Original Article

Impact of physical activity on the emerging crisis of obesity in Asia

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Obesity is associated with devastating health and fiscal consequences in countries where it is epidemic. It is beholden on us all to try to prevent obesity emerging in countries where its prevalence is starting to increase. There are many countries in Asia where this is so. Obesity prevention necessitates attention to both increasing physical activity and improving nutrition. In this paper we discuss a strategic approach for increasing physical activity. First, we need to better understand physical activity levels and the factors that impact it. Next, we need to design specific and targeted governmentally supported strategies to promote physical activity. Finally we need to critically and objectively evaluate these strategies and then promote those that are successful, and channel limited resources away from those that are not. These goals are achievable through collaborating and sharing technologies. We hope to prevent obesity from engulfing Asia.

Key words: Asia, energy expenditure, malnutrition, nutrition, obesity, physical activity.

Introduction

The World Health Organization (WHO) has declared obesity as a world epidemic.[1] In many developed countries a third, or even more of the population, are obese – using the definition of obesity as being a body mass index (BMI) of > 30 kg/m^2. In the United States, for example, more than half of the population is either overweight or obese and the problem is worsening.[2] Other countries such as the United Kingdom are not far behind.[3] Obesity carries with it an enormous health impact associated with the metabolic comorbidities, mechanical complications and cancer.[4,5] Metabolic comorbidities include diabetes, hypertension, hyperlipidemia and coronary artery disease. Mechanical complications include arthritis, sleep disorders, carpal tunnel syndrome, oedema and varicose veins. Obesity-related cancers include colon and breast cancer. Not only are there enormous health consequences for nations where obesity is commonplace, but there are also devastating financial consequences. It has been crudely estimated that obesity costs the United States more than 65 billion dollars per year. Not only are there enormous health and financial implications of obesity being epidemic but also once obesity is established in a population it has proven impossible to eradicate it or even significantly impact upon it. For the overwhelming majority (> 95%) of obese patients who seek help from their doctors, obesity is not cured.[6] Thus, it behoves us as a scientific and healthcare community to prevent obesity from taking hold in populations where it is relatively rare at present. Many Asian countries fall under this category. Of concern is that sparse objective data suggest that obesity is becoming more common and this is of even greater concern in populations particularly prone to diabetes such as Singapore. In these countries, one can perform crude modelling to predict that if obesity rates start to increase sharply, diabetes could soon impact more than a quarter of the population. Thus, in countries where obesity is starting to emerge and the prevalence to increase, it is time to act. In many Asian countries, now is that time.

What is the best approach for intervening in order to prevent obesity? No one, sadly, knows the answer to this question. However, based on nutritional principles and based on longitudinal data in countries where obesity is prevalent, there needs to be simultaneous action to improve nutritional quality and reverse sedentariness. Issues germane to improving nutritional quality are discussed elsewhere. In this paper, the issue of worsening sedentariness will be addressed.

Obesity and sedentariness

Is obesity associated with sedentariness? The answer appears to be, yes. The evidence that links low levels of physical activity with obesity genesis is indirect and primarily derived

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from population sources. Epidemiological studies have consistently shown a negative relationship between measures of physical activity (usually self-reports) and indices of obesity (usually, body mass index).[7] This relationship is present in most data sets obtained from the US population.[2] The relationship appears to be similar in men and women, and across all ages.[8–11] Further, there is evidence for a similar relationship in African-Americans[12] Hispanics[13] and Native Americans.[14] This inverse relationship between physical activity and BMI has been seen using both self-reports of amount of physical activity[2] and actual measurements made using doubly labelled water.[15–17]

Despite the lack of a definite prospective longitudinal study, there is evidence that low levels of physical activity may be contributing to the increasing incidence of obesity in the US population. In several cohort studies where indices of obesity over time were assessed without intervention, associations between low levels of physical activity and indices of obesity were found.[17–20] In these studies, baseline measures of physical activity were inversely related to BMI. In some, low levels of physical activity predicted high weight gain over the follow-up period and in some, decreases in physical activity over time were associated with greater weight gain.[18–20]

As physical activity declines in affluent and, in fact, in non-affluent populations, obesity increases. It is unclear whether declines in spontaneous physical activity, volitional exercise or both is/are to blame. Let us divide total physical activity into that activity performed *intentionally* during leisure time (leisure time physical activity; LTPA) or activity performed in daily living (lifestyle physical activity; LSPA), which is akin to non-exercise activity thermogenesis, NEAT.[21] Are there clear secular trends in LTPA and LSPA?

While there is ample data indicating that the vast majority of Americans get little or no LTPA, there is little evidence that this has changed dramatically over the past two decades.[22–25] Attractive sedentary activities such as television watching, video games and home-computer use compete now for LTPA. However, it is not possible with existing data to conclude that substantial decreases in LTPA have occurred simultaneously with the onset of the obesity epidemic. Thus, it is likely that declines in LSPA have contributed to the increased prevalence of obesity, but unfortunately it is difficult to quantify this contribution. While most obesity experts accept that technological advances have reduced the amount of LSPA required, this decline has not been documented to the extent to allow quantification of the changes.

In fact, it is only in recent years that attempts have begun to measure LSPA. All indications are that work-related physical activity has declined. However, the only prospective data available come from Finland, where a 225-kJ/day decline in work-related physical activity has occurred over 10 years.[26] Similarly, there is reason to believe that other forms of energy expended in activities of daily living have declined rapidly over the past two to three decades. One can, for example, estimate the energy savings due to proliferation of televisions and computers, remote control devices, microwave ovens and increased use of prepared foods. While each may reduce physical activity only slightly, together these energy savings accumulate and can have a significant impact upon total energy expenditure. Declines in energy expended for transportation has also likely declined in recent years. This can best be illustrated with data from the National Personal Transportation Survey.[26] In the US between 1990 and 1995, the number of annual walking trips had declined 12%, while the number of daily car trips had increased by nearly an identical amount.

Thus, there is good indirect evidence from countries where obesity is common that as obesity increases, so do markers of sedentariness. It seems likely that both cause and effect contribute to the epidemiological relationship of sedentariness and obesity (i.e., imposed sedentariness results in fat gain and obese persons become less active). Environment is a critical component for setting 'the tone of sedentariness' in a population. Industrialization, urbanization and improving income are each associated with markers of sedentariness that include car-use, clothes washing machines, seated work practices and even decreased leisure time physical activity. Furthermore, data from obesity intervention studies also point to the importance of physical activity as a key predictor of sustained weight loss and prevention of weight regain.[27,28] Thus, on balance, data strongly support the contention that a rigorous physical activity program is a key component for preventing obesity in a population.

Promotion of physical activity

How then does one successfully promote physical activity? If the answer to this question was known, this paper would be brief and our mandate for action immediate. Again, no one knows. A multitude of strategies has been employed to increase physical activity. Very few of these have been experimentally evaluated, however, and almost none of them using rigorous experimental standards. The data that there are, have been elegantly reviewed.[29] Overall, a number of messages emerge:

1. There is very little information on physical activity levels. Available data, albeit limited, are often crude and utilize techniques that have not been carefully validated. The Japanese National Nutrition Survey is an exception. These surveys plot trends in physical activity detected using pedometers over many years. They highlight the impact of industrialization and culture on sedentariness. Other data sets, for example from the United States, elegantly demonstrate the benefit of acquiring baseline physical activity data to allow the influence of variables such as season, economic changes, and industrialization to be evaluated. Data on baseline physical activity levels not only point to potential causal factors that promote sedentariness but also provide baseline data with which to evaluated the effectiveness of a given strategy.
2. The balance of studies suggests that targeted interventions are more likely to be successful than global, less specific interventions. 'Targeted' interventions can seek to impact specific populations or focused locations. Targeted populations might be those predisposed to

diabetes such as subpopulations in Singapore and India and the United States Native American tribes. Targeted locations, or 'microenvironments', might include sidewalks in industrial areas, inner-city playgrounds, and sign-posted walkways to promote a walking program. Successful targeting depends on in-depth knowledge of local populations and their environments.

3. Another apparent predictor of successful population-based physical activity interventions is strong governmental support. This does not necessitate governmental spending, but rather measures such a legislative support and access to pre-existing infrastructure. Another aspect of governmental support would be to facilitate the initiation and continuation of physical activity surveys.

In conclusion, with strong baseline physical activity determinations and targeted interventions supported by national leadership and infrastructure, it may be possible to impact physical activity and help prevent the enormous health burden and costs associated with epidemic obesity rates.

Devising approaches to promote physical activity

How then does one devise successful approaches to promoting physical activity to prevent the 'global obesity disaster'? There are three components: (i) characterize physical activity levels; (ii) devise targeted strategies; and (iii) evaluate strategies.

Characterizing physical activity levels

There are few, high-quality physical activity data sets gathered from populations, which is in large part because measuring physical activity is difficult and expensive. Furthermore, the data sets that do exist are difficult to compare between populations because of differences in methodology and study objectives. In fact, statutory health agencies such as the World Health Organization (WHO) and Food and Agricultural Organization of the United Nations (FAO/UN) have long bemoaned the lack of objective data on physical activity[30] although they readily identify the utility of such data for assessing energy needs in malnourished and obese populations.

Technologies have advanced and laboratories are prepared to collaborate to redress this lack of data. Physical activity investigators have agreed to collaborate (the Physical Activity Collaboration; PAC) and propose to devise a physical activity 'Tool Box'. The Tool Box will comprise a series of physical activity measurement devices/tools that have been validated using gold standard techniques that are commonplace in more specialist laboratories. Examples of these tools are shown in Table 1. The concept is that investigators working in countries where obesity is emerging and with specialist knowledge of local populations and environments could contact the PAC and obtain free validated, standardized tools for measuring physical activity (Measuring Activity Tools). The PAC investigators would provide comprehensive system of support that include:

- Study design and choice of controls
- Choice of activity measurement tools with predefine data on the sensitivity and specificity
- Aid with power calculations
- The measurement tools and/or materials with validation certificates
- Training and support to local investigators to ensure valid data acquisition
- Provision of quality control of data streams, assistance in data verification and facilitation of data analysis
- Data compilation
- Data dissemination (e.g.; web-based)

This approach would allow immediate and seamless data comparison between populations and thereby define for the first time physical activity levels at baseline. Such survey methodologies could readily be repeated to obtain longitudinal data.

Devise targeted strategies

It is important, as described above, to devise and employ culturally specific targeted strategies to promote physical activity. It seems wise that local healthcare professionals, public health scientists, nutritionists and governmental agencies devise such strategies that might range from a school-based physical activity campaign through promoting daily exercise in the workplace. Schemes might be of variable sophistication. For example, many communities, particularly those in rural areas, are unaware of even the concept of exercise providing health benefit. In such communities, clear educational messages might be the place to start. Other communities may require sophisticated interventions such as a multifaceted school-based program to promote physical activity.

Evaluation of strategies

Using tools similar to those noted above, it would be possible to objectively evaluate the impact of strategies to increase physical activity. It is critical to identify strategies not only that work, but also those that are less successful.

Table 1. Examples of tools in physical activity measurement tool box

- **Physical Activity Quantification Toolbox 1:** culturally defined, language sensitive questionnaires to assess physical activity and exercise paterns. Activity diary books.
- **Physical Activity Quantification Toolbox 2:** simple, mail-out electronic devices to log a correlate of physical activity.
- **Physical Activity Quantification Toolbox 3:** prepackaged aliquots of doubly labelled water, empty urine containers and mail-back instructions.
- **Physical Activity Quantification Toolbox 4:** Ready-to-go systems for precise determinations of physical activity.
- **New tool box development:** For example, GPS.

In this fashion, successful approaches can be promoted, modified and expanded and less successful approaches discouraged. It would be extremely powerful to use similar techniques globally, as defined above, because this will enable broad comparisons to be made of different approaches in different cultures.

Conclusion

In conclusion, obesity represents a global epidemic. It is necessary to intervene in populations where obesity is emerging to prevent the enormous health and fiscal cost associated with this disease. Measures need to be taken to both reverse sedentariness and improve nutritional quality. First, we need to better understand physical activity levels and the factors that impact it. Next, we need to design specific and targeted governmentally supported strategies to promote physical activity. Finally we need to critically and objectively evaluate these strategies and then promote those that are successful and channel limited resources away from those that are not. These goals are achievable through collaborating and sharing technologies. We hope to better understand physical activity, how to reverse sedentariness and thereby prevent obesity from engulfing Asia.

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