

# A U-Shaped Association Between Intensity of Internet Use and Adolescent Health



**WHAT'S KNOWN ON THIS SUBJECT:** Internet use has rapidly become a commonplace activity, especially among adolescents. Poor mental health and several somatic health problems are associated with heavy Internet use by adolescents.



**WHAT THIS STUDY ADDS:** Results of this study provide evidence of a U-shaped relationship between intensity of Internet use and poorer mental health of adolescents. Heavy Internet users were also confirmed to be at increased risk for somatic health problems in this nationally representative sample of adolescents.

## abstract

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**OBJECTIVE:** To examine the relationship between different Internet-use intensities and adolescent mental and somatic health.

**METHODS:** Data were drawn from the 2002 Swiss Multicenter Adolescent Survey on Health, a nationally representative survey of adolescents aged 16 to 20 years in post-mandatory school. From a self-administered anonymous questionnaire, 3906 adolescent boys and 3305 girls were categorized into 4 groups according to their intensity of Internet use: heavy Internet users (HIUs; >2 hours/day), regular Internet users (RIUs; several days per week and ≤2 hours/day), occasional users (≤1 hour/week), and non-Internet users (NIUs; no use in the previous month). Health factors examined were perceived health, depression, overweight, headaches and back pain, and insufficient sleep.

**RESULTS:** In controlled multivariate analysis, using RIUs as a reference, HIUs of both genders were more likely to report higher depressive scores, whereas only male users were found at increased risk of overweight and female users at increased risk of insufficient sleep. Male NIUs and female NIUs and occasional users also were found at increased risk of higher depressive scores. Back-pain complaints were found predominantly among male NIUs.

**CONCLUSIONS:** Our study provides evidence of a U-shaped relationship between intensity of Internet use and poorer mental health of adolescents. In addition, HIUs were confirmed at increased risk for somatic health problems. Thus, health professionals should be on the alert when caring for adolescents who report either heavy Internet use or very little/none. Also, they should consider regular Internet use as a normative behavior without major health consequence. *Pediatrics* 2011;127:e330–e335

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### KEY WORDS

adolescent, Internet, mental health, obesity, survey

### ABBREVIATIONS

HIU—heavy Internet user

RIU—regular Internet user

OIU—occasional Internet user

NIU—non-Internet user

SES—socioeconomic status

RRR—relative risk ratio

CI—confidence interval

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From its beginnings as a new technology in the 1990s, Internet use has rapidly become a commonplace activity, especially among young people.<sup>1</sup> Adolescents have adopted its use extensively, integrating it into many aspects of their daily life.<sup>2,3</sup> As in other countries,<sup>3–5</sup> the vast majority of 14- to 19-year-olds in Switzerland have reported using the Internet several times per week.<sup>6</sup>

The growing importance of the Internet for adolescents has gradually led health professionals to examine the health implications associated with this activity. Although recent, this literature has established a link between both mental and somatic health problems and heavy Internet use by adolescents. Anxiety disorders, depression, and suicidal ideation are reported among adolescent Internet addicts and other problematic users,<sup>7–9</sup> as well as, more generally, among heavy users.<sup>10,11</sup> Adolescents who spend a significant amount of time online also are known to experience frequently physical problems such as headaches and musculoskeletal pain,<sup>12,13</sup> probably linked with muscular contractures and lack of muscle-mobilizing activities. Poorer sleep and reduced sleeping time are problems more likely to be reported by young heavy Internet users (HIUs)<sup>12,14</sup> who are often using Internet late in the evening and night. Above all, at a time when obesity prevalence is critical, some cross-sectional and longitudinal studies have shown increased BMI among adolescents who spend long hours online daily<sup>10,15,16</sup> and, thus, do not engage in physical activity. All these studies have, however, tended to focus only on heavy Internet use, whereas few have on the potential correlates of low or nonexistent Internet use.<sup>17</sup> Most have also considered gender only as a possible confounder when analyzing Internet use and health, assuming that adolescent boys

and girls interact similarly with the Internet, which is a fact that remains unverified.

The aim of this article, therefore, was to examine the relationship that exists between different intensities of Internet use and both mental and somatic health, using a nationally representative sample of adolescent boys and girls. It was postulated that HIUs would be at greater health risk in comparison to regular users, and that low Internet users would be in good health.

## METHODS

Data were drawn from the 2002 Swiss Multicenter Adolescent Survey on Health (SMASH02) database, a nationally representative survey that includes 7548 adolescents in post-mandatory school aged 16 to 20 years. In Switzerland, school attendance is mandatory up to age 16. Afterward, ~30% of adolescents enter high school (these students are usually the most academically gifted and commonly enter university after), whereas ~60% begin vocational school (these are apprentices who usually have 1 or 2 days of classes per week and spend the rest of the week working in a company related to their field of study). Another ~10% do not engage in any additional education or training. The study was approved by the ethics committee of the University of Lausanne School of Medicine. An anonymous self-administered questionnaire covering a number of health issues and behaviors was completed by adolescents in their classrooms. A full description of the questionnaire and sampling method has been published elsewhere.<sup>18</sup>

The analyses were based on a weighted sample of 7211 subjects (3305 girls and 3906 boys) who had answered 3 categorical questions about the intensity of their Internet use over the previous 30 days. HIUs were de-

defined as those who reported being online for 2 hours or more every day. Similar cutoff points have been previously used in other studies.<sup>3,19,20</sup> Because no consensus exists in the literature regarding the definition of regular Internet use, regular Internet users (RIUs) were arbitrarily defined as those subjects who use the Internet several days per week but for <2 hours/day. Occasional Internet users (OIUs) were defined as those who use the Internet once per week or less, and non-Internet users (NIUs) as those who had not been online in the previous 30 days.

We selected the most salient health variables related to Internet use, on the basis of associations described in the literature.<sup>7–12,14–16</sup> Self-perceived health (excellent, very good, good, mediocre, and poor) was further dichotomized into good and poor (mediocre or poor). Overweight status ( $\leq 85$ th percentile for BMI according to age and gender<sup>21</sup>) was calculated by using self-reported height and weight. Frequency of headaches and back pain in the preceding year, using a 4-point scale, was dichotomized into frequent (quite or very frequent) and infrequent (never or rarely), whereas sleep quantity was self-reported as insufficient or sufficient (sufficient or too much). The presence of depression was assessed using the Depressive Tendencies Scale<sup>22</sup> (Cronbach's  $\alpha = 0.89$ ), which ranges from 1 (not depressed at all) to 4 (very depressed).

Because of their potential influence on the presence of health problems, several personal characteristics of participants (age, academic track [apprentice versus student], socioeconomic status [SES], the presence of a chronic condition, and the amount of physical activity) were used as adjusting variables in the multivariate analyses. The level of education of both parents was combined and used as a proxy mea-

sure of SES with 2 categories defined: low (both parents with a low level of education, defined as mandatory schooling or less) and high (at least 1 parent with higher education). A chronic condition was defined as a disease or condition that lasted for >6 months and required continuous medical care. A similar definition was used to characterize disability (6 months of limited body function). Physical activity was assessed through weekly participation in an extramural sport (further dichotomized as more than once per week and once per week or less) because it has been shown previously to affect positively both physical and mental health.<sup>23</sup>

All analyses were performed separately according to gender. Bivariate analyses were used to determine differences existing between the 4 groups regarding personal characteristics and health status. Analysis of variance was used for continuous variables and a  $\chi^2$  test for categorical ones. We performed multinomial regressions, controlling for all personal characteristics and comparing groups on all health factors concurrently because they may influence each other. RIUs were chosen as the reference group for comparison because it was hypothesized that they would represent the current norm of Internet use by adolescents. Results are shown as relative risk ratios (RRRs) with 95% confidence intervals (CIs). The analyses were performed with Stata 10.1 (Stata Corp, College Station, TX), which allows for computing coefficient estimates and variances that take into account the sampling weights, clustering, and stratification procedure.

## RESULTS

Among male adolescents, 7.3% were identified as HIUs, whereas the vast majority were either RIUs (44.9%) or OIUs (31.4%). One in 8 male adoles-

**TABLE 1** Characteristics and Health Status of Adolescent Boys According to the Intensity of Their Internet Use

	NIUs (N = 642), n (%)	OIUs (N = 1225), n (%)	RIUs (N = 1752), n (%)	HIUs (N = 286), n (%)	P
<b>Characteristics</b>					
Mean age (SE), y	18.23 (0.08)	17.98 (0.04)	17.86 (0.07)	17.85 (0.09)	.005
Students' academic track	23 (3.6)	210 (17.1)	525 (30.0)	81 (28.3)	<.001
Low SES	97 (16.1)	116 (10.0)	148 (8.7)	21 (7.3)	.001
Chronic health conditions	68 (10.9)	110 (9.3)	190 (11.0)	24 (8.5)	.670
Sport played more than once per week	319 (51.2)	739 (61.1)	1085 (62.6)	160 (56.7)	.010
<b>Health status</b>					
Perceived poor health	56 (8.8)	72 (5.9)	72 (4.1)	27 (9.6)	.016
Overweight	110 (17.8)	170 (14.4)	200 (11.8)	51 (18.0)	.040
Back pain often	231 (36.5)	270 (22.2)	377 (21.6)	66 (23.0)	<.001
Headaches often	138 (21.6)	197 (16.2)	245 (14.0)	42 (14.9)	.011
Sleep quantity insufficient	239 (38.4)	452 (37.3)	654 (37.8)	118 (42.0)	.791
Mean depressive scale (SE)	1.72 (0.04)	1.56 (0.02)	1.51 (0.02)	1.70 (0.06)	<.001

cents (16.4%) reported not having used the Internet during the month preceding the survey. At the bivariate level, as seen in Table 1, the 4 groups differed regarding age, academic track, SES, and physical activity. Overall, HIUs were the youngest (mean age: <18 years). Compared with both RIUs and HIUs, very few NIUs (3.6%) reported being students. NIUs reported a lower SES more frequently. In multivariate analysis (Table 2), male HIUs were more likely than RIUs to be overweight (RRR: 1.78 [95% CI: 1.07–2.95]) and to report higher depressive scores (RRR: 1.36 [95% CI: 1.01–1.81]).

At the other extreme, NIUs were more prone to report frequent back pain (RRR: 1.87 [95% CI: 1.26–2.79]) and higher depressive scores (RRR: 1.31 [95% CI: 1.02–1.67]).

In comparison with male adolescents, fewer female adolescents were HIUs (2.2%). The proportion of RIUs (41.5%) and OIUs (39.8%) among female adolescents was quite similar. One in 8 female adolescents reported no use of the Internet in the month preceding the survey. At the bivariate level, as seen in Table 3, all groups showed differences in age, academic track, and

**TABLE 2** Multivariate Analysis of Health Problems According to Intensity of Internet Use, According to Gender

	NIUs, RRR (95% CI)	OIUs, RRR (95% CI)	HIUs, RRR (95% CI)
<b>Boys</b>			
Perceived poor health	1.21 (0.56–2.60)	1.28 (0.79–2.07)	2.11 (0.93–4.76)
Overweight	1.38 (0.91–2.07)	1.25 (0.93–1.70)	1.78 (1.07–2.95)
Back pain very often	1.87 (1.26–2.79)	0.92 (0.66–1.28)	0.98 (0.63–1.53)
Headaches very often	1.26 (0.82–1.96)	1.22 (0.91–1.65)	0.92 (0.58–1.47)
Sleep quantity insufficient	0.79 (0.55–1.13)	1.03 (0.80–1.33)	1.16 (0.81–1.68)
Depressive scale	1.31 (1.02–1.67)	1.03 (0.86–1.24)	1.36 (1.01–1.81)
<b>Girls</b>			
Perceived poor health	0.94 (0.54–1.63)	0.86 (0.58–1.28)	0.85 (0.35–2.05)
Overweight	1.19 (0.34–4.14)	1.00 (0.54–1.83)	1.03 (0.39–2.67)
Back pain very often	1.06 (0.69–1.63)	0.96 (0.68–1.35)	0.88 (0.46–1.67)
Headaches very often	0.85 (0.61–1.20)	1.14 (0.90–1.46)	1.51 (0.82–2.77)
Sleep quantity insufficient	0.74 (0.53–1.04)	0.96 (0.75–1.23)	1.91 (1.07–3.42)
Depressive scale	1.46 (1.14–1.87)	1.24 (1.06–1.44)	1.86 (1.30–2.66)

Gender-specific multinomial regressions were controlled for age, academic track, SES, chronic condition, and physical activity; RIUs served as a reference.

**TABLE 3** Characteristics and Health Status of Adolescent Girls According to the Intensity of Their Internet Use

	NIUs ( <i>N</i> = 549), <i>n</i> (%)	OIUs ( <i>N</i> = 1314), <i>n</i> (%)	RIUs ( <i>N</i> = 1370), <i>n</i> (%)	HIUs ( <i>N</i> = 73), <i>n</i> (%)	<i>P</i>
<b>Characteristics</b>					
Mean age (SE), y	18.06 (0.08)	17.82 (0.04)	17.82 (0.05)	17.52 (0.14)	.007
Students' academic track	79 (14.5)	468 (35.6)	654 (47.7)	25 (34.4)	<.001
Low SES	80 (15.3)	142 (11.2)	105 (8.1)	8 (12.1)	.080
Chronic health conditions	28 (5.3)	132 (10.3)	122 (9.1)	15 (20.9)	<.001
Sport played more than once per week	196 (36.6)	470 (36.1)	595 (43.9)	34 (46.9)	.062
<b>Health status</b>					
Perceived poor health	33 (6.1)	84 (6.4)	71 (5.2)	7 (9.0)	.041
Overweight	54 (10.6)	111 (8.8)	102 (7.6)	8 (10.8)	.716
Back pain often	167 (36.4)	467 (35.7)	454 (33.2)	27 (37.5)	.723
Headaches often	192 (35.2)	515 (39.5)	493 (36.2)	37 (50.8)	.212
Sleep quantity insufficient	165 (30.7)	482 (37.3)	471 (34.8)	43 (58.6)	.597
Mean depressive scale (SE)	1.88 (0.06)	1.87 (0.02)	1.75 (0.03)	2.16 (0.10)	<.001

presence of a chronic condition. On multivariate analysis (Table 2), female HIUs were more likely than RIUs to report insufficient sleep (RRR: 1.91) and higher depressive scores (RRR: 1.86). In addition, OIUs and NIUs also reported higher depressive scores (RRR: 1.24 [95% CI: 1.06–1.44] and RRR: 1.46 [95% CI: 1.14–1.87], respectively).

## DISCUSSION

Our study provides evidence of a U-shaped relationship between intensity of Internet use and poorer mental health of adolescents, as depicted by self-reported depression scores within a large nationally representative sample of subjects aged 16 to 20 years. In addition, the results confirm HIUs to be at increased risk for somatic health problems, being associated with insufficient sleep among female adolescents and excessive weight among male adolescents. The data regarding depression lend additional support to previous studies that have focused on the mental health of adolescents who are HIUs.<sup>7–11</sup> Less expected is the finding that adolescents who reported lower Internet use (occasional or no use at all) seem at greater risk of depressive symptoms. Such findings underline the importance of distinguishing regular from

both low and heavy Internet use when analyzing the presence of potential health problems.

Similar nonlinear associations between mental health and at-risk behaviors have been reported among adolescents. Vanheusden et al<sup>24</sup> found a U-shaped association between alcohol consumption and internalizing problems, as well as a J-shaped association between alcohol use and aggressive behavior. They concluded that both nondrinkers and excessive drinkers differed from low-level drinkers in risk factors for poor mental health. Similarly, O'Donnell et al<sup>25</sup> found a U-shaped association between alcohol consumption and depressive symptoms in a sample of young people from several Western countries and a variety of cultural backgrounds. Some years ago, our research group also found a U-shaped association between cannabis use and social skills and physical activity.<sup>26</sup> Although such association with substance use has recently been challenged,<sup>27</sup> as far as Internet use is concerned, one can hypothesize that young people who do not use the Internet are in fact somehow outside the cultural environment of their peers. Thus, nonuse of the Internet is probably not linked to lack of access to a

computer (we controlled for the socioeconomic status of our subjects) but more to those who do not engage in social online activities with their peers, because adolescents mostly use the Internet as a way to stay connected with their friends.<sup>28</sup> In other words, although it is impossible with transversal data to assess the direction of the relationship we found, we can hypothesize that adolescents who use the Internet at lower levels avoid using it not because of their lack of access, but from their isolation with additional depressive symptoms. This hypothesis is supported by a recent prospective study reporting that depression was present before Internet addiction among a subset of adolescents in Taiwan.<sup>8</sup>

Regarding somatic health, female HIUs reported insufficient sleep in a higher proportion. Some authors mention that adolescent sleep may have decreased in the last decades partly because of the use of new technologies<sup>29</sup> and that sleep problems among them are linked to delayed bedtime hours and disturbed sleep modes.<sup>30</sup> Social live interactions are among the favorite online activities of female adolescents, regardless of their health condition,<sup>31,32</sup> which may explain why we found an association among girls only. Most evidence from the literature links heavy Internet use to obesity.<sup>15,16</sup> Our multivariate analysis leads to similar findings, but only among male adolescents. Overweight and obesity problems are lower among female adolescents than among male adolescents living in Switzerland<sup>33</sup> which may have prevented us from finding a link between weight problems and Internet use among female adolescents. In turn, male NIUs were found to be at increased risk of frequent back pain. Because the vast majority of male NIUs in our sample were in apprenticeships, 1 possible explanation for this



finding may be that they have more physical workloads than their peers who are still in high school. We could have expected such back pain to be present among HIUs, but Hakala et al<sup>13</sup> have reported that adolescents need to use the Internet at least 42 hours/week to be at risk of back pain, an amount of Internet use which probably concerns only a minority of our group. The major strength of our study is that it is based on a nationally representative sample of adolescents. However, some limitations must be addressed. Adolescents not attending post-mandatory school were not included in our study, which can limit the generalization of the results. Also, the nature and total amount of time dedicated to specific online activities were not assessed, which partly limits the interpretation of our results. The gathering of our data dates to 2002: since then, because of the evolution of multimedia technologies, access to Internet has been made easier (eg, cell phones or electronic diaries), and the total time spent online may have increased; however, an increase in the amount of total time spent online should not have altered the nature of the associations that we found.

## CONCLUSIONS

Our study, from which a U-shaped relationship between intensity of Internet

use and depressive symptoms is described, builds to some extent on a recent study in which moderate use of the Internet is shown to be associated with a more positive academic orientation than are nonuse or high levels of use.<sup>17</sup> The potential positive effects of a moderate use of the Internet have previously been stressed in a position article of the Canadian Paediatric Society.<sup>34</sup> It should be kept in mind, however, that the effect of Internet use on health is linked to not only the amount of time spent, but also the nature of these activities and the objectives followed by the young users.<sup>35</sup> As many parents currently expect advice from health professionals on what can be considered as a safe use of the Internet, this article provides some evidence that using the Internet several days per week to <2 hours/day has become a normative behavior during adolescence. Health care providers should thus be alerted both when caring for adolescents who do not use the Internet or use it rarely, as well as for those who are online several hours ( $\geq 2$  hours) daily. For many years, physicians and nurses who care for adolescents have used the so-called HEADSSS (home, education, activities, drugs, sexuality, suicide, safety) acronym to review the lifestyles of adolescents.<sup>36</sup> This article stresses the importance of adding routine questions

on Internet use to the list of items to review when caring for young people.<sup>37,38</sup>

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