



# Trends of 20 Health Risk Behaviours Among Adolescents in Morocco: Results of Three National Cross-Sectional School Surveys of 2006, 2010 and 2016

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**Background:** This study aimed to estimate the trends of 20 health risk behaviours among adolescents in Morocco.

**Methods:** Cross-sectional data from 13,109 adolescents (14 years median age) that took part in three waves (2006, 2010, and 2016) of the “Morocco Global School-Based Student Health Survey (GSHS)” were analysed.

**Results:** Among both boys and girls, five health risk behaviours (being physically attacked, annual injury, passive smoking, zero days walking or biking to school, and poor hand hygiene after toilet use) significantly declined over time, as well as among boys the involvement in physical fighting. Inadequate fruit intake and current tobacco use increased among both boys and girls over time, and among girls bullying victimization and among boys poor hand hygiene prior to eating increased over time.

**Conclusion:** More health risk behaviours decreased than increased in this study of three cross-sectional surveys over a period of 10 years. Additional school health promotion is needed.

**Keywords:** tobacco use, sedentary behaviour, nutrition, injury, psychological health, hygiene behaviour, protective indicators, interpersonal violence

## Introduction

In the upper middle-income nation of Morocco, most death (80%) is attributed to non-communicable diseases (NCDs).<sup>1</sup> NCDs and behavioural NCD risk factors are on the increase in Arab countries, including in Morocco.<sup>2</sup> Compared to other regions, adolescents in Eastern Mediterranean countries seem to have higher rates of NCD risk factors, such as obesity, tobacco use, unhealthy diet, sedentary behaviour, injury, violence, bullied, and mental problems.<sup>2–5</sup> In terms of interpersonal violence, in a study among adolescents in 11 countries of the Eastern Mediterranean region, the prevalence of participation in physical fights was 43.7% (past 12 months), physical attack 35.8%, and bullying victimization 43.9%,<sup>6</sup> and one-third of students in Morocco, Libya and Tunisia reported having been bullied (past month).<sup>7</sup> The prevalence of past 12-month injury increased among adolescents in Morocco from 2006 to 2010.<sup>8</sup> In a study among school adolescents (N= 669) from Kenitra, Morocco, 21.1% were physically inactive,

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45% reported sedentary behaviour (television viewing >2 h/day), 27.8% had 7 or more times fruits in a week and 49.2% had 7 or more time vegetables a week.<sup>9</sup> In another investigation among school adolescents in Taza city, Morocco (N=764), 60.6% consumed inadequate fruit and vegetables.<sup>10</sup> Tobacco use among adolescents in Morocco increased from 2006 to 2010.<sup>11</sup> In a study among school children in Agadir, Morocco the prevalence of passive smoking was 34.1% at home, 30.1% in schools and 36.4% in public places.<sup>12</sup> Regarding mental health, in a local survey among secondary school students in an urban area in Morocco (Tetouan), the most common mental problems included among others nervousness, restlessness, and fear.<sup>13</sup> “Alcohol use, dietary behaviours, drug use, hygiene, mental health, physical activity, sexual behaviours, tobacco use, violence and unintentional injury” are according to the World Health Organization the leading causes of morbidity/mortality among young people and adults worldwide.<sup>14</sup>

Intervention strategies need to be informed by epidemiological data of behavioural NCD risk factors over time in young people.<sup>5,15–17</sup> Several trend studies on health risk behaviours among adolescents in middle-income countries showed mixed results in terms increase of some and decrease of other health risk behaviours.<sup>16,17</sup> For example, in trend study among adolescents from 2005 to 2017 in Lebanon, interpersonal violence decreased and inadequate fruit and vegetable consumption increased.<sup>18</sup> Filling the research gap of assessing trends in the epidemiology of health risk behaviours in lower resourced countries, the aim of this study was assess 20 health risk behaviours in the 2006, 2010 and 2016 Morocco Global School-based Student Health Survey (GSHS). Results on the epidemiology of unhealthy behaviours over three cross-sectional surveys may provide important insights for school health programmes.<sup>13</sup>

## Methods

### Sample and Procedures

The study utilized nationally representative data from the 2006, 2010 and 2016 Morocco cross-sectional GSHS.<sup>14</sup> Methodology details have been described elsewhere and the data can be publicly accessed.<sup>14</sup> The study was granted ethics approval by a national ethics committee and written informed consent was obtained from participants.<sup>14</sup> “The study was conducted in accordance with the Declaration of

Helsinki.” The GSHS core questionnaire assesses 10 modules:

“Alcohol use, Dietary behaviors, Drug use, Hygiene, Mental health, Physical activity, Protective factors, Sexual behaviors that contribute to HIV infection, other sexually-transmitted infections, and unintended pregnancy, Tobacco use, Violence and unintentional injury.”<sup>14</sup>

### Measures

All core modules of the GSHS that were administered in the 2006, 2010 and 2016 Morocco GSHS formed part of this analysis (see [Supplementary file 1](#)). This included dietary behaviour (fruit and vegetable intake and the experience of hunger), physical activity, transportation to school and leisure-time sedentary behaviour, tobacco use (current tobacco use, and passive smoking), injury and violence (past 12-month injury, being bullied in the past month, involvement in a physical fight in the past year and having been physically attacked in the past year), hand hygiene (=HH) (hand washing before eating, after toilet and using soap when hand washing), psychological health (having friends, loneliness, sleep disturbance, and suicidal behaviour). In addition, protective indicators included attending school, parental and peer support. The intake of “less than two or more servings of fruits in a day” and “less than three or more servings of vegetables a day” were defined as insufficient.<sup>19</sup> “Inadequate physical activity was defined as not daily at least 60 minutes of moderate to vigorous-intensity physical activity.”<sup>20</sup> “Leisure-time sedentary behaviour was defined as spending three or more hours per day sitting.”<sup>21</sup>

### Data Analysis

Statistical calculations were conducted with STATA software version 15.0 (Stata Corporation, College Station, Texas, USA). Cross-sectional national datasets from three GSHS in Morocco in 2006, 2010 and 2016 were merged. Descriptive information was reported as proportions for each study year. Pearson chi-square tests were used for calculating differences in proportions. Data from the logistic regression analyses were utilized for each health risk behaviour adjusted by age group, food insecurity (hunger), and study year for boys and girls separately. Since most variables under study, such as dietary behaviour, physical activity, tobacco use, injury, violence, and mental health, may differ by sex, we conducted a sex-stratified analysis, in line with some previous studies.<sup>16–18,22</sup> Under 3.5% of the data were missing for all the variables used in the analysis. Participants

with missing data for age, sex, school grade, food insecurity (hunger), and each outcome variable were excluded from the analyses. To assess the potential for these missing values to bias results, logistic regressions were used to compare socio-demographic characteristics between adolescents without and with missing data. Taylor linearization statistics were applied in all analyses to account for the sample weighting and multistage study design. A weighting factor was applied to each student record to adjust for nonresponse and for the varying probabilities of selection. Results from the logistic regression analyses are reported as odds ratios (ORs) and 95% confidence intervals (CIs);  $p < 0.05$  was accepted as significant.

## Results

### Sample Characteristics

The total sample was 12,339 adolescents (Median age: 14 years, IQR: 3), and 45.6% were males. For the 2006 Morocco GSHS, the response rate was 84%, for the 2010 Morocco GSHS 92%, and for the 2016 Morocco GSHS 91% [14]. Compared to the first two surveys, the age group of 16 years and older significantly increased in the third survey ( $P < 0.001$ ) (see Table 1). No significant differences in sociodemographic characteristics were found between participants with complete data and those excluded because of missing values.

### Outcome Variables

#### Dietary Behaviour

The prevalence of insufficient fruit consumption significantly increased from 2006 to 2016 in both sexes, while inadequate vegetable intake and experiencing hunger among girls and boys did not change from 2006 to 2016.

#### Physical Inactivity and Leisure-Time Sedentary Behaviour

The proportion of inadequate physical activity was high among both boys (>83%) and girls (>88%), and both inadequate physical activity and leisure-time sedentary behaviour did not significantly change over time. The proportion of not walking or biking on any day in the past week to school significantly decreased from 42.0% among boys and 48.2% among girls in 2006 to 30.1% among boys and 32.7% among girls in 2016.

#### Tobacco Use

The prevalence of current tobacco use (12.1% among boys and 2.4% among girls in 2006) significantly increased in

**Table 1** Characteristics of Adolescent Students for 2006, 2010 and 2016 Surveys in Morocco (N=12,339)

Variable	2006 (N=2,670)	2010 (N=2,924)	2016 (N=6,745)
	N (%)	N (%)	N (%)
Sex			
Male	1312 (54.7)	1514 (55.4)	3488 (53.8)
Female	1303 (45.3)	1373 (44.6)	3085 (46.2)
Missing	55	37	172
Age in years			
13 years or younger	658 (25.6)	1082 (36.5)	1863 (26.8)
14	663 (25.5)	764 (26.8)	1147 (16.5)
15	680 (26.9)	585 (20.8)	1065 (15.3)
16 years or older	564 (22.1)	447 (15.9)	2558 (41.3)
Missing	105	46	112
Grade <sup>a</sup>			
1	941 (36.7)	1080 (36.2)	1600 (21.2)
2	830 (30.9)	824 (29.9)	1322 (18.9)
3	847 (32.4)	963 (33.8)	1459 (22.3)
4–6	0	0	2164 (37.5)
Missing	52	57	200

**Note:** <sup>a</sup>Grade 1–3 lower secondary education, Grade 4–6 upper secondary education.

both boys (19.4%) and girls (6.2%) in 2016. The proportion of past week passive smoking significantly decreased from 2006 to 2017 in boys (from 57.8% to 46.5%) and girls (from 49.3% to 34.0%).

#### Injury and Interpersonal Violence

The prevalence of injury decreased among boys and girls from 2006 to 2016. While being physically assaulted significantly decreased in both sexes, involved in physical fighting significantly decreased among boys and bullying victimization significantly increased among girls from 2006 to 2016.

#### Hand Hygiene

Poor HH (before meals) increased among boys, while poor HH (after toilet) decreased in both sexes from 2006 to 2016, and poor HH (with soap) did not change over time.

#### Psychological Health

The five indicators (“having no close friends, worry-induced sleep disturbance, loneliness, suicidal ideation, and suicide plan”) assessed did not change over time in both sexes.

## Protective Indicators

School truancy decreased in boys but did not change in girls over time, and peer support increased in both sexes from 2006 to 2016. Parental supervision significantly increased in both sexes from 2006 to 2016, while parental bonding and connectedness significantly decreased among boys but not among girls (see Tables 2 and 3).

## Discussion

The findings showed that across three GSHS in 2006, 2010 and 2016 in Morocco, a significant reduction among both sexes was found in the prevalence of being physically attacked, annual injuries, passive smoking, zero days walking or biking to school, poor HH (after toilet), and among boys in the involvement in physical fighting.

**Table 2** Health Risk Behaviours in 2006, 2010 and 2016 in Morocco: Male Adolescents

Outcome Variable	2006	2010	2016	Change Over Time Compared to 2006	
	N (%)	N (%)	N (%)	2010 Adjusted <sup>z</sup> OR (95% CI)	2016 Adjusted <sup>a</sup> OR (95% CI)
<b>Dietary behaviour</b>					
Fruits <2 day	614 (47.4)	784 (52.3)	2019 (57.3)	1.25 (0.99, 1.57)	1.47 (1.21, 1.78)***
Vegetable <3 day	878 (68.3)	925 (61.9)	2465 (71.7)	0.69 (0.56, 0.86)*	1.06 (0.83, 1.35)
Went hungry (mostly/always)	136 (10.4)	190 (12.5)	388 (9.6)	1.32 (0.84, 2.06)	0.94 (0.59, 1.52)
<b>Physical activity and sedentary behaviour</b>					
Inadequate physical activity	1076 (83.0)	1247 (84.3)	2955 (86.7)	1.02 (0.81, 1.29)	1.19 (0.97, 1.47)
Leisure-time sedentary behaviour	383 (30.1)	379 (25.3)	1006 (33.3)	0.88 (0.71, 1.07)	1.14 (0.90, 1.46)
0 days walk or bike to school	549 (42.0)	426 (28.7)	1036 (30.1)	0.52 (0.41, 0.66)***	0.58 (0.46, 0.74)***
<b>Tobacco use</b>					
Current tobacco use	151 (12.1)	211 (14.7)	688 (19.4)	1.70 (1.19, 2.40)**	1.95 (1.50, 2.55)***
Passive smoking	737 (57.8)	654 (43.8)	1606 (46.5)	0.57 (0.46, 0.71)***	0.55 (0.44, 0.70)***
<b>Injury and violence</b>					
Any serious injury	585 (52.7)	474 (36.3)	1217 (37.7)	0.53 (0.40, 0.69)***	0.59 (0.46, 0.75)***
Bullied	445 (41.1)	261 (17.5)	1390 (41.8)	0.25 (0.20, 0.31)***	1.08 (0.89, 1.30)
In physical fight	809 (62.2)	854 (56.6)	1671 (49.1)	0.77 (0.62, 0.97)*	0.61 (0.49, 0.76)***
Physically attacked	676 (52.0)	540 (35.7)	968 (27.0)	0.49 (0.39, 0.62)***	0.31 (0.25, 0.39)***
<b>Hand hygiene</b>					
Hand washing (before eating)	243 (18.9)	283 (19.3)	829 (25.9)	1.09 (0.84, 1.43)	1.49 (1.09, 2.03)*
Hand washing (after toilet)	462 (36.2)	314 (20.9)	969 (26.3)	0.43 (0.32, 0.60)***	0.61 (0.49, 0.76)***
Hand washing (with soap)	747 (58.5)	749 (50.2)	2030 (55.9)	0.71 (0.56, 0.91)**	0.80 (0.62, 1.02)
<b>Poor mental health</b>					
Having no close friends	125 (9.6)	115 (7.6)	336 (9.1)	0.85 (0.62, 1.16)	0.89 (0.67, 1.19)
Loneliness	180 (13.5)	206 (13.8)	536 (15.0)	1.06 (0.73, 1.54)	1.07 (0.80, 1.45)
Worry-induced sleep disturbance	168 (12.8)	189 (12.5)	513 (13.8)	0.98 (0.69, 1.46)	1.19 (0.87, 1.62)
Suicidal ideation	158 (12.2)	207 (13.9)	493 (14.0)	1.29 (0.85, 1.95)	1.22 (0.81, 1.92)
Suicide plan	144 (11.7)	192 (13.0)	473 (13.4)	1.31 (0.90, 1.91)	1.27 (0.90, 1.79)
<b>Protective factors</b>					
Truancy	511 (40.4)	623 (42.1)	1209 (35.6)	1.22 (0.93, 1.60)	0.72 (0.57, 0.90)**
Peer support (mostly/always)	268 (20.9)	406 (28.0)	886 (28.8)	1.56 (1.19, 2.05)**	1.53 (1.21, 1.93)***
Parents/guardians supervision (mostly/always)	387 (30.9)	632 (42.5)	1185 (38.0)	1.80 (1.49, 2.18)***	1.50 (1.22, 1.84)***
Parents/guardians connectedness (mostly/always)	346 (27.4)	368 (24.7)	679 (21.9)	0.82 (0.63, 1.07)	0.69 (0.55, 0.86)***
Parents or guardians bonding (mostly/always)	468 (37.5)	551 (37.1)	947 (31.4)	0.91 (0.68, 1.21)	0.72 (0.60, 0.87)***

Notes: <sup>a</sup>Adjusted for age group, food insecurity (hunger) and study year; \*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ .

**Table 3** Health Risk Behaviours in 2006, 2010 and 2016 in Morocco: Female Adolescents

Outcome Variable	2006	2010	2016	Change Over Time Compared to 2006	
	N (%)	N (%)	N (%)	2010 Adjusted <sup>a</sup> OR (95% CI)	2016 Adjusted <sup>a</sup> OR (95% CI)
<b>Dietary behaviour</b>					
Fruits <2 day	457 (35.1)	551 (40.5)	1568 (52.2)	1.35 (1.10, 1.65)**	2.03 (1.62, 2.54)***
Vegetable <3 day	931 (72.1)	755 (55.9)	2196 (72.6)	0.50 (0.38, 0.66)***	0.99 (0.74, 1.33)
Went hungry (mostly/always)	95 (7.4)	112 (8.2)	266 (8.4)	1.07 (0.80, 1.43)	1.03 (0.76, 1.38)
<b>Physical activity and sedentary behaviour</b>					
Inadequate physical activity	1136 (88.4)	1204 (89.3)	2781 (92.1)	1.28 (0.76, 2.13)	1.47 (0.95, 2.28)
Leisure-time sedentary behaviour	387 (30.1)	365 (26.8)	838 (31.3)	0.85 (0.62, 1.16)	1.00 (0.78, 1.29)
0 days walk or bike to school	624 (48.2)	431 (32.1)	1033 (32.7)	0.46 (0.34, 0.61)***	0.55 (0.41, 0.75)***
<b>Tobacco use</b>					
Current tobacco use	33 (2.4)	68 (4.9)	180 (6.2)	1.67 (0.90, 3.10)	2.07 (1.15, 3.70)*
Passive smoking	638 (49.3)	504 (37.3)	997 (34.0)	0.63 (0.48, 0.82)***	0.50 (0.40, 0.62)***
<b>Injury and violence</b>					
Any serious injury	417 (37.7)	295 (24.5)	659 (23.7)	0.52 (0.40, 0.67)***	0.47 (0.36, 0.62)***
Bullied	274 (23.7)	278 (21.0)	989 (33.9)	0.87 (0.61, 1.24)	1.80 (1.41, 2.29)***
In physical fight	277 (21.3)	331 (24.5)	621 (21.3)	1.08 (0.85, 1.36)	1.10 (0.86, 1.42)
Physically attacked	300 (23.3)	291 (21.7)	560 (18.6)	0.82 (0.61, 1.11)	0.67 (0.51, 0.87)**
<b>Hand hygiene</b>					
Hand washing (before eating)	226 (17.8)	267 (20.4)	613 (21.6)	1.32 (1.00, 1.75)*	1.21 (0.91, 1.61)
Hand washing (after toilet)	321 (25.0)	221 (16.4)	506 (15.8)	0.58 (0.41, 0.83)**	0.53 (0.39, 0.73)***
Hand washing (with soap)	598 (45.9)	598 (44.0)	1379 (42.4)	0.92 (0.68, 1.25)	0.80 (0.61, 1.06)
<b>Poor mental health</b>					
Having no close friends	171 (12.9)	144 (10.6)	337 (11.2)	0.88 (0.60, 1.29)	0.78 (0.58, 1.05)
Loneliness	282 (21.7)	313 (23.1)	743 (25.1)	1.23 (0.99, 1.52)	1.13 (0.93, 1.36)
Worry-induced sleep disturbance	236 (18.3)	260 (19.2)	624 (20.2)	1.26 (0.92, 1.71)	1.15 (0.90, 1.47)
Suicidal ideation	208 (15.8)	274 (20.0)	505 (17.9)	1.42 (1.02, 1.99)*	1.16, 0.86, 1.56)
Suicide plan	175 (13.6)	227 (16.9)	435 (14.6)	1.37 (1.00, 1.89)	1.05 (0.75, 1.47)
<b>Protective factors</b>					
Truancy	297 (23.3)	396 (29.7)	689 (24.7)	1.46 (1.10, 1.95)*	0.88 (0.67, 1.16)
Peer support (mostly/always)	340 (26.3)	437 (33.5)	896 (32.2)	1.44 (1.05, 1.96)*	1.41 (1.13, 1.76)**
Parents/guardians supervision (mostly/always)	383 (30.1)	637 (47.1)	1282 (46.5)	2.21 (1.75, 2.79)***	2.21 (1.82, 2.69)***
Parents/guardians connectedness (mostly/always)	343 (27.2)	407 (30.7)	782 (27.7)	1.16 (0.97, 1.39)	1.07 (0.92, 1.26)
Parents or guardians bonding (mostly/always)	554 (44.3)	548 (41.5)	1178 (41.8)	0.87 (0.72, 1.05)	0.90 (0.77, 1.05)

Notes: <sup>a</sup>Adjusted for age group, food insecurity (hunger), and study year; \*\*\*p<0.001; \*\*p<0.01; \*p<0.05

However, inadequate fruit intake and current tobacco use significantly increased among both sexes, and among girls bullying victimization and among boys poor HH (before eating) increased over time. Some of these positive changes may be attributed to the 2007 established school health programme, including the “early detection and treatment of the disease, health education programmes

for healthy life skills and establishment of healthy school environments” in Morocco.<sup>23</sup>

The prevalence of inadequate fruit consumption increased over time, which was also found in some Arab countries.<sup>17,18</sup> Yet, in a multicountry adolescent school survey, “Morocco had the highest percentage of adolescents meeting the WHO recommendations for the daily intake of fruit and vegetable

intake<sup>24</sup> but some local studies in Morocco also report a high prevalence of inadequate fruit and vegetable consumption.<sup>9,10</sup> The prevalence of hunger was low in this study and did not change over time, which may be reflected in the progress of poverty reduction in Morocco.<sup>25</sup>

The prevalence of physical inactivity and leisure-time sedentary behaviour in this study were similar to the global prevalence (85% physical inactivity and 30% sedentary behaviour),<sup>26</sup> higher than in a previous local study in Morocco,<sup>9</sup> and did not change over time. An increased use of mobile devices and the internet among adolescents<sup>27,28</sup> may have contributed to the continued high prevalence of sedentary behaviour in Morocco. However, the prevalence of walking or biking to school significantly increased in this survey from 2006 to 2010 and 2016, to almost 70% on any day of the week or 53.0% on 3–7 days a week, which is higher than the average in 27 Asia-Pacific countries (42.1%;  $\geq 3$  days/week).<sup>29</sup> It is possible that active school commuting increased because of increasing income inequality in Morocco<sup>25,29</sup> and increased peer support and parental supervision,<sup>30</sup> as found in this study.

Consistent with several studies,<sup>16,18,22,31</sup> interpersonal violence (physical fighting and physically assaulted) reduced over time in this study. On the contrary, in some other trend studies an increase in interpersonal violence was found.<sup>16,17</sup> Furthermore, in agreement with an earlier survey in Morocco,<sup>8</sup> the prevalence of injury decreased in this survey, while some other trend studies showed mixed results.<sup>16,17</sup> It is possible that an increase in peer support and parental supervision, as found in this survey, contributed to the decline in the interpersonal violence and injury prevalence in Morocco.<sup>32,33</sup> Being bullied increased among boys but not girls in this survey over time, but was still lower than the average in 11 Arab countries<sup>6</sup> but similar to in students in Libya, Morocco and Tunisia.<sup>7</sup> It is possible that the increase in active commuting to school, as found in this study, made boys more vulnerable to bullying victimisation.<sup>34</sup> There may also be lack of national programmes to reduce bullying in Morocco.<sup>35,36</sup>

The prevalence of current tobacco use increased and passive smoking decreased over the study period from 2006 to 2010 and 2016. In comparison, data from the “Global Youth Tobacco Survey (GYTS)” in Morocco show a decline of current tobacco use from 11.0% in 2006<sup>37</sup> to 9.5% in 2010<sup>38</sup> and 6.0% in 2016.<sup>39</sup> Factors influencing tobacco use among adolescents in Morocco may be related to some of the following: In the GYTS

2010, a significant number of students (38.0%) had received education about the dangers of smoking in the past year;<sup>38</sup> in the GYTS 2016, a high proportion of students (58.6%) noticed anti-tobacco messages in the media in the past month, and a low proportion of never smokers who thought they might enjoy smoking a cigarette (6.6%) (agree or strongly agree).<sup>39</sup> The decline in passive smoking in this survey over time was also observed in the GYTS from 27.1% living in homes where others smoke in their presence in 2006 to 19.7% in 2010 and to 15.2% in 2016.<sup>37–39</sup> Although some tobacco control measures are in place in Morocco, more can be done.<sup>40</sup> For example, the law in Morocco “mandates that health warnings appear on tobacco packages” but does not include that “health warnings on packages include a photograph or graphic.”<sup>40</sup>

Although this survey showed among both sexes a decline in poor HH (after toilet), poor HH (before eating) increased among boys in this study. Similar mixed results were found in previous trend studies among adolescents in Oman,<sup>17</sup> United Arab Emirates,<sup>22</sup> and in the Philippines.<sup>16</sup> Although psychological health indicators did not change over time in this study, a high proportion of several indicators, such as anxiety-related disturbances, was found. Previous investigations in Morocco<sup>12</sup> have also identified poor mental health as a significant problem among adolescents in Morocco.

Regarding protective indicators, school truancy decreased among boys, peer support increased for both boys and girls, and while parental supervision increased among both boys and girls, parental connectedness and parental bonding decreased among boys over time. In two other trend studies (in Oman and New Zealand),<sup>15,17</sup> one or two protective indicators increased, while there were no changes over time in the Philippines trend study.<sup>16</sup> It is possible that an increase in parental supervision helped via reducing opportunities and inclination of adolescents in decreasing school truancy.<sup>33,41</sup> The potential role of peer support and parental supervision in the prevention of truant behaviour of their children should be emphasized.<sup>33</sup>

Study findings show which specific health risk behaviours can be targeted in school health programmes among adolescents in Morocco. For example, smoking and bullying could be prevented by implementing various whole-school health interventions,<sup>42</sup> poor mental health may be reduced by “universal resilience-focused interventions (particularly cognitive-behavioral therapy-based approaches),”<sup>43</sup> and specific

targeted dietary behaviours could be improved with “specific school food environment policies, such as direct provision of healthful foods/beverages.”<sup>44</sup> In addition, multi-level “hand-washing interventions can reduce the incidence of diarrhoea, respiratory infections, and school absenteeism.”<sup>45</sup> School health promotion has been integrated into the curriculum of the school system in Morocco, yet, in a study most teachers who practiced health education indicated that they had not been trained in health education, and almost all expressed a need for training in health education.<sup>46</sup>

#### Limitations of the study

“Secondary education net-enrolment ratio” was 92.3% in Morocco in 2010 and 94.6% in 2016,<sup>47</sup> indicating that some out-of school adolescents were not included in this survey in Morocco. Several study variables were excluded from this analysis, since they were either not assessed in all three waves of the Morocco GSHS or had too many missing values. The study used anonymous self-reported data, which may have some bias but may have provided valid data, especially on sensitive issues.<sup>48,49</sup> Furthermore, the cross-sectional study design hinders us to make causal conclusions. To address this short coming, future studies should include a longitudinal design.

## Conclusions

In this large study across three cross-sectional adolescent surveys from 2006 to 2016 in Morocco, five health risk behaviours (being physically attacked, annual injury, passive smoking, zero days walking or biking to school, and poor HH after toilet) declined among both sexes, and among boys the involvement in physical fighting declined. Inadequate fruit intake and current tobacco use increased among both boys and girls over time, and among girls bullying victimization and among boys poor HH (before eating) increased over time. More health risk behaviours decreased than increased in this study of three cross-sectional surveys over a period of 10 years. Additional school health promotion is needed.

## Acknowledgment

The data source, the World Health Organization NCD Microdata Repository (URL: <https://extranet.who.int/ncdsmicrodata/index.php/catalog>), is hereby acknowledged.

## Disclosure

The authors report no conflicts of interest in this work.

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