

Problematic cell phone use for text messaging and substance abuse in early adolescence (11- to 13-year-olds)

Luigi Gallimberti¹ · Alessandra Buja² · Sonia Chindamo¹ · Alberto Terraneo¹ · Elena Marini¹ · Andrea Rabensteiner² · Angela Vinelli² · Luis Javier Gomez Perez² · Vincenzo Baldo²

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Abstract The aim of our study was to examine the association between problematic cell phone use (PCPU) for text messaging and substance abuse in young adolescents. This cross-sectional study was conducted on the basis of an ad hoc questionnaire, during the 2014–2015 school year in a province of the Veneto Region (Italy); it involved a sample of 1156 students in grades 6 to 8 (11 to 13 years old). A self-report scale based on the Short Message Service (SMS) Problem Use Diagnostic Questionnaire (SMS-PUDQ) was administered to assess the sample's PCPU. A multivariate logistic regression model was applied to seek associations between PCPU (as the dependent variable) and independent variables. The proportion of students who reported a PCPU increased with age in girls (13.5 % in 6th grade, 16.4 % in 7th grade, and 19.5 % in 8th grade), but not in boys (14.3 % in 6th grade, 18.0 % in 7th grade, and 14.8 % in 8th grade). Logistic regression showed that drunkenness at least once and energy drink

consumption raised the odds of PCPU, whereas reading books, higher average school marks, and longer hours of sleep were associated with lower odds of PCPU in early adolescence.

Conclusion: our findings confirm a widespread PCPU for text messaging among early adolescents. The odds of PCPU is greater in young people at risk of other substance abuse behavior.

What is Known:

- *Problematic cell phone use (PCPU) is associated with smoking and alcohol consumption in older adolescence.*

What is New:

- *PCPU is widespread in early adolescence and it is associated with other unhealthy types of behavior.*
 - *Prevention, based on a multicomponent intervention strategy, should take PCPU into account for early adolescents too.*
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✉ Alessandra Buja
alessandra.buja@unipd.it

Luigi Gallimberti
luigi.gallimberti@studiogallimberti.it

Sonia Chindamo
sonia.chindamo@gmail.com

Alberto Terraneo
alberto.terraneo@gmail.com

Elena Marini
elena.marini@icloud.com

Andrea Rabensteiner
andrea.rabensteiner@studenti.unipd.it

Angela Vinelli
angela.vinelli@sanita.padova.it

Luis Javier Gomez Perez
luisjavier.gomezperez@unipd.it

Vincenzo Baldo
vincenzo.baldo@unipd.it

¹ Novella Fronda Foundation, Foundation for Studies and Applied Clinical Research in the Field of Addiction Medicine, Via Marsala 42, 35122 Padova, Italy

² Department of Molecular Medicine; Laboratory of Public Health and Population Studies, Institute of Hygiene, University of Padua, Via Loredan 18, 35128 Padova, Italy

Keywords Adolescents · Alcohol consumption · Energy drink consumption · Problematic cell phone use · Substance abuse

Abbreviations

CPU	Cell phone use
ICT	Information and communication technology
PCPU	Problematic cell phone use
SMS-PUDQ	SMS Problem Use Diagnostic Questionnaire

Introduction

Information and communication technologies (ICT), such as computers, Internet, and mobile phones, have become a central part of the everyday life of adolescents [31]. Surveys conducted in various countries have shown rates of mobile phone usage by such young adolescents ranging from 76 to 99.4 % [8, 25, 31, 35]. The mobile phone has many features that make it very attractive and encourage its use, particularly in adolescence. Owning and using a mobile phone stimulates teenagers' personal autonomy [27]; it gives them prestige and a sense of identity in relation to their peers [19]; it can offer major technological innovations; it is a source of fun and entertainment; and it promotes the establishment and maintenance of interpersonal relationships [36].

As the use of these devices increases among adolescents, so do the problems of excessively intensive cell phone use and addiction. In Italy, Martinotti et al. [24] found an overall prevalence of problematic cell phone use (PCPU) of 6.3 % in a sample of 2853 adolescents attending high school. Other studies have reported even higher rates of PCPU or cell phone dependence in late adolescence (15 years of age and over) [31, 39]. Although it has been suggested that PCPU may per se be a risky behavior in adolescents [39], few studies have examined the PCPU-related risk factors vis-à-vis the domains already identified in the literature as being associated with the risk factors typically considered when examining other forms of dependence and substance abuse in adolescence, such as socio-demographic factors, the family, peer, and personality domains, and the behavioral domain [10].

The use of cell phones has been increasingly associated with socially unacceptable behavior [21]. For example, mobile phone use at school is disruptive and reduces students' attention in class [32]. There are also concerns that some cell phone users incur substantial debts [15] and that cell phones are being used to harass others [37]. In particular, there is growing evidence of these devices being used by children as a means to bully other children [7, 36]. Previous research has also found PCPU associated with psychological distress [2], low self-esteem [39], depression [40], substance abuse [5, 20,

39], and other risk-related behavior such as aggression, insomnia, and suicidal tendencies [39] in adolescent populations.

To our knowledge, few studies have assessed whether and how PCPU in young adolescents might be specifically associated with substance abuse in later adolescence. The aim of our study was therefore to examine the association between substance abuse and PCPU for text messaging by young adolescents.

Methods

Participants

This survey was conducted during the 2014–2015 school year in Padua, a city in the Veneto Region (north-eastern Italy) with a population of about 8000 young adolescents (age range 10–14). The survey involved a sample of 1156 students in grades 6 to 8 (corresponding in Italy to students from 11 to 13 years old) attending 60 classes at 7 different regular schools. One or two secondary schools were recruited on a voluntary basis from each of the six school districts in the province, and they took part in a school-based scheme for the prevention of underage substance abuse. A questionnaire was administered by the team managing the prevention scheme and completed by the students in 20 classes of 6th graders (33.88 % of the sample), 19 classes of 7th graders (30.24 % of the sample), and 21 classes of 8th graders (35.8 % of the sample).

Material

The tool used for the study was an ad hoc questionnaire developed on the basis of research conducted by Gallimberti et al. in 2011 [12]. The questionnaire administered to the students consisted of 136 multiple-choice questions covering all domains known to be associated with health risk factors, i.e., socio-demographic factors, family domain risk factors, peer domain risk factors, personality domain risk factors, and behavioral domain risk factors [10], as shown in Table 1. For analytical purposes, we categorized the following variables as a dummy: "Eat fruits and/or vegetables once a day" (Neither fruit nor vegetables/One of the two/Both), "No respect for the rules about returning home" ("They punish me"/"They don't punish me"), "Decision-making in group of friends" ("I usually decide what we do (leader)"/"We decide together or others decide for me"), "Time of returning home in the evenings" (From 16.00 to 21.59 h/From 22.00 h onwards), "Number of profiles on social networks" (none/one/two or more), "Number of friends on social networks" (none/1–50/51–199/≥200), "Smoking" (I don't smoke, or smoke less than once a month/I smoke at least once a month), "Alcohol" (I

Table 1 Questionnaire administered divided into domains associated with health risk factors

Domain risk factors	Variable name	Domain
Socio-demographic factors	Age	<i>How old are you?</i>
	Sex	<i>Are you (male or female)?</i>
	Nationality	<i>What's your nationality?</i>
Family domain	Not cohabitant parents	<i>Do your parents live together? (Yes/No)</i>
	Siblings >13 years old	<i>Do you have siblings over 13 years old? (Yes/No)</i>
	Number of Smartphones/PCs in family	<i>How many smartphones/PCs are there in your family? (None/One/Two/More than two)</i>
	Eat fruits and/or vegetables once a day	<i>Usually how many times a week do you eat fruit/vegetables? (Never/Less than once per week/2–4 times a week/5–6 times a week/Once a day, every day/More than once a day)</i>
	Education	<i>How would you define the education that you have received from your parents as regards obeying rules? (Flexible/Rigid/No rules)</i>
	No respect for the rules of returning home	<i>If you break rules, what do your parents do? (“They get very angry and punish me”/“They do not get angry but they punish me”/ “They get very angry but they do not punish me”/ “They do not get angry or punish me”)</i>
	Talk to father	<i>How easy is it for you to talk to your father? (Very easy/Easy/Difficult/Very difficult/Don't have or see them)</i>
	Talk to mother	<i>How easy is it for you to talk to your mother? (Very easy/Easy/Difficult/Very difficult/Don't have or see them)</i>
	Weekly pocket money	<i>Have you weekly pocket money? (Yes/No)</i>
	Weekly pocket money (amount)	<i>If so, how much money your parents give you weekly?</i>
Peer domain	Friend group size	<i>How large is your group of friends? (No fixed group/2–4 friends/5–9 friends/10–20 friends/>20 friends)</i>
	Decision friends group	<i>Who makes decisions in your group of friends? (“I usually decide what we do”/ “We decide together”/ “Others decide for me”)</i>
	Number of best friends	<i>How many best friends do you have? (None/One/Two/Three or more)</i>
	Talk to best friends	<i>How easy is it for you to talk to your best friend? (Very easy/Easy/Difficult/Very difficult/Don't have or see them)</i>
Personality domain	Parish groups/Volunteering/ Scouting	<i>Do you often go to parish/ volunteering/ scouting groups? (Yes/No)</i>
	Artistic activities	<i>Do you engage in artistic activities? (Yes/No)</i>
	Playing sports	<i>Do you play sports? (Yes/No)</i>
	Playing competitive sport	<i>Do you play competitive sports? (Yes/No)</i>
	Hours of sport a week	<i>How many hours a week do you spend practicing sport?</i>
	Enjoyment for reading	<i>Do you like reading? (Yes/No)</i>
	Like reading comics	<i>Do you like reading comics? (Yes/No)</i>
	Like reading magazines	<i>Do you like reading magazines? (Yes/No)</i>
	Like reading newspapers	<i>Do you like reading newspapers? (Yes/No)</i>
	Like reading texts on internet	<i>Do you like reading texts on the internet? (Yes/No)</i>
	Like reading books	<i>Do you like reading books? (Yes/No)</i>
	Reading frequency	<i>How often do you spend time reading? (Less than once a week/Once a week/More than twice a week/Every day)</i>
	Adherence to rules	<i>When people ask me to respect the rules: (“I always obey rules”/“Only when I believe they are right”/“I hate rules and try not to obey them”)</i>
	Enjoyment for school	<i>Do you like school? (“I do not like it at all”/ “I do not like it much”/ “I quite like it”/ “I really like it”)</i>
Average school mark	<i>What are your average school marks across subjects? (4 or less/5/6/7/8/9/10)</i>	
Behavioral domain	Hours of sleep	<i>How many hours do you sleep at night? (4 or less/5/6/7/8/9/10/More than 10)</i>
	Evenings out per week	<i>How many evenings a week do you go out with friends? (Never/One/Two/Three/Four/Five/Six/Every evening)</i>
	Time of returning home in the evenings	<i>What time do you return home in the evening? (18.00/19.00/20.00/21.00/22.00/23.00/24.00/Over midnight)</i>
	Number of profiles on social networks	<i>How many social network profiles do you have? (Number of profiles)</i>

Table 1 (continued)

Domain risk factors	Variable name	Domain
	Number of friends on social networks	<i>How many friends do you have in your social network profile?</i> (Number of friends on social networks)
	Internet access	<i>Do you have access to Internet?</i> (Yes/No/Only when supervised by my parents)
	Hours spent surfing the Internet	<i>On average, how many hours a day do you spend surfing the Internet?</i> (Number of hours)
	Hours spent playing with videogames	<i>On average, how many hours a day do you play with videogames?</i> (Number of hours)
	Hours spent watching TV	<i>On average, how many hours a day do you watch television?</i> (Number of hours)
	Scratch card buying	<i>Have you ever bought scratch and win cards?</i> (Yes/No)
	Video poker	<i>Have you ever bet money at video poker?</i> (Yes/No)
	Betting	<i>Have you ever placed bets on the internet?</i> (Yes/No)
Substance use	Smoking	<i>Have you ever tried smoking cigarettes?</i> (Yes/No)
	Smoking (last month)	<i>How often do you currently smoke?</i> (Don't smoke/ Smoke less than once a week/Smoke at least once a week/ Smoke every day)
	Alcohol consumption	<i>Have you ever tried to drink alcohol?</i> (Yes/No)
	Alcohol (last month)	<i>How often do you currently drink alcoholic beverages?</i> (Never /Rarely/ Every month/ Every week/ Every day)
	Drunkness at least once	<i>How many times did you drink so much that you became really drunk?</i> (Never/Once/2–3 times/4–10 times/More than 10 times)
	Energy drink consumption	<i>Have you ever tried to drink energy drinks beverages?</i> (Yes/No)
	Energy drink (last month)	<i>How often do you currently drink energy drinks beverages?</i> (Never /Rarely/ Every month/ Every week/ Every day)
	Marijuana smoking	<i>Have you ever tried smoking cannabis?</i> (Yes/No)

drink less than once a month /I drink at least once a month), “Drunkness” (never/at least once), and “Energy drink consumption” (I drink less than once a month /I drink at least once a month).

The dependent variable in our study was PCPU, and it was measured by means of a self-administered scale based on the Short Message Service (SMS) Problem Use Diagnostic Questionnaire (SMS-PUDQ) [30], which was included in the survey. This latter questionnaire has an acceptable internal consistency and correlates with other measures of problem SMS use. It consists of 8 items adapted from the diagnostic questionnaire developed by Young [41] to measure behavior indicative of Internet addiction, revised to reflect SMS use.

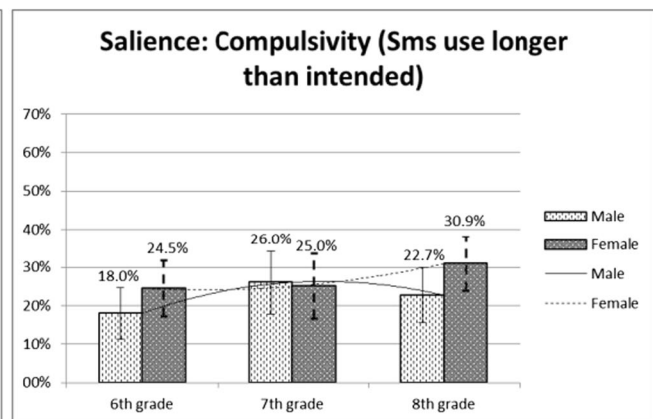
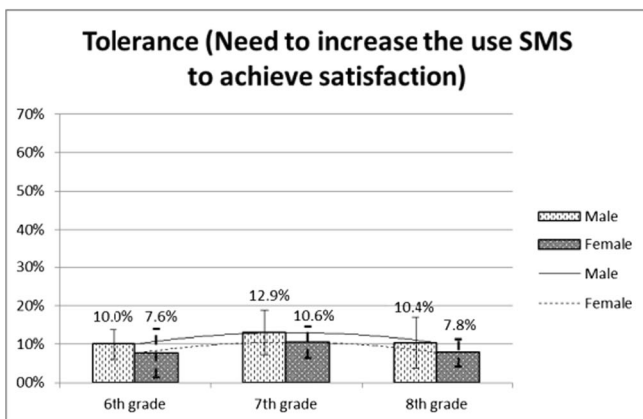
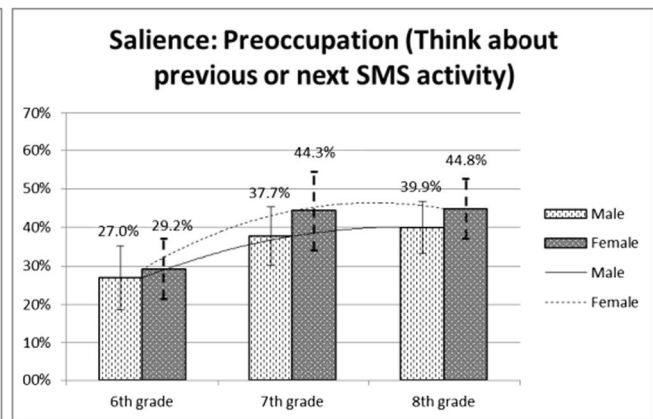
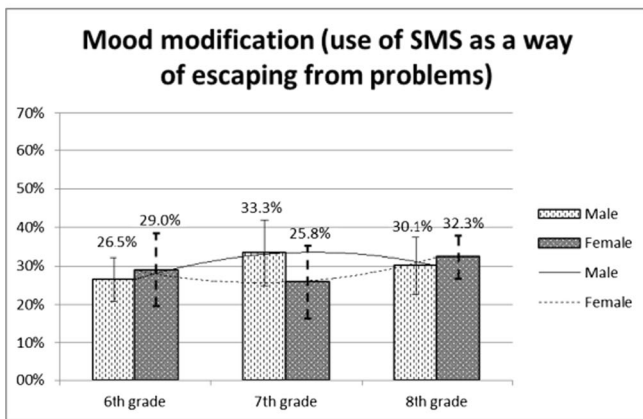
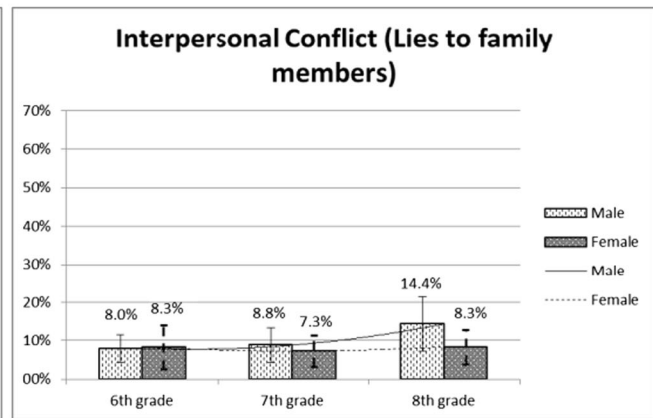
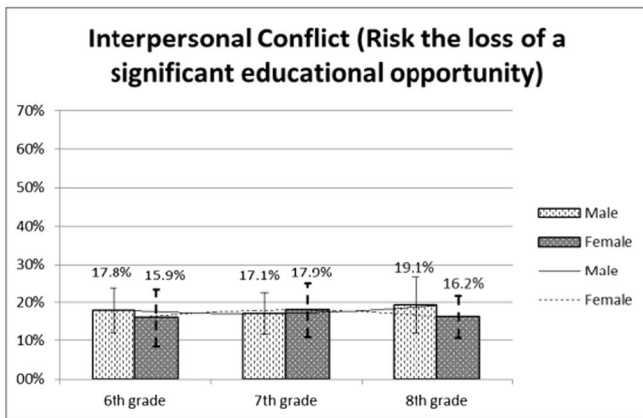
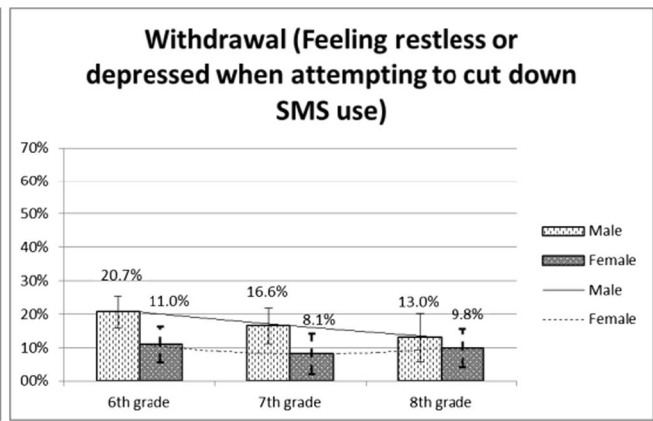
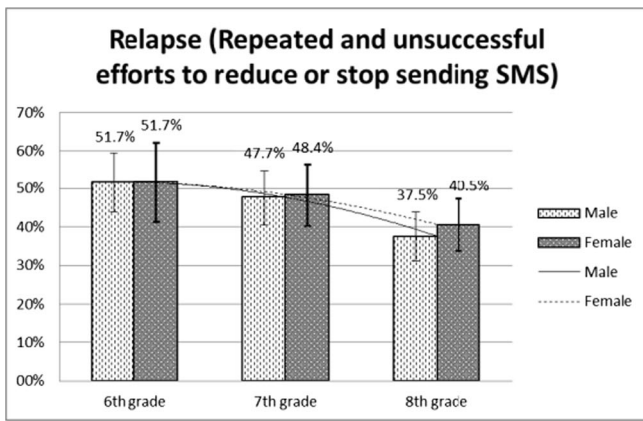
We measured the degree of PCPU from the answers given for these 8 self-rated items. Each response was scored both on a Likert scale (0=strongly disagree, 1=disagree, 2=agree, 3=strongly agree) and on a dichotomized scale (0, 0, 1, 1). The dichotomized scores for each item were then combined to obtain an overall PCPU score ranging from 0 to 8. Based on the results of the investigation conducted by Yen et al. [40], who found that having four or more symptoms of PCPU had the greatest potential for differentiating between adolescents

with and without functional impairments caused by cell phone use, we considered problematic use as a score of 4 or more.

Statistical methods

Proportions and 95 % confidence intervals were calculated, taking the clustering of the sample by school and classroom into account. A bivariate analysis was conducted between the variable PCPU and each variable in the above-described domains. Then a multivariate mixed-effects logistic regression was used to model binary outcome variables, using PCPU as the dependent variable, to take the clustered data into account. The independent variables superimposed on the model were sex, age, and nationality. All variables found associated with the dependent variable in the bivariate model were entered as covariates one at a time by means of a forward stepwise approach. Variables were retained in the model if the *p* value of the regression coefficient was <0.20.

Fig. 1 Proportion (%) of adolescents declaring agree or strongly agree in each item of SMS Problem Use Diagnostic Questionnaire (SMS-PUDQ). Error bars represent 95 % CIs



The statistical analyses were performed using STATA software, ver. 12.0

Results

We enrolled 1156 students, slightly more than half of them males (53.5 %), and most of them are Italian (85.5 %). The mean age of the sample was 12.04 years ($SD=1.04$ years).

Figure 1 shows the proportion of adolescents declaring that they agree or strongly agree in each item in the SMS-PUDQ. Among the 6th graders, more than 50 % of both boys and girls reported having repeatedly made unsuccessful efforts to cut back or stop sending text messages.

The proportions of adolescents classified as problematic cell phone users for text messaging by sex and class are shown in Fig. 2. It is worth noting that the percentage of students classified as problematic cell phone users for text messaging increased with age among the girls (13.5 % of the 6th graders, 16.4 % of the 7th graders, and 19.5 % of the 8th graders), but not among the boys (14.3 % of the 6th graders, 18.0 % of the 7th graders, and 14.8 % of the 8th graders).

Table 2 shows the results of the multivariate logistic regression model. Drunkenness at least once ($OR\ 3.66\ 95\ \% \ CI=1.15-11.59$)—which approached statistical significance, energy drink consumption ($OR\ 1.98\ 95\ \% \ CI=0.94-4.19$), reading texts on the Internet ($OR\ 2.07\ 95\ \% \ CI=1.02-4.20$), a larger number of close friends ($OR\ 1.66\ 95\ \% \ CI=1.00-2.75$), and female sex ($OR\ 2.18\ 95\ \% \ CI=1.01-4.72$)—increased the odds of PCPU, reading books ($OR\ 0.48\ 95\ \% \ CI=0.24-0.99$), whereas higher average school marks ($OR\ 0.53\ 95\ \% \ CI=0.36-0.77$), returning home later in the evenings ($OR\ 0.19\ 95\ \% \ CI=0.08-0.45$), and longer hours of sleep ($OR\ 0.69\ 95\ \% \ CI=0.52-0.90$) reduced the odds.

Discussion

To the best of our knowledge, the present study is the first to be conducted in Europe on PCPU in young adolescents. Our findings show that PCPU is widespread in early adolescence in Italy. The odds of PCPU are higher among adolescents who adopt other types of behavior related with the risk of substance abuse and are also associated with other risk factors associated with dependence and substance abuse in young adolescents. About 16 % of adolescents in our sample were classifiable as problematic cell phone users. This estimated prevalence is consistent with the figures reported in some, but not all studies conducted in other countries. López-Fernández et al. [22] found a prevalence of 14.8 % of problematic mobile phone users in a sample of 1132 Spanish adolescents aged 12 to 18, whereas other European studies on samples of a similar age (12 and older) have reported lower rates (5.57 and 6.3 %) [8,

24]. This discrepancy could be due to the different instruments and classification methods used [22]. Nevertheless, PCPU should be seen as a public health issue [24] because the uncontrolled, inappropriate, or excessive use of mobile phones can give rise to social, behavioral, and affective problems [9].

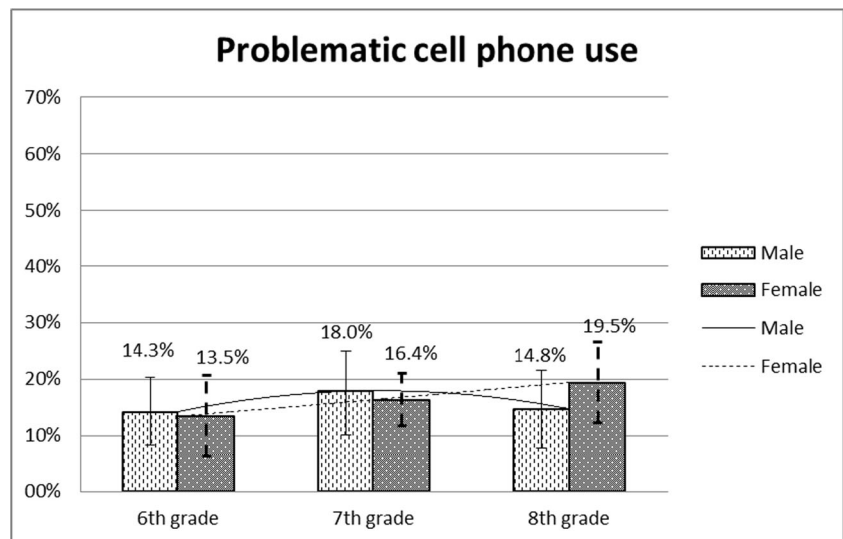
Our data suggest that drunkenness at least once and energy drink consumption are risk factors for PCPU. Several studies have found a link between adolescents' cell phone use and their substance abuse and other risky behavior. More precisely, a study on a sample of 14- to 16-year-old Finns confirmed that more intensive mobile phone usage was positively associated with tobacco and alcohol consumption [20]. An investigation conducted by Yang et al. [39] on ≤ 15 -year-old Taiwanese adolescents found PCPU associated with adolescent aggression, insomnia, and cigarette smoking, with alcohol drinking in girls under 15 and all boys, with betel nut chewing in boys, and with illicit drug use in girls under 15 and boys aged 15 or more. These authors hypothesized that PCPU, substance use, and aggression are an aggregation embedded in a chaotic lifestyle. Leena et al. [20] likewise spoke of a poor health-related lifestyle in which smoking, alcohol drinking, and mobile phone use play an important part.

Another result of our study worth emphasizing is the positive association between PCPU and the fact of having a larger circle of friends, which may reflect a greater tendency to extroversion in problematic cell phone users. Sociability is one of the major defining features of extroversion, and extroverts consequently tend to have larger circles of friends and social networks. This might promote a greater use of mobile phones, since these devices appear to serve as a tool of social influence [3].

Besides the above-described associations with PCPU, our study also identified several protective factors that make an adolescent less likely to be a problematic cell phone user. In our sample, the individuals who had better school grades were less likely to have PCPU, a finding that highlights the negative association between good academic performance and PCPU, and confirms the positive association between PCPU, or intensive cell phone use, and poor academic outcomes seen in other studies on adolescents. To be more specific, Sánchez-Martínez and Otero [31] found that intensive cell phone use was associated with poor school results in adolescents with a mean age of 15.7 years. The already mentioned Taiwanese study [39] also showed that boys aged 15 or more with PCPU were more likely to have dropped out of school than those without PCPU. It may be that individuals with better school grades are less often distracted by cell phone use while studying. This is congruent with the results of a study conducted by Junco and Cotton [18], who found a negative association between texting while doing schoolwork and overall average school marks in a large sample of college students.

A previous study found that reading was moderately popular and that interest in reading for pleasure declined over the

Fig. 2 Proportion (%) of adolescents classified as problematic cell phone users by sex and school grade. Error bars represent 95 % CIs



years in adolescents aged 11–15 years. In our sample, the young adolescents who read books for pleasure used mobile phone less problematically than those who do not read books. A possible explanation for this could be that a fondness for reading books reflects a lower tendency for extroversion. An extrovert has been defined [11] as a person who is sociable, needs to have people to talk to, and dislikes reading or studying alone. This personality trait has been identified as an important predictor of PCPU and associated with a greater

susceptibility to addictive behavior, such as alcoholism [17] or drug addiction [14]. On the other hand, we found reading texts on the Internet positively associated with PCPU. This might be because it is one of the mobile phone functions used by teenagers. A study on Italian adolescents aged 12–18 found that Internet access was an important explanatory factor for the mobile phone functions most often used by these teenagers [28]. So, problematic cell phone users might plausibly access the

Table 2 Logistic regression results analyzing associations between problematic cell phone use and behaviors associated with health: ORs and 95 % confidence intervals, *p* value ($P > |z|$)

Problematic cell phone use	OR	[95 % CI]	$P > z $
Age	0.86	0.58–1.28	0.469
Female (ref. male)	2.18	1.01–4.72	0.048
Not Italian (ref. Italian)	1.22	0.50–2.94	0.663
TV in the room—yes (ref. no)	1.24	0.61–2.53	0.552
Eat fruits and/or vegetables once a day—yes (ref. no)	0.91	0.60–1.38	0.666
Adherence to rules	1.49	0.73–3.04	0.272
Like reading texts on internet—yes (ref. no)	2.07	1.02–4.20	0.045
Like reading books—yes (ref. no)	0.48	0.24–0.99	0.046
Enjoyment for school—yes (ref. no)	0.81	0.49–1.31	0.387
Average school mark	0.53	0.36–0.77	0.001
Hours spent watching TV	1.66	0.87–3.18	0.124
Time of returning home in the evenings—after 10.00 pm (ref. before 10.00 pm)	0.19	0.08–0.45	0.000
Hours' sleep	0.69	0.52–0.90	0.007
Drunkenness at least once—yes (ref. no)	3.66	1.15–11.59	0.028
Energy drink consumption—yes (ref. no)	1.98	0.94–4.19	0.072
Number of best friends (ref none)	1.66	1.00–2.75	0.050
Friends on social networks (ref none)	1.11	0.82–1.51	0.495
Play competitive sport—yes (ref. no)	1.60	0.78–3.29	0.202
Age	0.86	0.58–1.28	0.469

Internet more frequently from their mobile phones and, thus, read Internet texts more often on their phones.

Sleeping more hours a day also proved to protect against PCPU in our sample, consistently with a previous review [5]. Yang et al. [39] found an association between PCPU and short periods of sleep at night in a large cohort of Taiwanese adolescents, and they suggested that intensive cell phone use might lead directly to a decrease in total sleep time by occupying a part of the time available or the content involved might even cause sleep problems. Mobile phone usage has been associated with fewer hours of sleep among Finnish adolescents too [29]. Japanese adolescents aged 13–15 who used their mobile phones every day were also found to be more awake in the evening and to have later wake-up times and fewer total hours of sleep [16]. They were also reportedly less satisfied with their night's sleep than students who did not use a mobile phone every day. Late-evening, exciting cell phone use can cause arousal and a greater alertness of the brain, the opposite of the calming effects conducive to sleep [34], and can thus delay the onset of sleep [23].

Our results demonstrate that PCPU is widespread in early adolescence and that PCPU is closely related to other unhealthy and risky types of behavior, such as alcohol abuse. Possible explanations for this linkage are still being debated, but the tendency for sensation and novelty seeking and impulsiveness typical of adolescence may underlie the increase in such unhealthy behavior patterns. In fact, high levels of novelty/sensation-seeking are powerful predictors of drug and alcohol use [1, 38], and there is evidence of impulsiveness being both a risk factor and a consequence of substance abuse [26]. Smetaniuk [33] identified poor impulse control as one the strongest predictors of PCPU. Other studies reported similar findings [4]. Adolescence is a time of profound neurodevelopmental change characterized by a growing influence of motivation substrates in the setting of immature inhibitory substrates. A stronger motivational drive for novel experiences, coupled with an immature inhibitory control system, can predispose individuals to impulsive actions and risky behavior. The adolescent's vulnerability to such tendencies thus places all adolescents at greater risk of unhealthy and risk-taking behavior, including PCPU and alcohol consumption, but individual genetic and environmental risk and protective factors may work in conjunction with developmental changes in brain function over time to generate a given adolescent's level of vulnerability to addiction [6]. Be that as it may, the association emerging from our research between PCPU and other risk-related behavior at such a young age underscores the need to include cell phone usage in programs designed to prevent substance abuse

and other risk-related behavior in early adolescence. As suggested by a previous study [13], parental monitoring of their children's media usage has protective effects on a number of their academic, social, and physical outcomes. Pediatricians and physicians generally are ideally placed to provide scientifically based recommendations to families: encouraging parents to monitor their children's media usage carefully can have far-reaching health benefits for their children.

The present study has several limitations that should be considered when interpreting our results. First, our data was cross-sectional, and this limits our ability to draw causal inferences, particularly concerning the direction of the association between PCPU in text message use and the behavioral health risk factors considered (which might be two-way). A second limitation of our study lies in that, because certain types of risk-related behavior, such as substance abuse, remain a sensitive topic among adolescents, our data may be biased by their under- or over-reporting their risk-taking behavior. To mitigate this potential bias, we used a self-administered questionnaire and guaranteed that respondents would remain anonymous.

In any case, this study revealed a widespread PCPU among early adolescents and an association between PCPU for text messaging and other unhealthy types of behavior. Health promotion schemes based on a multicomponent strategy of intervention should take the possibility of PCPU in early adolescence into account. Instead when such behavior has already developed in adolescents, it is worth considering the adoption of educational strategies at school aiming to provide families with advice on how to contain or eliminate this behavioral problem.

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Authors' contributions Dr Gallimberti conceptualized the study, coordinated all study phases, and approved the final manuscript as submitted. Dr. Buja designed the study, carried out the statistical analyses, reviewed and revised the manuscript, and approved the final manuscript as submitted. Dr Chindamo designed the data collection instruments, coordinated and supervised data collection at different school, and approved the final manuscript as submitted. Dr Marini, Dr Rabensteiner, and Dr Terraneo are involved in data collection at different schools and approved the final manuscript as submitted. Dr Gomez interpreted the data, critically reviewed and revised the manuscript, and approved the final manuscript as submitted. Dr Baldo designed the sampling methods, critically reviewed and revised the manuscript, and approved the final manuscript as submitted.

Compliance with ethical standards • The authors have no conflicts of interest to disclose. The founder had no role in study design; data collection, analysis, and interpretation; and manuscript drafting; or the decision to submit the paper for publication.

• The study was approved by the Ethical Committee at Padua Teaching Hospital. All procedures were in accordance with the ethical standards of our institutional research committee, and with the 1964 Helsinki Declaration and its later amendments, or comparable ethical standards.

• Consent to the students' participation was first obtained from the school director. If this was granted, the prevention program was included in the school's teaching plan, which is signed by parents at the start of the school year. Then all parents of the students enrolled were asked to sign a consent form and the students themselves also signed an assent form.

Conflict of interest The authors declare that they have no competing interests.

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