Is There a Lag Globally in Overweight Trends for Children Compared with Adults?

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Abstract

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Objective: To determine relative trends in prevalence for overweight for adults compared with children across high-income countries (Australia, United Kingdom, and United States), middle-income countries (Brazil and Russia), and low-income countries (China and Indonesia).

Research Methods and Procedures: Extant nationally representative survey data from 1971 to the present are used. Prevalence of overweight for adults ≥18.0 years of age and children 6.0 to 17.9 years of age were used. Absolute and relative annual rates of change in prevalence of overweight in children and adults were the key outcomes.

Results: Absolute rates of increase in overweight were higher among adults than among children in all studied countries except Australia. However, relative rates of increase in overweight indicate faster increases in overweight among children in Brazil, China, and the three high-income countries. As a result, the relative excess of overweight among adults, seen initially in all countries, increased in Indonesia and Russia, but it decreased in Australia, Brazil, China, United Kingdom, and United States. In Brazil, time trends indicate an acceleration in the annual rate of change in overweight for children and a deceleration for adults, whereas in the United States, the increase in overweight shows acceleration for both children and adults.

Discussion: In absolute terms, overweight increased faster among children than adults only in Australia; however, the relative gap between children and adults is closing in four additional countries, Brazil, China, the United Kingdom, and the United States.

Key words: child obesity, adult obesity, obesity trends

Introduction

There is little in the way of systematic comparisons of the changes in overweight facing children and adults. This is partly because of the fact that we have not and may never have ways to identically measure child and adult fatness. This paper compares rates of change among children and adults through the use of representative samples of adults and children from several points in time. In other words, the goal is not to compare the prevalence of each group but to use comparable standards across a set of countries and time periods to examine rates of change.

The existence of the global obesity epidemic has been noted repeatedly and has led to the World Health Assembly's determination in 2003 that the improvement of dietary and physical activity patterns and the reduction of obesity are major worldwide issues (1–3). The data are most clear for adults because of the large number of nationally representative studies of adult weight and height. Currently, very high levels of overweight and obesity exist in countries as diverse as Australia, the United States, Egypt, Mexico, and South Africa (4,5). For children and adolescents, the data are less clear. Globally, there is no definitive set of nationally representative studies on children and adolescents available. The best overview and estimate of global prevalence of obesity and overweight among children and adolescents come from the reviews (6) and a smaller trends analysis of four countries (7). Both studies used definitions of overweight and obesity developed for the International Obesity Task Force (7,8).

This paper focuses on the analysis of nationally representative data over periods ranging from 8 to 25 years to examine the trends of overweight for adults and children for a wide range of developed and developing countries, which include the United States, the United Kingdom, Australia,

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Brazil, Russia, China (a nine province study), Indonesia, and Vietnam. The primary hypothesis we tested was that adult overweight increased earlier than child overweight in all countries. Furthermore, we examined whether the lag between adult and child overweight increases differs between developing and developed countries.

Research Methods and Procedures

Our overall strategy was tempered by the number of times that nationally representative surveys of children and adults have been collected in most countries. In developing countries, the focus in most health surveys has been on preschoolers and pregnant women, whereas in some developed countries, the focus has been more on adults. Our access to data for Japan and one or two other high-income countries with similar data was limited, or we would have expanded this study to more higher-income countries. If all of the data we could get were perfect and we could have found five to seven surveys for each country, we could have regressed the prevalence rates for whatever age-sex groupings we had on the year of the survey (beginning with zero for the first survey and the number of years to each subsequent one). With a polynomial functional form, we could have actually rigorously tested for the rate of increase, the point of inflection, and other relationships. Unfortunately, the best countries have only four points, or the points are so close together that a more complex function form makes no sense. This forced us to a more descriptive strategy, which is described below.

Country Databases

Australia. The surveys in Australia are all large-scale. Unfortunately, they are not totally comparable in sampling. The Risk Factor Prevalence Studies were conducted by the National Heart Foundation of Australia in 1980, 1983, and 1989 (9). They were designed to provide national measurements for height and weight along with other data. In all three studies, participants were weighed and had their height measured by a trained nurse. In the 1989 study, participants also had their waist circumference measured, and information on self-reported height and weight was also collected. The 1995 National Nutrition Survey was conducted between January 1995 and January 1996 on 13,800 individuals (10). It is important to note that our age grouping differs from the published data on Australian child obesity (10). We focus on an older age group with higher prevalence levels to allow comparability with the earlier Australian data on children available to us. The Australian Diabetes, Obesity and Lifestyle Study, a survey conducted in 1999–2000 by the International Diabetes Institute, provided national measurements of height and weight (11,12). The study collected information in urban and non-urban areas in all states and the Northern Territory and sampled >20,000 people ≥25 years of age. The National Dietary Survey of School Children, Australia, 1985 was focused only on children. For Australia, sample weights to adjust the data to provide nationally representative statistics were available for only two of the surveys, so we must consider these trends as suggestive of Australian trends.

Brazil (1975, 1989, and 1997 Surveys). Data used in this study come from three successive nationwide surveys, in 1974–1975, 1989, and 1996–1997, undertaken by the Brazilian agency in charge of national statistics. Similar sampling procedures and data collection processes were used in the three surveys (13,14). Because the most recent survey was restricted to the northeastern and southeastern regions (the two most populous regions where ~70% of Brazilians live), the analyses presented here will consider only the sample of households studied by the three surveys in those two regions. In the three surveys, trained teams measured weight using calibrated portable scales, with the individuals wearing light-weight clothing and no shoes. Height was measured with metal tapes on bare-footed individuals, with the head held in the Frankfort plane.

China Health and Nutrition Surveys (1991, 2000, and 2004). The China Health and Nutrition Longitudinal Surveys (CHNSs)[1] covered nine provinces that vary substantially in geography, economic development, and health indicators, which provide a broad-based indication of the trends China is facing. Although the CHNSs are not nationally representative surveys, previous findings regarding the patterns and trends in people's diet and body composition from the CHNS are almost identical to those from national surveys and the China National Bureau of Statistics (15,16). Anthropometric measurements were carried out by well-trained health workers who followed standard protocol. Weight was measured in light-weight clothing to the nearest 0.1 kg with a beam balance scale. Height was measured without shoes to the nearest 0.1 cm, using a portable stadiometer. The 1991, 2000, and 2004 data were used.

Indonesia. The survey from Indonesia was based on 1993 and 2000 data (17). The 1993 Indonesia Family and Life Survey (IFLS) was the first wave (IFLS1) of a longitudinal survey conducted in 1993–1994 in 321 communities and 13 provinces by the RAND Corporation in collaboration with Lembaga Demografi, University of Indonesia. The 1993 IFLS is representative of 83% of the population of Indonesia. The survey included information from 7162 households. The 2000 survey is a repeat survey of these households, where the recontact rate was 95.3% of IFLS1 households (18).

[1] Nonstandard abbreviation: CHNS, China Health and Nutrition Longitudinal Survey; IFLS, Indonesia Family and Life Survey; RLMS, Russian Longitudinal Monitoring Survey; NHANES, National Health and Nutrition Examination Survey; VLSS, Vietnamese Living Standard Survey.

Russian Longitudinal Monitoring Survey (1992 and 1998). The Russian Longitudinal Monitoring Survey (RLMS) is the first nationally representative household survey in the Russian Federation. All members of more than 6400 households from all regions of Russia were surveyed 12 times from 1992 to 2003. Sampling for the first set of 1992–1994 surveys was different than for a new cohort of communities and households for the 1995–2003 surveys. The 1995 (6th round) and 2003 (12th round) data were used. Details about RLMS have been described previously (19). Weight and height were measured to follow a protocol similar to the one used in the U.S. National Health and Nutrition Examination surveys (NHANES). The RLMS is replenished annually. An entirely new Moscow and St. Petersberg sample was collected in 2003, and the sample weights were used to provide for nationally representative statistics at all times.

United Kingdom. The National Heights and Weight Survey, 1980; The Dietary and Nutritional Survey of British, 1986–1987; The Health Survey for England, 1995 and 2003; and The National Diet and Nutrition Survey: Adults 19 to 64 years of age, 2000–2001 were used. All of the surveys were nationally representative, with multistage stratified random samples. In the surveys of 1995 and 2003, data of children were available (20).

U.S. NHANES. The NHANES program of the National Center for Health Statistics, Centers for Disease Control and Prevention, includes a series of cross-sectional nationally representative health examination surveys beginning in 1960. Each cross-sectional survey provides a national estimate for the U.S. population at the time of the survey, enabling examination of trends over time in the U.S. population. In each survey, a nationally representative sample of the U.S. civilian non-institutionalized population was selected using a complex, stratified, multistage probability cluster sampling design. Previous national surveys include the first, second, and third NHANES surveys (NHANES I, 1971–1974; NHANES II, 1976–1980; and NHANES III, 1988–1994). Beginning in 1999, NHANES became a continuous survey without a break between cycles. The procedures followed to select the sample and conduct the interview and examination were similar to those for previous surveys. This report is based on data for individuals from the first 3 years of the continuous NHANES (1999–2002). Two or more years of data are necessary to have adequate sample sizes for subgroup analyses (21).

Vietnam. Two Vietnamese Living Standard Surveys (VLSSs) were conducted in 1992–1993 and 1997–1998. These were conducted by the General Statistical Office and are nationally representative in both urban and rural sectors (General Statistical Office 1994, 2000). Both of the VLSS surveys are multipurpose surveys that collect weight and height data (22). A 2002 survey was designed by the Ministry of Health and collected by the General Statistical Office in a manner quite similar to the VLSSs.

Classifications of Overweight

This analysis focuses on the prevalence of overweight among children from 6 to 17 years of age and adults ≥18 years of age. The criteria for defining overweight were based on BMI. For adults, we used the single BMI cut-off of 25 kg/m^2, whereas for children, we used sex- and age-specific BMI cut-offs that are equivalent to 25 kg/m^2 at 18 years of age (8).

Statistical Methods

Sample weights were available for some of the countries, allowing us to adjust the descriptive statistics so that the data are nationally representative. For Brazil, Indonesia, Russia, and the United States, results were weighted, whereas for Australia, this was possible for only two surveys. For the other countries, we must consider these results only suggestive of national patterns and trends. This is particularly true for China, where the sample is a longitudinal one without full sample replenishment and with lack of weights. For China, however, we found that our pattern and trend results mirror those of the national nutrition surveys of 1992 and 2002 (23). Prevalence data were calculated for each country at the time of the survey for children 6.0 to 17.9 years of age and for adults (men, women, and total) ≥18.0 years of age. The absolute change in prevalence between two points in time was divided by the length of time in years to create the absolute annual rate of change in prevalence (expressed in percentage points). The annualized rate of change in prevalence is particularly useful in handling issues where initial prevalence rates are much lower for children than for adults. An annual percentage relative change in prevalence was calculated by dividing the absolute rate of change by the baseline prevalence rate and multiplying the result by 100.

Results

General Patterns for Adults and Children

Table 1 displays the prevalence of overweight among children and adults according to surveys conducted between 1971 and 2004 in eight countries. In general, rates of overweight for both children and adults tended to be higher in the higher-income, more developed countries (Australia, United Kingdom, and United States), intermediate in the mid-income countries (Brazil and Russia), and lower in the lower-income, less developed countries (China, Indonesia, and Vietnam). In every country, overweight was always more common in adults than in children. Changes in prevalence across the surveys indicate increases in overweight prevalence for both children and adults in all countries, except in Russia, where only overweight in adults increased. Because of the fact that the level of child overweight was so miniscule in Vietnam in 1992 and increased very little by 2002 but the relative rate of change was huge, a decision

Table 1. The prevalence of overweight plus obesity for adults ages 18 and older and children ages 10–17.9 (weighted when possible)

Country	Beginning year		Middle years		Final year	Annual change in the prevalence	Annual relative change %
Australia	**1980**	**1985**	**1989**	**1995**	**2000**		
Children ages 10–17.9		13.3		29.9		1.7	12.4
Adult males	51.9		57.1		70.2	0.9	1.8
Adult females	31.4		40.3		57.1	1.3	4.1
Total adults	41.5		48.5		62.9	1.1	2.6
Brazil	**1975**		**1989**		**1997**		
Children ages 10–17.9	3.7		7.5		12.6	0.4	10.7
Adult males	15.7		25.8		35.6	0.9	5.6
Adult females	24.4		37.4		37.8	0.6	2.4
Total adults	20.0		31.8		36.7	0.7	3.7
China	**1991**				**2004**		
Children ages 10–17.9	4.8				11.4	0.5	10.4
Adult males	10.3				26.0	1.2	11.7
Adult females	15.2				28.4	1.0	6.7
Total adults	12.9				27.3	1.1	8.6
Indonesia	**1993**				**2000**		
Children ages 10–17.9	3.4				4.0	0.1	2.7
Adult males	7.9				11.4	0.5	6.3
Adult females	15.3				22.1	1.0	6.4
Total adults	12.0				17.0	0.7	6.0
Russia	**1995**				**2004**		
Children ages 10–17.9	11.3				11.1	0.0	-0.2
Adult males	40.6				47.4	0.8	1.8
Adult females	57.9				58.4	0.0	0.1
Total adults	50.2				53.4	0.4	0.7
Vietnam	**1992**		**1997**		**2002**		
Children ages 10–17.9	0.2		1.1		1.4	0.1	46.3
Adult males	1.0		2.9		4.3	0.3	33.7
Adult females	2.2		5.4		6.5	0.4	19.6
Total adults	1.6		4.3		5.5	0.4	24.5
U.S.A.	**1971–1975**	**1976–1980**	**1988–1994**		**1999–2002**		
Children ages 10–17.9	15.3	15.2	25.7		33.2	0.7	4.2
Adult males	52.0	49.2	57.7		66.8	0.5	1.0
Adult females	42.3	39.9	49.6		61.0	0.7	1.6
Total adults	46.1	44.4	53.5		63.8	0.6	1.4
U.K.	**1980**	**1986–1987**	**1995**	**2000–2001**	**2003**		
Children ages 10–17.9			21.6		25.8	0.5	2.4
Adult males	43.0	47.8	60.4	67.8	68.4	1.1	2.6
Adult females	34.1	36.3	51.4	53.6	57.5	1.0	3.0
Total adults	38.4	42.0	55.6	60.0	62.5	1.0	2.7

was made to exclude the Vietnamese data from further analysis. Furthermore, in subsequent analyses, data were constrained to the 1985–2004 period, during which all countries had at least two surveys: one earlier survey conducted between 1985 and 1995 and one more recent survey conducted between 1996 and 2004. This allowed us to

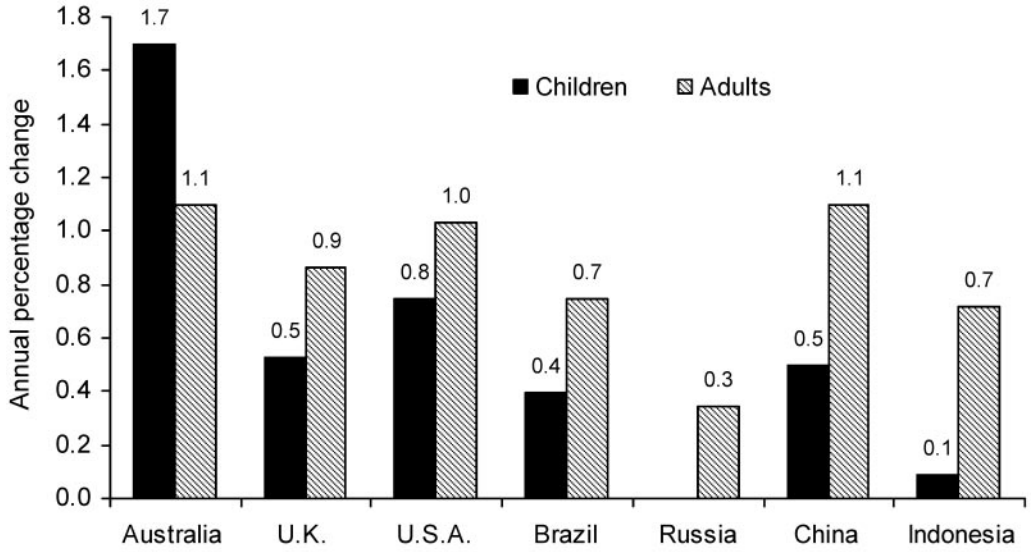

Figure 1: Annual absolute change in the prevalence of overweight in seven countries from 1985/1995 to 1995/2004.

compare absolute and relative changes in overweight prevalence calculated from a relatively common period of time. Earlier data on children and adults, available for only Brazil and the United States, are discussed separately.

Rates of Change in Overweight across the Countries

Figures 1 and 2 compare the annualized rate of change of overweight prevalence among children and adults in the studied countries (except Vietnam). These rates were calculated for all countries using an initial survey conducted between 1985 and 1995 and a final survey conducted between 1996 and 2004. The average interval between the surveys was ~10 years (ranging from 7 years in Indonesia to 10 years in Australia and the United States). Figure 1 focuses on annual absolute increases (expressed in percentage points), whereas Figure 2 focuses on annual relative change (expressed as percentage of the baseline prevalence). For countries with more than two surveys in the period 1985–2004, we compared figures from the first and the last surveys.

The comparison of absolute rates of change in overweight seen in children and adults shows much higher rates among

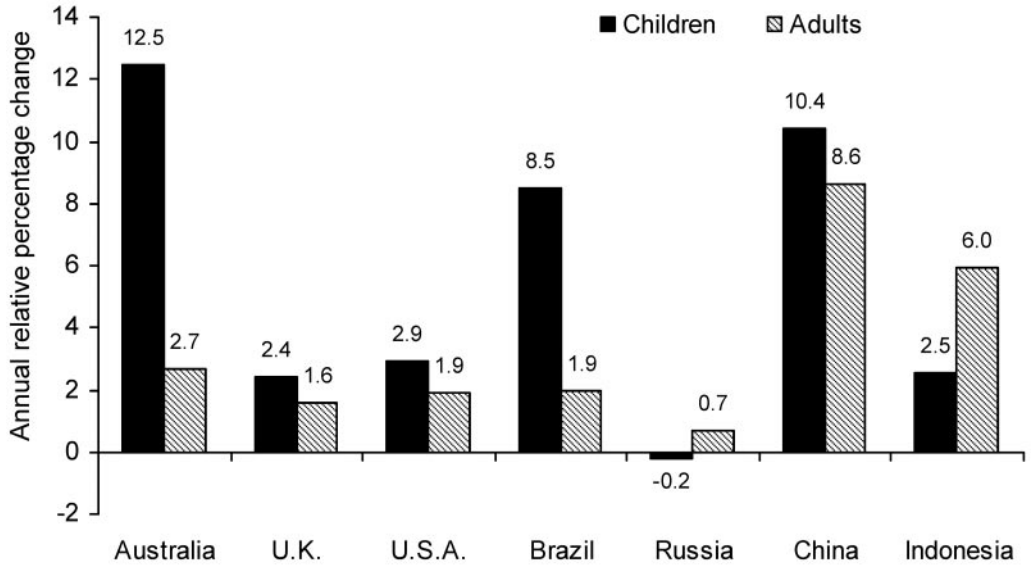

Figure 2: Annual relative change in the prevalence of overweight in seven countries from 1985/1995 to 1995/2004.

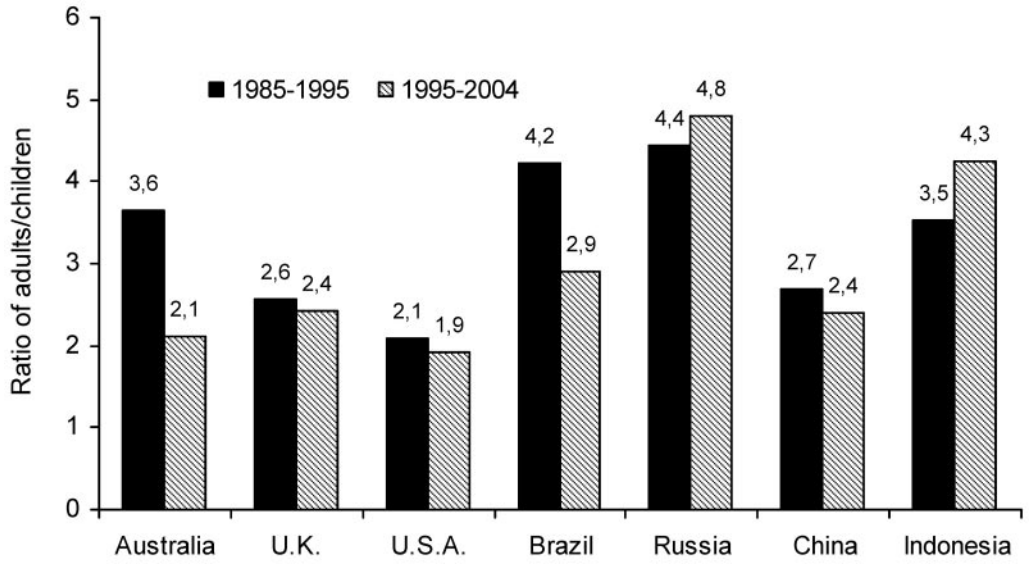

Figure 3: Relative excess of overweight in adults compared with children in seven countries in two periods.

adults in China and Indonesia, moderately higher rates among adults in the United Kingdom, United States, and Brazil, and higher rates among children in Australia. In Russia, overweight increased only among adults (Figure 1).

Does a Lag for Children Exist?

The relative rates of change in overweight were higher for adults than for children in Indonesia and in Russia, where overweight increased only among adults. In Brazil, China, and the three developed countries, overweight increased relatively more among children than among adults (Figure 2). As a result, the relative excess of overweight among adults, seen initially in all countries, increased in Indonesia and Russia but decreased in Australia, Brazil, China, the United Kingdom, and the United States (Figure 3).

Figure 4 compares earlier and recent changes in overweight prevalence among children and adults in Brazil and the United States. Earlier changes refer mostly to mid-1970s and the 1980s and recent changes to the 1990s and earlier 2000s. In the case of Brazil, time trends indicate an acceleration in the speed of increase in overweight for children and a deceleration for adults, whereas in the case of the

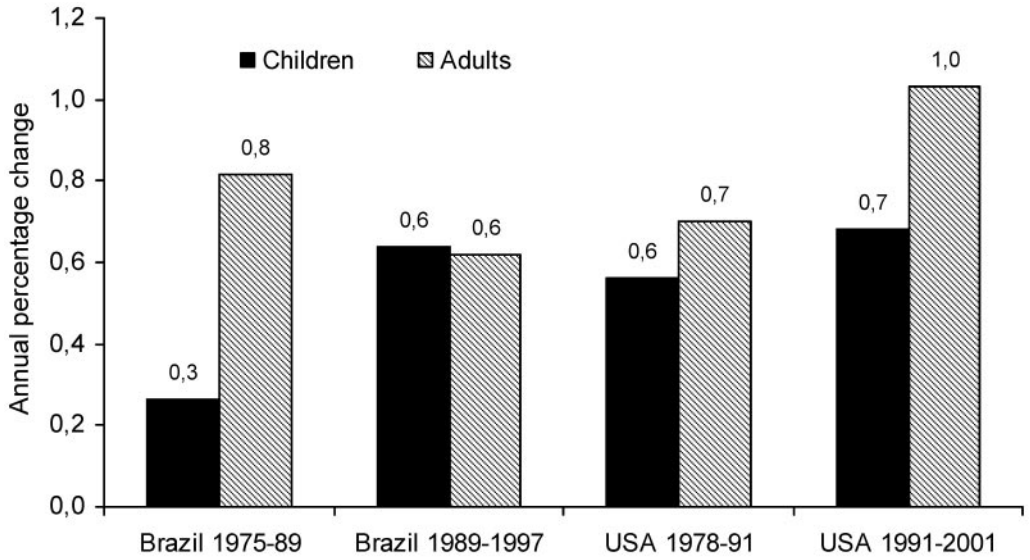

Figure 4: Annual absolute change in the prevalence of overweight in two countries in two successive periods.

United States, the increase in overweight shows acceleration for both children and adults, with a greater rate of increase for adults.

Discussion

Using data from seven nations, in absolute terms, overweight seems to be increasing faster among adults than children. Furthermore, it seems that child overweight is lagging considerably behind adult overweight in onset of any increase. Moreover, only in Australia was there empirical evidence that the increase in child overweight was greater than that for adults. However, in relative terms, that is, taking into account the baseline prevalence, overweight increased faster among children than among adults in five of the seven countries: namely the three developed countries, Brazil, and China. While the countries used represent a large portion of the world's population and are most likely representative of global patterns, we lack data from Africa, the Middle East, and Western and Central Europe. Nevertheless, from other research we have undertaken on diet, physical activity, and economic and demographic patterns (5,24), we expect these patterns to hold globally.

It is unfortunate that, for most countries, few points in time were available to assess change; moreover, there are few countries with several points for both adults and children. Therefore, the ability to fully translate these results into global trends that are robust is limited.

There are two issues related to these results. First, why do these patterns of change occur, and second, what can we learn from studying this topic? We begin with the former question. The major possibilities are as follows.

- Biological differences among age groups that cause differences in the response to the same environment. (For example, infants and preschool children are less immune-competent than older children and adults, and, therefore, more vulnerable to a "dirty" environment.) Thus, for instance, if it were found that insults during the fetal development period were critical and that these emerged mainly in adults, this might be one reason for the difference (25,26).
- Differences in the environmental change faced by adults and children. For instance, does technology at work change faster than that at home, so that adult energy expenditures have decreased more? Or do adults eat away from home more and do their away-from-home consumption patterns change more than children's?
- Differences in the interaction between biological and environment variables. The fact that there seems to be a continuum of differences from lower to higher income countries in the prevalence of overweight in individuals of all ages does not necessarily rule out biological factors. Further study of the differential changes in diet, activity, and other factors is needed to understand these issues.

Further study might allow us to understand the effect of major environmental factors if we can study countries where overweight trends for adults and children are occurring at quite different times. Indonesia, Vietnam, and China are examples of such countries. Furthermore, in Vietnam, the initial absolute levels and the annual rates of change in the prevalence were so low that we excluded these data from some analyses.

The fact that the annual rate of change in the prevalence of overweight is generally greater for adults leads us to suggest that it is important that governments continue to focus preventive activities on both children and adults. While children may be more amenable to preventive activities, so many food and activity patterns of children are linked with those of their parents that it is important to continue the broader focus. Furthermore, as shown here globally, it is expected that child overweight will rise later in many countries, and addressing adult overweight is most important. Further research should examine in greater detail the timing and inter-relatedness of the trends for adults and children. In the meantime, these results point to the need for a focus on both children and adults rather than the focus found in some countries on only children.

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