

Phantom Phone Signal: why it should be of interest for psychiatry

Segnale Telefonico Fantasma: perché dovrebbe interessare la psichiatria

SIMONE PISANO^{1,2*}, GABRIELE MASI³, GENNARO CATONE⁴, PIETRO MURATORI³,
ANNARITA MILONE³, RAFFAELLA IULIANO⁵, ANGELO REGA⁶, VINCENZO PAOLO SENESE⁷,
PIA SANTANGELO¹, MARIA PIA RICCIO^{2#}, CARMELA BRAVACCIO^{2#}

*E-mail: pisano.simone@gmail.com

¹Child and Adolescent Neuropsychiatry, Department of Neuroscience, Santobono-Pausilipon Hospital, Naples, Italy

²Department of Translational Medical Sciences, Federico II University, Naples, Italy

³IRCCS Fondazione Stella Maris, Scientific Institute of Child Neurology and Psychiatry, Calabrone (Pisa), Italy

⁴Department of Formative, Psychological and Communication Sciences, Suor Orsola Benincasa University, Naples, Italy

⁵Neonatology Unit, "Ospedale del Mare", Naples, Italy

⁶Natural and Artificial Cognition Lab, Department of Humanistic Studies, Federico II University, Naples, Italy

⁷Department of Psychology, University of Campania "Luigi Vanvitelli" (Caserta), Italy

[#]These authors contributed equally

SUMMARY. Phantom Phone Signal (PPS) refers to the false perception of a mobile phone ringing, vibrating and blinking, when in fact it did not. A recent literature about PPS is growing, parallel to an increasing interest about its possible psychopathological implications. The present review aims to synthesize the current knowledge about the phenomenon, and to present a conceptual framework that integrates PPS as a putative index of psychopathology. Furthermore, we propose possible directions for further research. The phenomenon seems highly prevalent, irrespective of age and gender, although estimates are still inconsistent. We have analysed possible factors associated to PPS, disentangling them in person-related (i.e. characteristics of individuals who experience PPS) and phone use-related factors (i.e., time spent using the phone, time of the mobile in vibrating mode, the carrying location of the device, average number of call/message in a day, etc). Literature regarding the association between PPS and mental illness is limited, as most of the samples are not clinical and too sectorial. Preliminary data suggest that anxiety/depression and stress-related problems seem to be the psychopathological background favouring the experience of PPS. Despite PPS is a common phenomenon, it usually do not seem to significantly impact the people's quality of life. However, they deserve attention, given the huge diffusion of phone mobiles, particularly in children and adolescents, as it may be an index for emotional or stress-related difficulties. Future studies are needed to better clarify its frequency and its possible impact on everyday life. Studies in clinical samples may further clarify its psychopathological implications.

KEY WORDS: phantom vibration, phantom ringing, psychiatry.

RIASSUNTO. Il termine Segnale Telefonico Fantasma (Phantom Phone Signal - PPS) si riferisce alla falsa percezione di un telefono cellulare che squilla, vibra o si illumina, quando in realtà ciò non avviene. La letteratura sul PPS sta crescendo, parallelamente all'aumentato interesse riguardo le sue possibili implicazioni psicopatologiche. La presente revisione ha lo scopo di sintetizzare le attuali conoscenze sul fenomeno e di presentare una cornice concettuale che integri il PPS come indice di possibile psicopatologia. Inoltre, vengono proposte direzioni per future ricerche. Il fenomeno sembra molto presente, in qualsiasi età e genere, anche se i valori stimati non sono ancora del tutto certi. Abbiamo analizzato possibili fattori associati al PPS, suddividendoli in fattori "legati alla persona" (per es., le caratteristiche degli individui che sperimentano il PPS) e fattori "legati all'uso del telefono" (per es., tempo trascorso nell'uso del telefono, tempo in modalità vibrazione, luogo dove si porta con sé il dispositivo, numero medio di telefonate/messaggio effettuati e ricevuti al giorno). La letteratura riguardo l'associazione tra PPS e malattia mentale è limitata, poiché la maggior parte dei campioni studiati sono non clinici e troppo settoriali. Dati preliminari suggeriscono che problemi di ansia/depressione e condizioni legate allo stress possono essere il sottofondo psicopatologico che favorisce l'esperienza del PPS. Nonostante il PPS sembra sia un fenomeno comune, esso non sembra impattare eccessivamente sulla qualità di vita delle persone. Tuttavia, richiede attenzione per la ampia diffusione degli smartphone, soprattutto tra bambini e adolescenti, perché può essere un indice di difficoltà emotive o legate allo stress. Futuri studi sono necessari per chiarificare la frequenza e il suo eventuale impatto sulla vita di tutti i giorni. Studi in campioni clinici possono ulteriormente chiarificare le sue implicazioni psicopatologiche.

PAROLE CHIAVE: vibrazione fantasma, squillo fantasma, psichiatria.

Phantom Phone Signal: why it should be of interest for psychiatry

INTRODUCTION

Mobile phones are currently representing the main tools for communication and entertainment, and they are strongly influencing our daily lives. Although these tools can be very helpful in many daily activities, the rapidly increasing diffusion, particularly in children and adolescents, is parallel to an increased risk of loss of control, with negative effects on individual psychological functioning, peer and family interactions, academic performance and daily life. Despite its frequency in general population, neither the Diagnostic and Statistical Manual of Mental Disorder, 5th Edition (DSM-5)¹, nor the International Classification of Disease, 10th Edition (ICD-10)² give a definite nosological place to phone related addictions and related problematic behaviours (i.e., text message dependence). The growing awareness of the different behavioral addictions related to electronic devices led to the inclusion of Internet Gaming Disorder into the fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5), under Section 3, as a condition that requires further study before becoming an official mental disorder (American Psychiatric Association, 2013). Similarly, the World Health Organization (WHO) has included Gaming Disorder into the new release version of the International Classification of Diseases 11th Edition³ (ICD-11; WHO, 2018). However, other addictive behaviors more closely related to phone cell are not included in the Internet Gaming Disorder criteria.

Among the more recently described phenomena related to the huge use of mobile phone, phantom phone signal (PPS) is receiving growing attention^{4,5}. The term PPS refers to the phantom perception of phone ringing or vibrating, when in fact it did not. The first description of the phenomenon by Laramie in 2007 reports on the false perception of the phone ringing, defined “ringxiety”⁶. Following, the increasing interest in the study of phone signal perceptions led to the creation of a more detailed and specific set of definitions, such as “phantom vibration” (PV), “phantom ringing” (PR) and “phantom blinking” (PB), referring to the wrong perception of phone vibrating, ringing or blinking, respectively. Several other wordings are vibrxiety, hypovibrochondria and fauxcellarms⁷ and, more precisely, Phantom Vibration Syndrome (PVS), Phantom Ringing Syndrome (PRS), converging in the more inclusive definition of Phantom Phone Signals (PPS), which refers to individual’s perception of all phone signals, including ringtone, notification sound, vibration or light signals⁸.

To date, PPS has been prevalently explored in health professionals or university students, probably because it is assumed that these categories are more prone to an intensive use of the mobile phone, and more confident with its technology, for professional or social reasons. However, PPS was recently described also in school aged children and in adolescents, as in these age ranges mobile phone use is basically ubiquitous (>90% of adolescents⁹, 69% of children^{9,10}). Few studies have analyzed clinical samples. In the present review, we summarize the current knowledge about the phenomenon of PPS and its possible determinants, proposing a conceptual framework that integrates PPS in some forms of psychopathology. Possible directions for further researches are suggested. In the present narrative review, we will try to retain the wording that was used in the original study. The literature search was made using Pubmed. We used the terms “phantom phone signals”, “ringxiety”, “phantom vibration” and “phantom ringing”. Possible other papers were retrieved

using the reference lists of the selected papers. We updated the literature search up to October 2020.

EPIDEMIOLOGY

According to the available studies, PPS resulted to be a common phenomenon, although data about prevalence are not consistent. The only review in the literature reports a prevalence for PPS ranging between 27.4% and 89%⁷. In his seminal study, Laramie (2007) investigated 320 mobile phone users about their emotional and behavioural relationship with their mobile, and found that 2/3 of the population referred to have experienced “ringxiety”⁶. Further, Saaid Al-An et al.¹¹, in a study conducted on 200 young adults (mostly, medical students), found that 4% of them experienced frequent ringxiety, 73% moderate ringxiety, and only 23% of them did not report such symptoms. In the same study, vibration false feeling was present in the 47% of the sample. Rothberg et al.¹² found that 68% of a medical staff population experienced PVS, 13% of them perceiving phenomenon every day, and 87% of them weekly or monthly. According to Drouin et al.⁴, approximately 89% of 290 undergraduates had experienced phantom vibrations, 40% of them at least once a week, and most of them had experienced PVS between one and five months after getting their mobile phone. An Indian study about ringxiety and mobile phone usage patterns in medical college students found a prevalence of ringxiety of 34.6%¹³. In the Tanis et al. study, about 82% of respondents indicated to have experienced at least once some forms of PPS, and about 50% of them indicated a frequency of at least once a week. PVS was the most prevalent sensation, being reported in 47% of the participants more than once episode per month, compared to 33% for PRS and 26% for PB⁸.

The longitudinal study of Lin et al.¹⁴, including 74 medical interns, showed that the baseline prevalence of PVS was 78.1%, increased up to 95.9% and 93.2% in the third and sixth internship months, and then gradually decreased to 50.0% two weeks after the internship ended. Kruger et al.¹⁵ confirmed that the most common experience was PV (82%), and the less common PR (45%), with phantom notification in the middle (50%). In a wider sample of undergraduate students, the authors found the following percentage of prevalence: PV 76%, PR 29%, and phantom notifications 44%.

Mohammadbeigi et al.¹⁶ studied PPS in Iranian undergraduate medical students, and found that 70.1% of the participants experienced at least one type of PPS, and 32.5% of them experienced both PV and PR. The prevalence was 54.3% for PV and 49.3% for PR. In Mangot et al.’ study¹⁷, including 93 medical interns, 60% of the participants reported PV, and 42% had experienced PR. Finally, Pisano et al.¹⁸ reported that, in a sample of young students aged 10 to 14 years, PPS resulted a common phenomenon, with a prevalence of 58.9%.

DEMOGRAPHIC FACTORS: GENDER, AGE AND OCCUPATION

To date, only a part of the studies examined gender ratio in patients with PPS, and results are quite inconsistent. Sub-

ba et al.¹³ found an even distribution of ringxiety between gender. Consistently, Tanis et al.⁸ found not statistically significant differences between males and females experiencing PPS at least once a week, or PR or phantom blinking. Saaid Al-Ani et al.¹¹, on the contrary, reported that PR was more common in males.

Regarding PV, in Tanis et al.⁸ males experienced the phenomenon significantly more frequently than females (61.3% versus 49.1%). According to the Authors, this difference may be accounted for by the different position of the phone, as men generally carry the phone in their pocket, while women more likely in a purse or on a table⁸. On the contrary, Mohammadbeigi et al.¹⁶ report that PV was more common in females, and PR more frequent in males. In Pisano et al.¹⁸ the prevalence of PR or PV was higher in females, with increasing rates with age.

Few studies examined the role of both age and occupation on PPS, and they consistently suggest that PPS is much more common in youth than in adults^{8,12}. Furthermore, in Tanis et al.⁸ students and people working at sales and office have higher rates of PPS, compared to unemployed. Furthermore, there is a negative correlation between age and intensity of phone use.

PERSON-RELATED FACTORS ASSOCIATED WITH PHANTOM PHONE SIGNALS

Person-related factors refer to the characteristics of the individuals who experience PPS, including the exposure to stressful conditions and specific personality traits predisposing to PPS. Lin et al.¹⁴ conducted a study on 74 medical interns before, during, and after their internship, exploring the association between PPS and anxiety, depression and stress. They found that, before starting the internship, the prevalence was 78.1% for PV and 27.4% for PR; both the sensations became more frequent during the year of internship, with a peak of 95.9% for PV at the third month, and 87.7% for PR at the sixth month. Two weeks after the end of the internship, PV decreased below baseline levels (50%), while PR, although decreased, remained significantly higher than the baseline (54.2%). Although they could not demonstrate any association between PPS and anxiety or depression, the increased rates of both PV and PR during the internship were associated to the stress induced by this experience. Chen et al.¹⁹ investigated the association between PR/PV and anxiety, depression and occupational burnout in a sample of adult employees of a high-tech agency. They found that anxiety and depression were not related with PV or PR, while they noted an independent association with the occupational burnout, concluding that PV and PR may be considered a stress-induced phenomenon.

In its seminal study Laramie⁶ proposed that, in the general population, PR was associated with an impulsive personality dimension. The Lin's et al.¹⁴ study about personality traits showed that before internship, interns with PR, compared to those without PR, had significantly higher scores of novelty seeking trait, one of the three dimensions of personality measured with the TPQ – Tridimensional Personality Questionnaire²⁰. However, during internship, the two groups did not differ in harm avoidance and reward dependence, as

well as in other indices of the TPQ. The baseline personality traits predicted most of the anxiety and depression during internship, but they did not have any predictive power on the development of PV/PR¹⁴.

Tanis et al.⁸ observed a weak significant positive correlation between PPS and the personality characteristics “need for popularity” and “need to belong”, with the first being the stronger predictor of PPS. This finding suggests that individuals who are motivated to appear popular and engage in communication with others can more frequently experience PPS.

Kruger et al.¹⁵ also aimed to explore possible associations between PPS and psychological attributes, specifically those related to insecurity in interpersonal relationships. They found that individuals scoring higher in attachment anxiety had more frequent experiences of PR and phantom notifications, while attachment avoidance and sensation seeking did not predict PPS. Furthermore, they found that individuals scoring higher in attachment anxiety were more likely to experience PPS when they were expecting a call or a message, and when they were concerned about something that could be communicated them by phone.

Drouin et al.⁴ examined personality factors that are related to frequency and bother of PV. They found that people higher in conscientiousness experienced phantom vibrations less frequently, and those who had strong reactions to text messages (higher in the emotional reaction subscale of text message dependence) were more bothered by phantom vibrations.

PHONE USE-RELATED FACTORS

Phone use-related factors refer to “external” elements related to phone use, i.e., the amount of exposure to mobile use. Tanis et al.⁸ suggested that individuals who are more exposed to phone signals are also more prone to develop PPS. Both Saaid Al-Ani et al.¹¹ and Tanis et al.⁸ found that the sensation was linked to the duration of using mobile per day, while Catchings et al.²¹ did not find any statistical association between ringxiety and amount of hours spent using phone.

Regarding PV, Saaid Al-Ani et al.¹¹ found that it was associated not only to the time spent using the mobile phone, but also to the personal feeling of being important while using the phone¹¹. In the study of Saaid Al-Ani et al.¹¹, the 27% of the participants defined themselves as “mobile addicted”, and in this subgroup, PPS was very common. Tanis et al.⁸ further supported both the relation between excessive phone use, phone addiction and PPS, as well as the relationship between perceived phone importance and PPS experience. Additionally, Rothberg et al.¹² found that PV was associated with the total time the device was carried, and the time during which the mobile was in vibrating mode. They suggested that repeated use of the vibration mode resulted in the intermittent perception that the device is vibrating, when actually it was not, and that the PV was equally present using pagers or cell phone. They also found an association between PV and the device location (with breast pocket position being more closely associated with PV)¹². Lin et al.¹⁴ failed to confirm these results, as the only element increasing the odds of PV (but not PR) was the use of vibration mode.

Phantom Phone Signal: why it should be of interest for psychiatry

These data are consistent with Mangot et al.¹⁷, supporting a significant relationship between prevalence of phantom sensations and the use of the phone in vibration mode and the average number of call/message received in a day. On the contrary, regarding PR, Saaid Al-Ani et al. did not find any correlation with the type of mobile ringing tone¹¹.

Another possible phone-related factor is the time after which people began experiencing PPS. According to Rothberg et al.¹², 16% of the subjects experienced PV after less than a month after starting to use the device, 23% after a year or more, and most of the subjects between one month and one year. In Lin et al.¹⁴, the 41% of the individuals began to experience PV after one to five months after using the cell phone.

IMPLICATIONS FOR PSYCHIATRY: PHANTOM PHONE SIGNAL AND MENTAL DISORDERS

At present, few studies have explored the relations between PPS and mental disorders and/or psychopathological dimensions. Lin et al.¹⁴ evidenced that medical interns with severe PV/PR had higher depression and higher anxiety scores than interns with subclinical PV/PR, but total anxiety scores were not significantly elevated during the third month of internship. Furthermore, scores of cognitive/affective and somatic depression subscales were elevated during internship. More specifically, interns with severe PV/PR had more somatic depression, while interns with only severe PR had more cognitive/affective depression. In a subsequent study, Lin et al.²² examined the same data with a dimensional approach, disentangling the population into three groups based on the severity of PV and PR. The subclinical group was characterized by no PV/PR, and by defining the symptoms as “not bothersome at all”, the moderate group described them as “a little bothersome”, and the severe group as “very bothersome”. With this approach, the authors found that interns with severe PV or PR had higher levels of somatic depression and subjective and somatic anxiety than the interns with subclinical PV or PR, but only interns with severe PR had more cognitive/affective depression than the subclinical PR group.

Mangot et al.¹⁷ examined stress level and pattern of phone use in a population of medical interns. Both the perceived stress and smartphone addiction score were significantly lower in students who did not perceive PV as compared to those who did. In the only study exploring PPS in youth population (pre-adolescents aged 10-14 years), Pisano et al.¹⁸ reported an association between the presence of PPS and both emotional problems and temper tantrums. They were relevant predictors of the presence and intensity of PPS, even after controlling for age, gender and phone-related variables.

Despite PV/PR are common phenomena, they usually do not seem to significantly affect people's quality of life. In Rothberg et al.¹², 93% of the population found the episodes to be not at all or only a little bothersome, while the remaining 7% found it bothersome or very bothersome. Similarly, Drouin et al.⁴ found that only 7% of their subjects found PV bothersome and 2% found it very bothersome (a total of 9%). Of interest, 86% of the participants did not use specif-

ic strategies to stop the sensation. This may imply, as suggested by the authors, that people consider PPS a normal part of the human-mobile phone interactive experience. Authors also suggest that emotional reactions could be used as a possible target of the treatment, aimed to decrease them through relaxation techniques or cognitive behavioural therapy with an adjunctive positive effect on text message dependency⁴.

The triggering events and the biological and psychopathological mechanism underpinning these false perceptions are still controversial. Rothberg et al.¹² suggest that these sensations could be defined as auditory or tactile hallucinations, with the brain perceiving a stimulus not actually present, resulting from a misinterpretation by cerebral cortex of incoming sensory signals. The phantom sensations might originate in presence of schemas based on expectancies and anticipation of phone signals by brain^{6,12}. The exposure to frequent phone signals may habituate people to associate them to social⁴ or urgent work communications^{14,22}, resulting in the formation of schemas that increase the probability of misinterpreting other perceptive stimuli as such⁴. Kruger¹⁵ suggests that PPS may be a type of pareidolia (the perception of a familiar pattern in a stimulus), and can thus be viewed as a psychological phenomenon influenced by individual differences in personality, condition and context. We have highlighted the role of negative emotions behind the cognitive mechanism from which auditory hallucinations may arise in non-psychotic subjects¹⁸. More than “true” hallucinations, we proposed a conceptualization of PPS within the context of negative emotionality and stress-related frameworks. Far from conceiving PPS as a marker of mental illness, psychiatrists and psychologists should pay a particular attention to emotional or stress-related problems. In this perspective, it was recently demonstrated that depression and anxiety can explain a portion of stress-induced PVS and PRS, in medical interns²³.

Future studies should explore the relationship between PPS and Internet or Phone Addictions, as well as with other associated behavioural addictions. Some suggestions of link between ringxiety and smartphone, social media or internet addiction come from some studies^{17,18,24,25}, but with controversies²⁶. It was also suggested that PPS may be included as a symptom of the new concept named nomophobia (NO MOBILE PHONE PHOBIA), which is a psychological condition when people have a fear of being detached from mobile phone connectivity; nomophobia, in turn, was described to be associated to cyberbullying and some other psychopathological symptoms²⁷.

CONCLUSIONS AND FUTURE DIRECTIONS

PPS is an emerging phenomenon that spans across social habits and psychopathology. We suggest possible directions for future researches. First, a more comprehensive way of assessment would be welcome by researchers and clinicians in order to achieve a more systematically and more standardized gathering of data. Studies on PPS would benefit from larger surveys on general population. The major limitation of the available epidemiological studies is that the samples are often too sectorial. More in-depth studies should be focused on

detailed analysis of the relationships among age, type of employment, phone use, stress level and psychopathology. More studies on adolescents are needed, as young people are traditionally considered more fragile and increasingly exposed to technology use. Similarly, studies including clinical samples (i.e. with depression and/or anxiety, but also obsessive/compulsive disorder, psychosis and post traumatic stress disorder) may shed a new light on the psychopathological implications of PPS. Finally, longitudinal studies aimed to investigate the trend of these phenomenon over time may help clinicians to a better comprehension of PPS, its clinical relevance, and its possible impact on everyday life.

Conflict of interests: Gabriele Masi was in the advisory boards for Eli Lilly, Shire and Angelini, has received research grants from Eli Lilly, Shire, and Lundbeck, and has been speaker for Eli Lilly, Shire, Lundbeck, FB Health and Otsuka. Other authors have no conflict of interests to declare.

REFERENCES

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (5th Edition). Washington, DC: APA Press, 2013 [trad. it. DSM-5. Manuale diagnostico e statistico dei disturbi mentali. Milano: Raffaello Cortina Editore, 2014].
2. World Health Organization. The ICD-10 classification of mental and behavioural disorders: clinical descriptions and diagnostic guidelines. Geneva: World Health Organization, 1992.
3. World Health Organization. International Classification of Diseases 11th Edition. Geneva: World Health Organization, 2018.
4. Drouin M, Kaiser D, Miller D. Phantom vibrations among undergraduates: prevalence and associated psychological characteristics. *Comput Human Behav* 2012; 28: 1490-6.
5. Livingstone S, Smith P K. Annual Research Review: harms experienced by child users of online and mobile technologies: the nature, prevalence and management of sexual and aggressive risks in the digital age. *J Child Psychol Psychiatr* 2014; 55: 635-54.
6. Laramie D. Emotional and behavioral aspects of mobile phone use. (Unpublished doctoral dissertation). Alliant International University, Los Angeles, CA. 2007.
7. Deb A. Phantom vibration and phantom ringing. *Asia Pacific Psychiatry* 2015; 7: 231-9.
8. Tanis M, Beukeboom C, Hartmann T, Vermeulen I. Phantom phone signals: an investigation into the prevalence and predictors of imagined cell phone signals. *Comput Human Behav* 2015; 51: 356-62.
9. Schüz J. Mobile phone use and exposures in children. *Bioelectromagnetics* 2005; 26: S45-S50.
10. Takano Naoki. Children's use of mobile phones 2014: a special report. GSMA 2015.
11. Saaid Al-Ani G, Mohammed N, Hassan A. Evaluation of the sensation of hearing false mobile sounds (phantom ring tone; ringxiety) in individuals. *Iraqi Postgraduate Medical Journal* 2009; 1: 90-4.
12. Rothberg M, Arora A, Hermann J, Kleppel R, St Marie P, Visintainer P. Phantom vibration syndrome among medical staff: a cross sectional survey. *Br Med J* 2010; 341: c6914.
13. Subba S, Mandelia C, Pathak V, et al. Ringxiety and the mobile phone usage pattern among the students of a medical college in South India. *J Clin Diagn Res* 2013; 7: 205-9.
14. Lin YH, Lin SH, Li P, Huang WL, Chen CY. Prevalent hallucinations during medical internships: Phantom Vibration and Ringing Syndromes. *PLoS One* 2013; 8: e65152.
15. Kruger D, Jaikob D. High ringxiety: attachment anxiety predicts experiences of Phantom Cell Phone Ringing. *Cyberpsychol Behav Soc Netw* 2016; 19: 56-9.
16. Mohammadbeigi A, Mohammadsalehi N, Moshiri E, Anbari Z, Ahmadi A, Ansari H. The prevalence of Phantom Vibration/Ringing Syndromes and their related factors in Iranian students of medical sciences. *Asian J Psychiatr* 2017; 27: 76-80.
17. Mangot AG, Murthy VS, Kshirsagar SV, Deshmukh AH, Tembe DV. Prevalence and pattern of Phantom Ringing and Phantom Vibration among medical interns and their relationship with smartphone use and perceived stress. *Indian J Psychol Med* 2018; 40: 440-5.
18. Pisano S, Muratori P, Senese VP, et al. Phantom Phone Signals in youths: prevalence, correlates and relation to psychopathology. *PLoS One* 2019; 14: e0210095.
19. Chen CP, Wu CC, Chang LR, Lin YH. Possible association between Phantom Vibration Syndrome and occupational burnout. *Neuropsychiatric Dis Treat* 2014; 10: 2307-14.
20. Cloninger CR, Przybeck TR, Svrakic DM. The Tridimensional Personality Questionnaire: U.S. normative data. *Psychol Rep* 1991; 69: 1047-57.
21. Catchings D, Bush L, Copes B, Schaefer A, Wixom E. Cell phone use and psychological correlates: an explorative study. Paper presented at the 2010 Undergraduate Research and Scholarship Conference, Idaho, United States, 2010.
22. Lin YH, Chen CY, Li P, Lin SH. A dimensional approach to the phantom vibration and ringing syndrome during medical internship. *J Psychiatr Res* 2013; 47: 1254-8.
23. Lin YH, Lin KI, Pan YC, Lin SH. Investigation of the role of anxiety and depression on the formation of Phantom Vibration and Ringing Syndrome caused by working stress during medical internship. *Int J Environ Res Public Health* 2020; 17: 7480.
24. Ramesh Masthi NR, Pruthvi S, Phaneendra MS. A comparative study on social media usage and health status among students studying in pre-university colleges of Urban Bengaluru. *Indian J Community Med* 2018; 3: 180-4.
25. Li L, Lin TTC. Over-connected? A qualitative exploration of smartphone addiction among working adults in China. *BMC Psychiatry* 2019; 1: 186.
26. Lin YH, Chang LR, Lee YH, Tseng HW, Kuo TB, Chen SH. Development and validation of the Smartphone Addiction Inventory (SPAI). *PLoS One* 2014; 9: e98312.
27. Catone G, Senese VP, Pisano S, et al. The drawbacks of information and communication technologies: interplay and psychopathological risk of nomophobia and cyber-bullying, results from the bullying and youth mental health Naples study (BYMHNS). *Comput Hum Behav* 2020; 113: 106496.