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Original article

Time for an Adolescent Health Surveillance System in Saudi Arabia: Findings From "Jeeluna"

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See Related Editorial p. 249

A B S T R A C T

Purpose: With the increasing burden of noncommunicable disease, adolescence is viewed as an opportune time to prevent the onset of certain behaviors and promote healthy states. Although adolescents comprise a considerable portion of Saudi Arabia's population, they have received insufficient attention and indicators of their health status, as a first step in a prevention cycle are unavailable. This study was carried out with the aim of identifying the health risk behaviors and health status of adolescents in Saudi Arabia.
Methods: This cross-sectional, school-based study was carried out in all 13 regions of Saudi Arabia. Through multistage, cluster, random sampling, intermediate, and secondary school students were invited to participate. Data were collected by means of a self-administered questionnaire addressing health risk behaviors and health status, clinical anthropometric measurements, and laboratory investigations.
Results: A total of 12,575 adolescents participated. Various health risk behaviors, including dietary and sedentary behaviors, lack of safety measures, tobacco use, bullying, and violence were highly prevalent. Twenty-eight percent of adolescents reported having a chronic health condition, 14.3% reported having symptoms suggestive of depression, 30.0% were overweight/obese, and 95.6% were vitamin D deficient.
Conclusion: Behaviors and conditions known to persist into adulthood and result in morbidity and premature mortality are prevalent among adolescents in Saudi Arabia. Preventive measures and local

IMPLICATIONS AND CONTRIBUTION

Although adolescents constitute a significant portion of Saudi Arabia's population, little is known about their health status. This nationally representative study has identified the high prevalence of health risk behaviors and salient health conditions, which, for the first time, will serve as adolescent health indicators and support policy and program development.

Conflicts of Interest: The authors declare that they have no competing interests.

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health policies are urgently needed and can impact adolescents and future adults. Establishing adolescent health surveillance is necessary to monitor trends and impacts of such measures.
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Improvement has been seen in public health with decreasing infant mortality rates and advances in prevention and treatment of communicable disease [1–4]. During the same period, however, the burden of noncommunicable disease (NCD) has been increasing [3,4], with 63% of global deaths being caused by NCD [5]. Attention has therefore turned to how nations can advance efforts that impact the onset of risky behaviors associated with NCD [6]. This has led to a focus on adolescence and the opportunities to promote health and prevent onset of risk behaviors known to persist into adulthood and result in morbidity and premature death [6].

Adolescence, a time of opportunity, has gained increasing global attention [2,7,8]. It is the transitional period from childhood to adulthood corresponding to the age of 10–19 years, roughly corresponding to the age of onset of puberty and onset of adult identity, respectively [9]. Many physical, cognitive, emotional, and social developmental changes occur during this period [10], and experimentation and risk behaviors may begin. Because of the prevalent health risk behaviors and specific health problems, clinical guidelines and recommendations have been published to guide health care providers in screening practices and approach to adolescents [11,12]. Leading global organizations and scientific journals have dedicated special reports [2] or series [7] to adolescence.

Eighty-eight percent of the world's 1.2 billion adolescents live in developing countries with a considerable number living in the Arab world [2]. Despite the *youth bulge* witnessed in this region, national data sets on adolescents are lacking and there is a shortage of adolescent health services and programs [13]. Furthermore, the research carried out in the region has generally excluded important aspects of adolescent health including alcohol/substance use and sexual/reproductive health [14] because of cultural sensitivities and taboos associated with such.

The Kingdom of Saudi Arabia (KSA) has a population exceeding 27 million, and 20% of its population are adolescents aged 10–19 years [15]. Local research has largely focused on adults. Efforts have shifted toward NCDs as there has been a rising burden of NCDs and road traffic injuries [16]. When viewed through a life course approach, however, it becomes evident that optimal adolescent health and well-being are essential prerequisites for advances to be made with decreasing the burden of disease witnessed among adults.

Literature addressing the health needs and risks of adolescents in KSA are lacking, with none representative of national needs. National indicators of adolescent health that are necessary for guiding policy and decision makers in establishing the required services, programs, and future national strategic plans are unavailable. Concrete recommendations on improving school health and directing resources toward priority health risk behaviors are also necessary. A surveillance system, such as that available in some countries [17] and that allows identification of trends, does not exist. The national adolescent health study we present here, "Jeeluna" (Arabic for "Our Generation"), was therefore conceived with the aim of identifying the health needs and status of adolescents in KSA.

Methods

This school-based, national cross-sectional study was conducted in all 13 regions of KSA. Variations in some local cultural values/norms may exist in different geographical areas/regions.

Education system in Kingdom of Saudi Arabia

Preprimary through secondary school education is under the jurisdiction of the Ministry of Education (MOE) [18]. Schools are gender segregated. Classic Arabic language is used in education and is understood by all despite the differences in regional dialects. In 2011, the overall youth literacy rate was 98% [19].

Participants' sampling and sample size

A sample size of 11,361 was determined to estimate the population proportions of different characteristics with a prevalence of 30%, a 1% margin of error, and a 99% confidence, taking the multilevel nature of having pupils within schools, within type, within regions, and within gender into account. The sample size was additionally increased by 5% to account for contingencies such as nonresponse, resulting in a total sample size of 12,000 participants.

We used a stratified, cluster random sampling procedure. Based on student population per region, district, gender, and school level, proportionate sampling for each district was made to identify the sample size per district.

A list of intermediate and secondary schools enlisted with the MOE served as a source from which schools were drawn using computer-based randomized sampling. Through stratification, a good representation of both genders and the number of intermediate versus secondary school students in each of the regions was ensured. Classes within selected schools were randomly selected. Sampling was clustered by inviting all students from a selected class to participate. An information letter was sent to students and parents, and their consent, as well as student assent, were obtained.

School inclusion/exclusion criteria. Any male/female, intermediate/secondary, public/private school in a Saudi Arabian city/town that functions during the day was eligible. Evening schools and schools that only serve special needs students were excluded.

Data collection

Data-collecting teams in all regions/districts received standardized training. Data collection involved the following: (1) administration of self-administered questionnaire; (2) anthropometric measurements; and (3) blood sampling for laboratory investigations.

Administration of self-administered questionnaire. The *Youth Risk Behavior Survey* [17] and the *Global School-based Student Health*

Survey [20] cover priority health risk behaviors among adolescents. Items relevant to our study's objectives were adopted and underwent cultural adaptation when relevant. Items that were found to be culturally inappropriate were not included (e.g., sexual behaviors and sexually transmitted diseases). To address psychosocial domains as done in adolescent clinical care [21], questions regarding home and education were added, as were questions pertaining to health status. Our final questionnaire included the following 11 domains: (1) family; (2) education/schooling; (3) nutrition/dietary behaviors; (4) activities, including physical activity and technology use (sedentary activity); (5) safety; (6) sleep; (7) violence and bullying; (8) tobacco and substance use (including alcohol use); (9) health; (10) health services; and (11) health knowledge. Students were ensured that their responses would remain anonymous and confidential.

Anthropometric measurements. Height was measured to the nearest .5 cm and weight to the nearest .1 kg using an electronic scale (Omron SC100 digital scale; Omron Healthcare, Inc., Lake Forest, IL). The calculated body mass index (BMI) was plotted on the Center for Disease Control and Prevention BMI charts [22]. BMI's were interpreted, based on the norm for age and sex, to be underweight, healthy weight, overweight, or obese if $<$5th, 5th to $<$85th, 85th to $<$95th, or $\geq$95th percentiles, respectively.

Laboratory investigations. Total 25-hydroxy vitamin D3 was measured in serum samples using immunoassay analyzer Architect 2000 (Abbott, IL). Blood samples were analyzed for hemoglobin by cell counter hematology analyzer (Abbott, IL).

Data analysis

Data were weighted to account for the probability of selection of students within each school, and the probability of selection of schools, stratified by gender and grade (intermediate and secondary), within each district. We used Statistical Analysis Software SURVEYFREQ procedure (SAS Version 9; SAS Institute, Cary, NC) to analyze the data and adjust for the complex sampling design. Means and standard deviations for continuous variables and frequencies and percentages for categorical variables were calculated. Gender differences were detected by chi-square tests.

Ethical considerations

The ethics committees at King Abdullah International Medical Research Center and the MOE reviewed and approved this study. Permission from the selected schools' principals, active written parental consent, and student assent were necessary. The printed information provided to students/parents documented the "sensitive" topics that would be addressed, as per Institutional Review Board (IRB) requirements. Students were given the option to opt out of blood sampling.

Results

School and student's response rates

A total of 282 schools were invited to participate; 21 schools refused (92.5% school response rate) mainly because of conflicting times with other activities. The "gatekeeper" to one school district was not responsive, and several failed attempts were made to schedule training and site visits there with no clear reason as to why. Schools refusing participation, except for the four schools in the nonresponsive district, were replaced through random school selection according to the original criteria for selection. A total of 278 schools participated in the final sample. As for the district that did not participate, neighboring districts within the same region did participate, and therefore participation from all regions occurred.

A total of 12,575 students participated, giving a student response rate of 32.7%. Many field teams only recruited the minimum requirement of 50 students/school despite receiving a larger number of positive consents. Nonetheless, the final participant sample was consistent with the original population proportion sampling frame. Furthermore, weighting of the data was carried out to ensure national representation of the sample.

Participants' demographics

Fifty-one percent were boys. Mean age of participants was 15.8 ± 3.4 years. Fifty-one percent of students were in secondary school, and 87.3% were of Saudi Arabian origin. Three percent reported having a paying job.

There is no international consensus on a set of indicators for adolescent health. Some have recommended that it includes "measures of health and well-being, social role transitions, risk and protective factors, and health service system responses" [23].

Health risk behaviors and health status

Health risk behaviors. Table 1 shows the prevalence of some important health risk behaviors and gender differences.

Dietary behaviors. Only 54.8% were found to consume breakfast daily/most of the time. Thirty-eight percent and 54.3% of adolescents had at least one serving of fruit or vegetable per day, respectively. Thirty-eight percent and 21.8% reported drinking at least two carbonated beverages or one energy drink daily, respectively.

Activities. Almost half of all adolescents did not engage in any physical exercise. Females reported complete absence of exercise much more than males (59.3% vs. 31.7%, $p < .0001$).

Forty-two percent spent at least 2 hours/day watching television. Considerable amounts of time were spent performing other sedentary activities.

Behaviors affecting traffic safety. Only 13.8% reported seat belt use sometimes/always when passengers in a vehicle, whereas 35.4% had ever been in a car accident.

Bullying and violence. Twenty-five percent reported exposure to bullying at school during the 30 days preceding the study. Twenty percent were involved in physical violence at school or community during the preceding year.

Tobacco and substance use. Sixteen percent and 10.5% had ever smoked cigarettes or sheesha (water pipe), respectively. Sixteen percent reported solvent sniffing in the preceding month with females reporting this more than males (21.4% vs. 11.5%, $p < .0001$). Frequencies of misusing prescription medications and other substances were lower.

Table 1
Health risk behaviors among adolescents in Saudi Arabia and gender differences

Health risk behaviors	Prevalence			Prevalence by gender					
	n = 12,575 (%)	95% CI		Male n = 6,444 (%)	95% CI		Female n = 6,131 (%)	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
Dietary behaviors (daily)									
Breakfast intake (sometimes/daily)[a]	54.8	50.8	58.7	62.3	60.7	64.0	46.3	44.6	48.0
Fruit intake (≥1 servings)	38.1	34.0	42.1	43.6	41.5	45.7	31.8	29.7	33.9
Vegetable intake (≥1 servings)	54.3	50.7	58.0	55.7	53.8	57.7	52.8	50.8	54.8
Carbonated beverage consumption (≥2 drinks)	37.5	34.0	41.1	43.9	41.9	45.9	30.4	28.3	32.5
Energy drinks consumption (≥1 drinks)	21.8	19.7	23.9	25.5	23.8	27.2	17.7	16.1	19.3
Activity									
Physical exercise (daily)	13.7	10.4	16.9	19.0	17.4	20.6	7.7	6.9	8.5
Television viewing (≥2 hours/day)	42.4	41.0	43.9	40.4	38.8	42.1	44.7	42.8	46.6
Video game playing (yes)	55.6	47.7	63.4	68.0	66.4	69.6	41.6	39.3	43.9
Internet use (≥2 hours/day)	30.1	26.8	33.4	26.0	24.3	27.8	34.6	32.5	36.8
Cellular phone (>1 hour/day)	14.8	13.2	16.3	13.2	12.0	14.4	16.6	14.8	18.3
Traffic safety									
Seat belt using (sometimes/always)	13.8	11.4	16.3	17.0	15.3	18.7	10.2	9.0	11.4
Car taking without permission (yes)	17.9	11.7	24.2	28.6	26.8	30.4	5.9	5.1	6.7
Bullying and violence									
Exposure to bullying[a]	25.0	23.0	27.0	27.1	25.1	29.0	22.7	21.3	24.2
Exposure to violence at school[b]	20.8	15.8	25.7	28.9	26.3	31.5	11.7	10.4	12.9
Exposure to violence in community[b]	19.7	17.6	21.8	22.9	21.3	24.5	16.1	14.6	17.6
Tobacco and substance (ever use)									
Cigarette smoking	16.2	12.5	19.9	22.1	20.0	24.2	9.6	8.2	10.9
Sheesha smoking	10.5	8.4	12.5	13.5	11.8	15.3	7.1	5.7	8.4
Solvents sniffing	16.2	12.7	19.6	11.5	10.3	12.6	21.4	19.7	23.0
Prescription medication use for nonmedical purpose	7.2	5.7	8.7	6.0	5.3	6.8	8.5	7.4	9.6
Alcohol consumption	1.4	1.1	1.8	2.1	1.7	2.5	.7	.5	1.0
Stimulants use	1.5	1.1	1.9	1.6	1.3	1.9	1.4	1.0	1.8
Marijuana use	1.0	.6	1.5	1.6	1.2	2.0	.4	.2	.6

CI = confidence interval.
[a] During the past 30 days.
[b] During the past 12 months.

Health status. Table 2 shows the health status among adolescents in KSA by gender.

Self-reported chronic health conditions. Overall prevalence was 28.6%, with bronchial asthma being the most prevalent.

Self-reported mental health symptoms. Fourteen percent and 6.7% had depression or anxiety symptoms, respectively, always/most of the time during the past year. Symptoms of an underlying mental health problem were more prevalent among females ($p < .0001$).

Measured indicators of health status. These include: (1) Weight. Only 54.8% had healthy weights; 30% were overweight or obese; and 15.2% were underweight. (2) Vitamin D. Most (95.6%) adolescents were vitamin D deficient (<50 nmol/L). (3) Hemoglobin. Ten percent were anemic.

Health services access

Twenty-four percent of adolescents reported difficulty in accessing health care services when in need. Only 52.0% reported that their physician spent sufficient time with them during their health care visit.

Discussion

By far, this is the largest study on adolescent health conducted in KSA. It is also the first study in the country, and possibly the region, that has addressed adolescent health in a comprehensive manner so as to include sensitive topics such as alcohol and substance use and multiple indicators reflective of adolescent health.

Health-related behaviors and states

The multiple domains addressed in this study have clearly shown that the behaviors that put adolescents at risk for serious health problems exist and indeed such problems are saliently present. Although adolescents in KSA, similar to those in other parts of the world, engage in health risk behaviors, there are some behaviors or states that particularly stand out, including: (1) poor dietary habits, inadequate physical activity, and overweight/obesity; (2) lack of traffic safety; (3) bullying and violence; and (4) tobacco and alcohol/substance use.

Poor dietary habits, inadequate physical activity, and overweight/obesity. The poor dietary choices, such as low fruit or vegetable intake and high soft drink consumption exceed other regional or global rates [24–28]. Lack of physical activity is strikingly prevalent and worse among females. Although not unusual to have sedentary lifestyles in some parts of the region, possibly because of extreme weather conditions limiting outdoor activities, physical activity is even more limited among females with absence or inadequate physical education at girls' schools, along with cultural attitudes that may restrict females in outdoor settings, and lack of facilities designated for female physical activity [29].

One third of adolescents were found to be overweight/obese. Although similarly high rates have been found in neighboring high-income countries [24,26], much lower rates are reported for other

Table 2
Health status among adolescents in Saudi Arabia and gender differences

	Prevalence			Prevalence by gender					
	n = 12,575 (%)	95% CI		Male n = 6,444 (%)	95% CI		Female n = 6,131 (%)	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
Self-reported health status									
Chronic illness									
Bronchial asthma	8.4	7.1	9.8	10.8	9.6	11.9	5.8	5.1	6.5
Allergies (not asthma)	4.9	3.5	6.2	4.2	3.5	4.9	5.6	4.7	6.5
Hematological disorder	3.7	2.9	4.6	3.1	2.5	3.7	4.5	3.7	5.2
Skin disorders	3.6	2.6	4.6	3.1	2.6	3.6	4.2	3.4	5.0
Musculoskeletal	1.5	1.0	1.9	1.5	1.0	2.0	1.4	1.0	1.8
Genitourinary	1.2	.7	1.6	.9	.6	1.2	1.4	.9	1.8
Diabetes	.7	.5	1.0	.9	.7	1.2	.6	.3	.8
Others	4.6	3.8	5.4	5.0	4.0	6.0	4.2	3.3	5.0
Mental health									
Sadness/depression	14.3	11.0	17.6	10.1	9.3	11.0	19.0	17.6	20.4
Anxiety	6.7	5.2	8.3	4.6	3.9	5.3	9.1	8.0	10.2
Measured indicators of health status									
BMI[a]									
Underweight	15.2	13.7	16.7	17.2	15.3	19.0	13.0	11.8	14.2
Healthy weight	54.8	51.2	58.4	48.8	47.2	50.3	61.5	60.0	63.1
Overweight	14.1	13.4	14.9	13.9	12.8	15.0	14.5	13.4	15.5
Obese	15.9	12.6	19.1	20.2	18.7	21.7	11.0	9.8	12.3

BMI = body mass index; CI = confidence interval.
[a] BMI: underweight <5 centile; healthy weight 5 to <85 centile; overweight ≥85 to <95 centile; and obese ≥95 centile based on Center for Disease Control and Prevention charts (2000).

neighboring lower income countries [27]. Identifying the determinants across borders is an area worthy of addressing. The high prevalence of overweight/obesity is consistent with it being the leading risk factor for disease found among adults in KSA [16] and underscores the significance of a life course approach to health.

Vitamin D deficiency is most prevalent in South Asia and the Middle East [30]. We found a higher prevalence than that reported in neighboring countries [31]. Further analysis to identify the determinants of vitamin D levels is necessary, as are studies to explore optimal levels for our local adolescent population.

Lack of traffic safety. Our findings on traffic safety are alarming. They are consistent with reports of road traffic injury being the leading contributor to disability adjusted life years among male adults in KSA [16]. Local legislation mandates seat belt use for drivers and front seat passengers but is not enforced. Although the legal age for obtaining a driving license is 18 years, it is not uncommon to witness under-aged adolescents driving illegally. Education on this matter and law enforcement by the government are much needed.

Bullying and violence. This has largely been neglected in the region. One of every five adolescents reporting exposure to violence in the past year is serious and surprising. Bullying is often portrayed as peers simply teasing or roughly "playing" with one another. Parents tend to underestimate the impact of these behaviors, and school professionals have a low-moderate level of awareness of maltreatment [32]. Fortunately, the political status is more stable in KSA, and collective forms of violence witnessed in neighboring/nearby countries have not taken place locally.

Tobacco and alcohol/substance use. At the other end of the spectrum were the striking lower prevalence rates of tobacco and alcohol/substance use in comparison to global rates. These are culturally sensitive issues, and gaining IRB approval to address them was a lengthy and cumbersome process within itself. Alcohol is legally banned in KSA, accessibility is limited, and its consumption is associated with religious and cultural stigma. The high prevalence of solvent sniffing, however, was an interesting finding. The higher prevalence seen among females may be explained by limited unsupervised outdoor access and hence the potential convenience of accessing solvents. Saudi Arabian society is conservative, and self-reports of tobacco, alcohol, or other substance use may be an underestimate. Nonetheless, the ability to address these behaviors, which are considered to be taboo, is certainly a milestone.

Social context of adolescence

With increased pursuits of higher education in KSA, age of onset of marriage has also increased. Sexual activity is accepted only within a matrimonial relationship; any premarital sexual activity is strictly forbidden and brings extreme taboo to the partners and their families. Enquiring about sexual relations and activity, therefore, is inappropriate in the local context, and any existing activity is largely kept secretive. Although sexual behaviors are important issues in global adolescent health, there is scarce regional literature [14], and a conscious decision was made to not include sexual health and activity in the current round of Jeeluna. With this current evidence of existing health risk behaviors among adolescents in KSA, along with brief reports of gaps between sexual knowledge and interest [33], however, addressing sexual behaviors becomes a necessity in future surveys.

Youth unemployment rates are very high in the region [34]. Adolescents in KSA, however, are not expected to have jobs as their education is priority. It is therefore no surprise that a minority of adolescents reported having jobs. Higher education is provided free of charge to citizens, so the typical age for onset of formal employment is post college/university degree attainment.

System's responses to health services

Identification of the reasons behind why one of every four adolescents reported difficulty in accessing health care services is

important and must be addressed at a systems' level. Insufficient time spent with their physician is an indirect message that health care providers either lack the necessary training and knowledge or interest in addressing adolescent health, as listening and effective communication are key in adolescent health care.

Access to health care, including mental health services, building local capacity in adolescent health, and capitalizing on the high rates of school enrollment through enhancing school health programs are not far fetched in a high-income country such as KSA. Mobilization of such efforts is urgently needed.

Limitations, barriers, and future implications

Declining student response rates have been witnessed over the years [35], making nonresponse bias a concern. Whether nonrespondents are more or less involved in risky behaviors or have varying chronic health conditions is unknown. Adolescents who were absent on the day of the survey, dropped out of school, or have disabilities may have had different needs/behaviors. Analysis of characteristics of schools and participants of high-response and low-response rate schools showed no difference in characteristics and key adolescent risk behaviors/conditions ($p > .05$). Furthermore, weighting of the data was carried out to ensure representativeness. Both processes have been recommended to reduce nonresponse bias [36]. Well-established national surveys, such as the Behavioral Risk Factor Surveillance System, in the United States have response rates as low as 27.7%, and weighting of their data, similar to what was done with Jeeluna data, is standard procedure for ensuring data representativeness [37].

Two additional points may have contributed to the low-response rate: (1) reluctance of students and/or parents to participate in a study addressing sensitive issues. Saudi Arabian society is very conservative, and several issues addressed in the study are considered to be taboo. Whether reluctance in participation was student or parent driven is unknown as there was no direct contact with parents/guardians. Students received the information at school and were expected to share the information with their parents and (2) the research culture is in its infancy. The general public may not be aware of the relevance of research and how it can be used to impact their community.

School response rate was particularly impressive and much higher than that reported in the Youth Risk Behavior Survey [17]. In addition to gaining IRB approval from our research/academic institute, we also sought approval from the MOE and support was gained from the Minister. This probably had a positive impact on the school response rate and may be an indirect reflection of potential success with upstream approaches for initiatives in the country. Political and leadership will, including that of religious scholars, is important for future rounds of Jeeluna or other large-scale research studies. Investing in publicizing about future surveys through media campaigns, including social media to support further buy-in at the individual level is recommended. These media campaigns need to be coupled with increasing public awareness about adolescent health and development. Emphasis on the need to know the needs of our adolescents to effectively plan for their services may support the public's understanding of the importance of such initiatives.

Dissemination of the current findings at the local level through conducting stakeholder workshops and media involvement is important and intended. We are optimistic that this will be the first step in gaining support for a subsequent cycle of Jeeluna and initiating an adolescent health surveillance system in KSA.

The burden of adolescents' suffering is largely preventable, and further delay in addressing the existing gaps between regional demographics and the paucity of services/programs dedicated to serve our adolescents will only result in national, economic, and social crisis. Being a high-income country with an abundance of resources, KSA is at an advantage, and investing in our young population will prevent further burden on the long run. We are optimistic that this rich information on the adolescents of KSA will initiate a series of reports on the status of adolescent health in the country, as has been the global recommendation [23]. This evidence will be the drive for informing government policy and for establishing the necessary services/programs to address the needs of adolescents and support their health promotion. Our results support the importance of establishing a surveillance system with the data from this first round of Jeeluna serving as the baseline. This will allow a true public health approach in which we will be able to address local trends and compare adolescent indicators across nations and regions. To build a public health regulatory cycle, repeated monitoring of health determinants and health status is needed that feed into and evaluate results of interventions to improve adolescent health which seem badly needed.

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