serves to educate students as well as teachers, staff, coaches, and food service workers through online resources, benefiting the community as a whole. A study has shown that school-site health promotion can positively impact the health habits of students by increasing their physical activities.

With sufficient commitments, schools can provide health services such as overweight screening, preventive counseling, weight management assessment, and treatment or referral. School nurses take important roles in coordinating and advancing those health services while school counselors are needed to provide supportive counseling for students dealing with health and/or psychological concerns related to obesity.

7. Future research plan

To test the effectiveness of the school-based primary prevention model for obesity, a sample of 154 residential students from Fryeburg Academy (a high school located in Fryeburg, Maine) will be observed and surveyed. Living in the dormitories, this sample of participants will be maximally exposed to the school's food service and health resources.

First, initial observations will be made to understand the general diet patterns of the participants. Participants who display consistently unique diet patterns will be identified and followed up. The unique diet patterns include but are not limited to balanced and healthy diets, diets majorly composed of fried and/or sugary food, diets majorly composed of fruits and vegetables, diets high in carbohydrates, and diets high in fats and proteins. Those participants will be handed a two-part survey questionnaire to complete. Minor participants will be given parental consent forms for approval. The questions in the first part of the survey include personal information such as weight and height (used to calculate BMI value), waist size measurement (help to access obesity-related health risks), age, ethnicity, smoking

habit, type of physical activity (athletic program vs. individual-oriented fitness plan), daily physical activity intensity (fairly, low, medium, intense), average sleep time and quality, level of sugar-craving, and level of tiredness. The questions in the second part of the survey are used to evaluate participants' access to health and food services in school. They include frequency of dining in the school cafeteria, likelihood to choose fried and/or sugary dishes, likelihood to choose healthy fat and protein sources over unhealthy ones, likelihood to complete a meal with dessert, frequency of adding fruit and vegetables to the diet, the proportion of fruit and vegetables in a meal, frequency of purchasing snacks in a school's vending machine or snack store (if so the type of chosen snack), if took or take physical education course(s), if took or take health and wellness course(s), and the frequency of reaching out to the school's counselors and Health and Wellness Center for health-related concerns. A brief explanation of each question will be stated. Each participant will be labeled with a corresponding number so that they can anonymously participate in this experiment and that confidentiality is guaranteed. The participants will then be grouped according to their answers, which will be scaled and quantified.

The same two-part survey questionnaire will be handed out to the same participants next year for comparison. Analysis and conclusion can then be drawn depending on whether the difference between data sets appears to be significant or not.

This experiment will identify and evaluate the level of correspondence between the existing model, which was made for public school day students, and a private school among residential students. Recommendations for model revision will be suggested. Participants will as well be able to access the general (non-individualized) results at the end of the experiment, along with a comprehensive recommendation/pamphlet of school-based and outside-of-school health resources that students can access for a variety of purposes.

References

- [1] Copeland KC, Chalmers LJ, Brown RD. Type 2 diabetes in children: oxymoron or medical metamorphosis. *Pediatr Ann.* 2005;34:686–697.
- [2] Kann L, McManus T, Harris WA, Shanklin SL, Flint KH, Hawkins J, et al. Youth Risk Behavior Surveillance — United States, 2015. *MMWR Surveill Summ* 2016;65(6):1–174.
- [3] O'Connor EA, Evans CV, Burda BU, Walsh ES, Eder M, Lozano P. Screening for obesity and intervention for weight management in children and adolescents: evidence report and systematic review for the US Preventive Services Task Force. *JAMA* 2017;317(23):2427–44.
- [4] Liu LL, Lawrence JM, Davis C, Liese AD, Pettitt DJ, Pihoker C, Dabelea D, Hamman R, Waitzfelder B, Kahn HS; SEARCH for Diabetes in Youth Study Group. Prevalence of overweight and obesity in youth with diabetes in USA: the SEARCH for Diabetes in Youth study. *Pediatr Diabetes.* 2010 Feb;11(1):4-11.
- [5] Institute of Medicine. Weighing the options. Criteria for evaluating weight-management programs. National Academic Press: Washington, 1998, pp 210- 233.
- [6] Allensworth DD, Kolbe LJ. The comprehensive school health program. Exploring an expanded concept. *J School Health* 1987; 57: 409 - 412.
- [7] Chaddha A., Jackson E.A., Richardson C.R., Franklin B.A. Technology to Help Promote Physical Activity. *Am. J. Cardiol.* 2017;119:149–152.
- [8] Janssen I., Leblanc A.G. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int. J. Behav. Nutr. Phys. Act.* 2010;7:40.
- [9] Hu EY, Ramachandran S, Bhattacharya K, Nunna S. Obesity Among High School Students in the United States: Risk Factors and Their Population Attributable Fraction. *Prev Chronic Dis.* 2018 Nov 8;15:E137.
- [10] United States, Department of Health and Human Sciences (USDHHS), Public Health Service. Guidelines for school and community programs to promote lifelong physical activity among young people. *MMWR* 1997; 46: 1 - 36.
- [11] Kahan D, McKenzie TL. The potential and reality of physical education in controlling overweight and obesity. *Am J Public Health.* 2015 Apr;105(4):653-9.

- [12] Burghardt J, Devaney B. The School Nutrition Dietary Assessment Study. Mathematica Policy Research: Princeton, 1993.
- [13] Wier, L., Ayers, G., Jackson, A. et al. Determining the amount of physical activity needed for long-term weight control. *Int J Obes* 25, 613–621 (2001).
- [14] National school lunch program and school breakfast program: nutrition objectives for school meals (7 CFR 210, 220). *Fed Regist* 1994; 59: 30218 - 30251.
- [15] Wolfe WS, Campbell CC. Nutritional health of school-aged children at Upstate New York: What are the problems and what can schools do? Cornell University: New York, 1991.
- [16] Bowman SA, Gortmaker SL, Ebbeling CB, Pereira MA, Ludwig DS. Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. *Pediatrics*. 2004 Jan;113(1 Pt 1):112-8.
- [17] Story, M. "School-Based Approaches for Preventing and Treating Obesity." *Nature News*, Nature Publishing Group, 26 Apr. 1999.
- [18] Briefel, Ronette R., et al. "School Food Environments and Practices Affect Dietary Behaviors of US Public School Children." *Journal of the American Dietetic Association*, Elsevier, 21 Jan. 2009.
- [19] Karimy M, Eshrati B. The effect of health promotion model-based training on promoting students' physical activity. *J Kermanshah Univ Med Sci*. 2012;16(3):e78795.
- [20] Small ML, Majer LS, Allensworth DD, Farquhar BK, Kann L, Pateman BC. School health services. *J School Health* 1995; 65: 319 - 326.
- [21] Kubik, M. Y., Story, M., & Davey, C. (2007). Obesity prevention in schools: Current role and future practice of school nurses. *Preventive Medicine*, 44(6), 504-507.
- [22] Morrison-Sandberg LF, Kubik MY, Johnson KE. Obesity prevention practices of elementary school nurses in Minnesota: findings from interviews with licensed school nurses. *J Sch Nurs*. 2011 Feb;27(1):13-21.
- [23] Larrier, Yvonne I., et al. "The Role of School Counselors in the Childhood Obesity Epidemic." *Journal of School Counseling* 9.3 (2011): n3.