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ORIGINAL ARTICLE

Problematic mobile phone use in adolescence: a cross-sectional study

Giovanni Martinotti · Corrado Villella · Domitilla Di Thiene · Marco Di Nicola · Pietro Bria · Gianluigi Conte · Maria Cassano · Filippo Petruccelli · Nicola Corvasce · Luigi Janiri · Giuseppe La Torre

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Abstract
Aim In recent years, mobile phone use has become increasingly common among Italian youth, while a growing scientific literature has been identifying the occurrence of a problematic mobile phone use which seems to share some features of other conditions often referred to as behavioural addictions. The study aimed to assess the prevalence of problematic mobile phone use in a population of Italian adolescents and its association with other behavioural addictions.
Subjects and methods The Mobile Addiction Test (MAT) was administered to 2,790 high school students from Barletta, an Italian town, together with the South Oaks Gambling Screen-Revised for Adolescents (SOGS-RA), the Compulsive Buying Scale (CBS), the Internet Addiction Test (IAT), the Exercise Addiction Inventory (EAI), the Work Addiction Risk Test (WART).
Results MAT scores fitted a Gaussian distribution model. Scores≥17 was found as a cut-off value over which identifying problematic mobile phone users. Overall prevalence of problematic mobile phone use was 6.3%; this condition was associated with other behavioural addictions like compulsive buying.
Conclusion Problematic mobile phone use in adolescence should become a public health issue, and it could be a cause of health problems and social costs.

Keywords Adolescence · Behavioural addictions · Information and communication technologies · Mobile phones

G. Martinotti · C. Villella (✉) · M. Di Nicola · P. Bria · G. Conte · L. Janiri
Institute of Psychiatry and Psychology, Università Cattolica del Sacro Cuore,
largo Francesco Vito, 1,
00168 Rome, Italy
e-mail: cvillella2001@yahoo.com

D. Di Thiene · G. La Torre
Sapienza University of Rome, Clinical Medicine and Public Health Unit,
Viale Regina Elena 324,
00185 Rome, Italy

M. Cassano · N. Corvasce
Local Health Unit, Drug Addiction Service,
via Alcide De Gsperi 20,
70051 Barletta, Italy

F. Petruccelli
Department of Human and Social Sciences, University of Cassino,
via Guglielmo Marconi 10,
Cassino 03043, Italy

Introduction

Mobile phone use has become increasingly common among Italian adolescents during the last years: 92 and 97.8% of youth aged 11–17 and 14–17, respectively, use mobile phones; 91.7% of youth aged 14–17 use their own mobile phones. Among youth aged 14–17, this device is used to make phone calls (93.6%), send SMS (81.3%), play games (52.1%), change ringtones (46.9%), use the phonebook (42.7%), shoot, send, receive photos (38.8%), listen to music (33.3%) shoot, send, receive videos (15.2%), plan the datebook (11.2%), record conversations (10.3%), make video-calls (5.1%), connect to the Internet (4.1%) (Istituto Nazionale di Statistica 2008). Mobile phone use can provide many benefits, but a problematic use can be commonly identified.

Walsh et al. (2008) carried out a qualitative exploration on 32 young Australians aged between 16 and 24 years, focusing on the psychological factors relating to mobile

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phone use and whether mobile phone addiction was occurring amongst this group. Mobile phone addiction was described applying Brown's criteria for behavioural addictions such as: cognitive salience, as the activity dominates the person's thoughts and behaviours; conflict with other persons or activities; euphoria or relief, a feeling of short-term pleasure from engaging in the behaviour; tolerance or loss of control over the behaviour; withdrawal, as experiencing unpleasant feelings when unable to engage in the behaviour; relapse and reinstatement, indicated when people unsuccessfully attempt to cut down on the behaviour, subsequently engaging in similar or higher levels than previously (Brown 1993).

Other studies focused on the occurrence of a problematic mobile phone use, which seems to share some features with other conditions, often referred to as behavioural addictions (Rutland et al. 2007; Hyun Ha et al. 2008). In accordance with this hypothesis, Bianchi and Phillips (2005) developed the Mobile Phone Problem Use Scale, a self-report instrument, validating it in a sample of adults. Higher scores obtained on this scale have been correlated with measures of extraversion and low self-esteem, but not with neuroticism (Bianchi and Phillips 2005), and with high self-monitoring and high approval motivation, but not with loneliness. These traits have been commonly reported in the literature on addictive disorders (Takao et al. 2009). Unfortunately, this scale has not been tested on adolescents, and no cut-off point has been indicated in order to identify problematic mobile phone users, and consequently to estimate the prevalence of this condition. Yen et al. (2009) have recently developed the problematic cellular phone use questionnaire (PCPU-Q), a self administered 12-item questionnaire based on the diagnostic criteria for substance dependence proposed by the DSM-IV-TR (American Psychiatric Association 2000), and assessing the functional impairment related to problematic cellular phone use. In a survey on a large sample of Taiwanese adolescents, the authors identified a cut-off score of 4 or more, and found an association between problematic cellular phone use and depression (Yen et al. 2009. However, at the moment there is no study that clearly defines the differences between normal and problematic use, and the criteria for mobile phone addiction, its epidemiology and social costs. The aims of the present study are:

- Using the mobile addiction test (MAT) (Società Italiana Intervento Patologie Compulsive. Mobile Addiction Test. www.siipac.it accessed on 03 June; SIIPaC 2010) for the choice of a cut-off point for accessing problematic use of mobile phones identified by a deviation of 2 standard deviations (SD) from the mean score and defined as problematic for its association with other dysfunctional behaviours
- Assessing the prevalence of problematic mobile phone use according to this cut-off point
- Assessing the association between problematic mobile phone use and behavioural addictions in order to verify the hypothesis which considers this phenomenon as one of these conditions

Methods

Study design and population

A questionnaire study was carried out on the problematic use of mobile phones and other behavioural addictions in an adolescent population. In all, 2,853 students were evaluated during a health promotion program about behavioural addictions held in the upper intermediate schools in Barletta, a town with around 100,000 inhabitants in southern Italy. All of the six upper intermediate schools in town were invited to take part. All the schools joined the project except one, which was under renovation at the time of assessments.

Materials

Our main aims were to provide a validation of the MAT, a screening test described below, to assess the prevalence of this phenomenon, and to check for the association with other behavioural addictions, i.e. pathological gambling, compulsive buying, Internet addiction, work addiction and exercise addiction.

Mobile Addiction Test (MAT). The MAT is a questionnaire developed by Italian authors in order to assess problematic mobile phone use (SIIPaC 2010). The ten items evaluate how the mobile phone use affects the subjects' routine; answers A were scored 1 point, answers B were scored 2 points, answers C 3 points.

South Oaks Gambling Screen-Revised for Adolescents (SOGS-RA) (Winters et al. 1993, b, 1995). This is a 19-item questionnaire derived from the South Oaks Gambling Screen (SOGS; Lesieur and Blume 1987). It varies from the original SOGS by a decrease of one in the number of the scoring items, minor changes in some response options and minor changes in the wording of some items. Poulin (2002) produced further evidence of its reliability and validity. Following indications from Ladouceur et al. (2000), in the present study, a cut-off score of 5 or higher was chosen to identify probable pathological gamblers.

Compulsive Buying Scale (CBS) (Faber and O'Guinn 1992). The scale contains 13 items derived from previous research and theoretical models of compulsive buying. Subjects are asked to rate how true each item was for them on a

scale ranging from 1 (not at all) to 7 (very much). The scale has a negative cut-off score of −1.34, identifying compulsive buyers. The scale is highly reliable (alpha = 0.95), one dimensional, and valid, and it has been previously used in several studies in adults and college students (Koran et al. 2006; Roberts 1998).

Internet Addiction Test (IAT) (Young 1998). The IAT is a 20-item questionnaire in which respondents are asked to rate each item on a 5-point Likert scale, according to how Internet use affects their daily routine, social life, productivity, sleeping patterns and feelings. Young suggests that a score of 70 or more means that Internet use is causing significant problems. Widyanto and McMurran (2004) supported the reliability and validity of this test.

Work Addiction Risk Test (WART) (Robinson 1989). The WART is a 25-item self report inventory, assessing the respondents' work habits. Each item is scored on a 4-point Likert scale. Scores≥70 identify work-addicted individuals (Robinson 1989). Several studies have determined its reliability and validity (Flowers and Robinson 2002; Robinson 1996; Robinson 1999; Robinson and Post 1994; Robinson et al. 1992).

Exercise Addiction Inventory (EAI)(Terry et al. 2004; Griffiths et al. 2005). The EAI consists of six statements based on a modified version of the components of behavioural addiction. Each statement has a 5-point Likert response option coding so that high scores reflect attributes of addictive exercise behaviour. A cut-off score of 24 or more identifies individuals considered at risk for exercise addiction. The scale has been demonstrated to have construct and content validity, and it has a good internal and test-retest reliability.

Procedure

The research protocol was designed by the Institute of Psychiatry of the Catholic University of Rome together with the Addictive Disorders Service of the Local Health Unit. The study protocol complied fully with the guidelines of the Ethics Committee of the Catholic University of Rome, and was approved by the Institutional Review Boards in accordance with local requirements. It was conducted in accordance with Good Clinical Practice guidelines and the Declaration of Helsinki (World Medical Association 2009). The students were informed about the aims of the study, their participation was voluntary and free. The self report questionnaires were anonymous and they were personally administered at school, in the presence of the teachers.

Statistical analysis

We composed descriptive statistics—mean, mode, median, standard deviation (SD)—and graphs (histogram and box plot). Normality of quantitative variables was assessed with the Q-Q plot test and skewness and kurtosis measurements. A linear regression model was used in order to verify the influence of age and gender on the total score. The Anova *F* test was used to study the effects of gender and age in a multivariate analysis. Furthermore, a multiple regression analysis was performed using MAT scores as dependent variables and gender and age as independent variables.

Data were stratified by gender, and then, in order to choose a cut-off score for the MAT, a multiple logistic regression analysis was performed using different cut-off scores, in order to choose the best value for considering a participant as a problematic mobile phone user. This allowed us to identify risk factors associated with problematic mobile phone use.

Different levels of cut-off concerning MAT scores were considered as the dependent variable, while age, SOGS-RA, CBS, IAT, WART and EAI scores were used as independent variables. Multiple logistic regression analyses were performed via the backward elimination procedure as described by Hosmer and Lemeshow (1989), while the goodness of fit of the regression model was tested using the Hosmer and Lemeshow test (Hosmer and Lemeshow 1989).

Results

Out of 3,249 students attending the schools involved, 2,853 (87.8%) entered in the study, while 2,794 (97.8% of the participants) completed the MAT. Among the participating students, 1,129 were females (40.4%) and 1,665 males (59.6%), aged 13–20 years. The MAT scores ranged from 0 to 22 and fitted a normal (Gaussian) distribution model, both for the general population and for boys and girls separately, as shown in the following graphics. Concerning

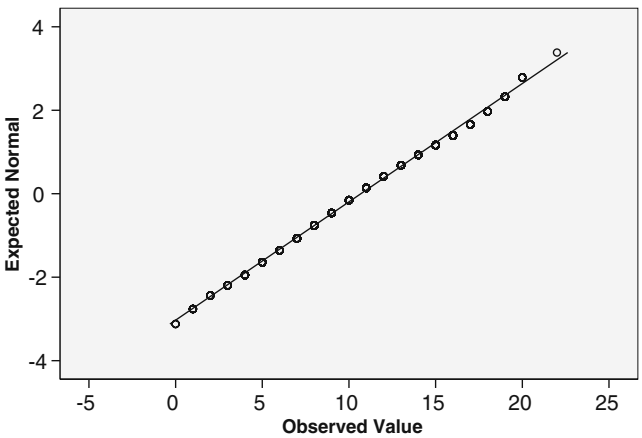

Fig. 1 Normal Q-Q plot of the MAT score observed in respect to the normal distribution (*dotted line* vs *unbroken line*)

Table 1 Multiple linear regression analysis for MAT scores as the dependent variable and age and gender as independent variables

Model	Non-standardized coefficients		Standardized coefficients	*t*	*p*
	B	SE	Beta		
Constant	9.458	0.642	14.738	<0.001	
Gender	0.872	0.136	0.121	6.401	<0.001
Age	0.053	0.039	0.026	1.360	0.174

ANOVA F test=23.00 ($p<0.001$). *SE* standard error

the MAT score distribution, a normal distribution trend was found (Fig. 1, the normal Q-Q Plot) with skewness and kurtosis ranking very close to 0 in value (skewness 0.11; kurtosis −0.093).

Thus, the prevalence of problematic mobile phone use, with a cut off score of 17, is 6.3% in the overall population, 6.1% among boys, and 6.5% among girls ($p=0.51$).

The mean MAT score for the total population was 10.69 with an SD of 3.53. Mean scores were 11.22 (SD=3.34) for girls and 10.32 (SD=3.61) for boys. This difference was statistically relevant both in a univariate analysis, according to Student's t test, and in a multivariate analysis, according to ANOVA F test. Scores were not significantly affected by age (Table 1). In the multiple logistic regression analysis gender showed no significant effect, while age had a mild protective effect (Table 2). The multiple logistic regression model which best fitted the data was the one which used a cut-off score of 17, both for boys (Table 3), and for girls (Table 4).

Thus, the prevalence of problematic mobile phone use, with a cut off score of 17, is 6.3% in the overall population, 6.1% among boys, and 6.5% among girls ($p=0.51$). In simple logistic regression analyses, problematic mobile phone use in boys was associated with all of the other behavioural addictions, and in the girls it was associated with all of the other behavioural addictions except for exercise addiction.

The multiple logistic regression analyses (Tables 3 and 4) identified a significant association between mobile phone problematic use and pathological gambling [OR cut-off 16: 2.75(1.68–4.5); OR cut-off 17: 3.93(2.32–6.67); OR cut-off 18: 4.73(2.39–9.35); OR cut-off 19: 2.73(1.03–7.25)] and compulsive buying for the boys—(OR cut-off 16: 2.47 (1.54–3.96); OR cut-off 17: 2.82 (1.68–4.75); OR cut-off 18: 4.09(2.1–7.98); OR cut-off 19: 3.62(1.5–8.75)—and between problematic mobile phone use and compulsive buying—OR cut-off 16: 2.94(1.73–5); OR cut-off 17: 2.99 (1.54–5.81); OR cut-off 18: 3.22(1.31–7.9); OR cut-off 19: 9.17(2.48–33.82)—for the girls, while other associations were no longer evident.

Discussion

The MAT could be a useful screening test in large populations, and scores higher than 17 could identify subjects with a problematic mobile phone use. This cut-off score, almost corresponding to the Mean+2 SD (= 17.75) was selected because it provided the best model in the multiple logistic regression analyses we performed in order to identify the association with other behavioural addictions.

Girls score higher than boys, but gender did not result as being a risk factor for this condition when controlled by age in a multiple logistic regression analysis; on the other hand, in this analysis, age resulted as a mild protective factor, even if it had no significant effect according to the linear regression analysis. Problematic mobile phone use is associated with different conditions in the two genders; this could reflect the difference in prevalence of gambling and other addictive behaviours in the two genders, in line with previous research (Shaffer et al. 1999; Petry et al. 2005; Greenberg et al. 1999).

With an overall prevalence of 6.3%, or even higher according to the Taiwanese study cited before (Yen et al. 2009), problematic mobile phone use should become a public health issue, because of its short- and long-term effects. Mobile phone use when driving leads to an increased risk for road accidents (Haigney 2001), with a

Table 2 Logistic regression with different cut-off values defining the dependent variable (MAT scores), considering age and gender as covariates

	Cut-off 16		Cut-off 17		Cut-off 18		Cut-off 19	
	OR crude	OR (IC95%)	OR crude	OR (IC95%)	OR crude	OR (IC95%)	OR crude	OR (IC95%)
Age	0.98 (0.92–1.06)	0.97 (0.9–1.04)	0.96 (0.88–1.05)	0.9 (0.82–0.98)	0.97 (0.86–1.09)	0.89 (0.79–1.01)	1.02 (0.86–1.22)	1.04 (0.87–1.24)
Gender	1	1	1	1	1	1	1	1
	1.45 (1.13–1.85)	1.47 (1.14–1.89)	1.11 (0.82–1.51)	1.13 (0.83–1.54)	0.95 (0.62–1.44)	0.96 (0.63–1.47)	0.67 (0.35–1.29)	0.66 (0.34–1.27)

Table 3 Logistic regression with different cut-off values for variable MAT as the dependent variable (males)

	Cut-off 16		Cut-off 17		Cut-off 18		Cut-off 19	
	OR crude	OR (IC95%)	OR crude	OR (IC95%)	OR crude	OR (IC95%)	OR crude	OR (IC95%)
Age	1.05 (0.95–1.16)	1.11(0.99–1.24)	1.04 (0.92–1.17)		0.98 (0.84–1.14)		1.05 (0.85–1.3)	
SOGS over 5	1	1	1	1	1	1	1	1
	4.43 (2.93–6.7)	2.75(1.68–4.5)	5.7 (3.63–8.93)	3.93(2.32–6.67)	7.39 (4.22–12.92)	4.73(2.39–9.35)	7 (3.29–14.96)	2.73(1.03–7.25)
CBS under 1.34	1	1	1	1	1	1	1	1
	2.93 (1.94–4.41)	2.47(1.54–3.96)	3.54 (2.23–5.61)	2.82 (1.68–4.75)	5.06 (2.85–9)	4.09(2.1–7.98)	4.93 (2.26–10.78)	3.62(1.5–8.75)
IAT over 70	1	1	1		1		1	1
	7.19 (2.92–17.67)	3.69(1.29–10.58)	5.42 (1.94–15.14)		8.03 (2.6–24.79)		12.07 (3.31–43.96)	4.32(0.98–19.13)
WART over 70	1 1.63 (0.92–2.89)		1 2.28 (1.25–4.15)		1 2.8 (1.33–5.92)		1 2.2 (0.75–6.48)	
EAI over 24	1	1	1	1	1	1	2.06 (0.77–5.51)	
	1.94 (1.19–3.18)	1.67(0.99–2.83)	2 (1.14–3.53)	1,8 (0.98–3.28)	2.77 (1.39–5.55)	2.45(1.16–5.2)		
Hosmer-Lemeshow's test		<0.001		0.64		0.29		0.06

quadrupling of the risk of a collision during the time spent on a call (Redelmeier and Tibshirani 1997). An excessive mobile phone use has been identified as a risk factor for neck-shoulder and low back pain in adolescents (Hakala et al. 2006), for hearing and vision problems (Meo and Al-Drees 2005) and, in the long term, for some kind of brain tumour (Hardell et al. 2008). Furthermore, mobile phone use could interfere with school life and social environments (Selwyn 2003). Problematic mobile phone use is not yet to be considered as a sound diagnostic construct, but recent studies (Walsh et al. 2008; Hyun Ha et al. 2008; Takao et al. 2009; Yen et al. 2009) are in line with the hypothesis defining it as a behavioural addiction. Our study was the first to assess the association between problematic mobile phone use and other behavioural addictions. This association could be due to common risk factors and common features between different behavioural addictions, which seem to be inter-correlated phenomena (Di Nicola et al. 2010; Villella et al. 2010).

Recent data suggest that these conditions share genetic and neurobiological bases with drug addictions (Brewer and Potenza 2008). However most research has been focused on pathological gambling, while data on problematic mobile phone use are still missing.

Table 4 Logistic regression with different cut-off values for variable MAT as the dependent variable (females)

	Cut-off 16		Cut-off 17		Cut-off 18		Cut-off 19	
	OR crude	OR (IC95%)	OR crude	OR (IC95%)	OR crude	OR (IC95%)	OR crude	OR (IC95%)
Age	0.89 (0.8–0.98)		0.86 (0.76–0.99)		0.95 (0.79–1.15)		1.02 (0.74–1.4)	
SOGS over 5	1		1	1	1		1	1
	3.67 (1.69–7.97)		6.23(2.77–14)	2.73 (0.97–7.64)	6.28 (2.27–17.39)		17.03 (4.95–58.63)	5.91 (1.28–27.39)
CBS under 1.34	1	1	1	1	1	1	1	1
	3.33 (2.06–5.38)	2.94(1.73–5)	4.13 (2.33–7.31)	2.99 (1.54–5.81)	5.32 (2.5–11.31)	3.22(1.31–7.9)	14.52 (4.52–46.64)	9.17 (2.48–33.82)
					1			
IAT over 70	1 9.13 (2.75–30.34)	1 5.44 (1.53–19.35)	1 12.51 (3.73–42.03)		19.8 (5.51–71.16)	1 11.03 (2.71–44.93)	1 22.1 (4.27–114.31)	
WART over 70	1 2.31 (1.32–4.06)		1 3.44 (1.83–648)	1 3.09 (1.53–6.25)	1 3.39 (1.43–8.02)		1 3.93 (1.6–14.56)	
EAI over 24	1		1		1		1	
	0.98 (0.46–2.1)		1.34 (0.56–3.22)		1.98 (0.68–5.77)		3.04 (0.65–14.14)	
Hosmer-Lemeshow's test		0.28		0.71		0.58		0.78

Adolescence is a period at great risk for the development of addictive behaviours: nearly 60% of individuals who initiate drug use and 80% of those who start drinking alcohol (Johnston et al. 2005) or smoking cigarettes (Department of Health and Human Services 1994) do so at or before 18 years of age, and problem and pathological gambling are highly prevalent in adolescent populations (Shaffer et al. 1999; Villella et al. 2010). This susceptibility depends on both neurobiological (Schepis et al. 2008) and psychological (Marcelli and Braconnier 2004) processes taking place in this period of life. The limitations of the study are: (1) the survey was conducted in only one town, (2) information bias could have occurred in collecting data on mobile phone use, and (3) the results must be confirmed in other settings.

In a salutogenic process in which individuals and communities take collaborative actions (Simonelli et al. 2010), schools can play a key role in health promotion programs (Paulus 2007), in both primary prevention, through health education, increasing knowledge and awareness of the risks, and secondary prevention, offering at-risk youth the support of school counsellors, in line with a strategy proposed for pathological gambling (Messerlian et al. 2005).

Health promotion strategies focusing on this issue should be developed targeting the adolescent population, considering that a pathway could lead adolescents through classical and operant conditioning—both through excitement and increased arousal and through relief from anxiety and depressive states—and habituation to the development of a behavioural addiction (Blaszczynski and Nower 2002), and that excessive mobile phone use could be a cause of health problems—most notably brain tumours (Hardell et al. 2008; Hardell and Carlberg 2009; Kundi 2010), road accidents (Redelmeier and Tibshirani 1997; Haigney and Westermann 2001; Ship 2010), semen alterations (Jurewicz et al. 2009), orthopaedic (Hakala et al. 2006), and hearing and vision problems (Meo and Al-Drees 2005) with consequent social costs.

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Conflict of Interest The authors declare that they have no conflict of interest.

Ethical approval The study protocol complied fully with the guidelines of the Ethics Committee of the Catholic University of Rome, and was approved by the Institutional Review Boards in accordance with local requirements. It was conducted in accordance with Good Clinical Practice guidelines and the Declaration of Helsinki.

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