Functional gastrointestinal disorders, lifestyle habits, and smartphone addiction in adolescents

Mauro Cinquetti,[1] Marco Biasin,[2] Marco Ventimiglia,[3] Linda Balanzoni,[4] Denise Signorelli,[5] Angelo Pietrobelli[6]

[1]Maternal and Child Department, Azienda ULSS 9 Scaligera, Verona; [2]Department of Surgical Sciences, Dentistry, Gynecology and Pediatrics, University of Verona, Verona; [3]IBD Unit, Villa-Sofia Hospital, Palermo; [4]Maternal and Child Department, Azienda ULSS 9 Scaligera, Verona; [5]Health Management, Azienda ULSS 9 Scaligera, Verona, Italy; [6]Department of Surgical Sciences, Dentistry, Gynecology and Pediatrics, University of Verona, Verona, Italy, and Pennington Biomedical Research Center, Baton Rouge, LA, USA

Abstract

We performed a cross-sectional study. In spring 2019, 1,594 students (mean age 12.87 years) completed a questionnaire on gastrointestinal symptoms, smartphone use, Quality of Life (QoL), dietary habits, and physical activity. Based on the Rome IV criteria, 30.9% of participants met the symptom-based criteria for FGIDs and 8.9% experienced ≥2 disorders simultaneously. Well-being was less frequently reported by children with FGIDs than others (29.0% *vs.* 48.2%; p < 0.001). Participants addicted to smartphones reported low than others well-being (18.0% *vs.* 25.8%; p < 0.001), they also showed higher prevalence of FGIDs [Odds Ratio (OR), 1.98; 95% Confidence Interval (CI), 1.47–2.68; p < 0.001]. Among dietary habits, skipping breakfast (OR, 1.50; 95% CI, 1.09–2.05; p = 0.01) and low fruit consumption (OR, 1.66; 95% CI, 1.172.36; p = 0.005) were more frequent in participants with FGIDs. FGIDs are common in pediatric populations. FGIDs have an impact on QoL. Some dietary habits and physical activity are associated with these disorders. Smartphone addiction was found to be associated with FGIDs.

Introduction

Functional Gastrointestinal Disorders (FGIDs) are common in children[1] and represent an important social and medical burden.[2] FGIDs are defined as brain–gut axis disorders using the new Rome IV criteria.[3] This brain–gut connection explains the reason for stress and psychological factors being closely linked to gut dysfunctions, gastrointestinal symptoms, illness, and disease.[4] This could be one of the reasons contributing to the challenges in investigating the risk factors of FGIDs.

A recent systematic review[1] determined that overall FGID prevalence in children and adolescents ranged from 9.9% to 29% and reached as high as 87% in some clinical samples. These data were collected using the Rome III criteria because to date, only two widespread epidemiological studies[5,6] have been published using the new Rome IV criteria, and neither of them were conducted in Italy.

Several studies have investigated different risk factors;[7–9] however, no studies have assessed the association among FGIDs, lifestyle habits, and smartphone addiction. Therefore, the present study aimed to assess the prevalence of FGIDs in children aged 11–14 years using the new Rome IV Diagnostic Criteria in a large sample and to investigate their association with lifestyle and smartphone addiction.

Materials and Methods

Studied population

Our cross-sectional observational study involved students aged 11–14 years of seven middle schools in Verona, Italy, located

either downtown, close to the city, or in the countryside (Verona district). To enhance racial, ethnic, and socioeconomic diversity and maximize the external validity of the data, we used intentional sampling of schools by selecting public and private schools as study sites to obtain a sample as representative of the adolescent population as possible. The study was purposefully designed to enroll a higher proportion of children from public than from private schools to resemble the education system of the country. In particular, we chose these schools because they could be representative of the different habits existing among the city, suburbs, and province. The questionnaires were completely anonymous. An invitation to participate was sent to the parents of all school children aged 11–14 years from the seven schools. School children whose parents refused to participate were excluded from the analysis. In total, we collected 1,706 completed questionnaires.

The study was conducted between March and May 2019. This study was approved by the school authorities and the ethical review board of our institute.

Questionnaires used in the survey

We used a questionnaire comprising four parts: the first part was the Italian version of the Smartphone Addiction Scale Short Version for Adolescents and Young Adults (SAS-SV)[10] to investigate smartphone use among school children. The second part included some questions from the Harvard Youth/Adolescent Food Frequency Questionnaire, a simple self-administered questionnaire completed by older children and adolescents, which can provide nutritional information about this age group.[11] The third part investigated physical activity using some questions from the rapid assessment of physical activity questionnaire[12] (we investigated only the extra-school time dedicated to physical activity, we didn't included the two hours spent for physical activity in classes practiced weekly in Italian schools). The fourth part was the official version of the Rome Foundation questionnaire for children and adolescents to investigate FGIDs. We added a question from the SF-36 health survey questionnaire[13] to evaluate the Quality of Life (QoL) of children as well as a question to assess whether children have requested medical attention in the year before. We collected data regarding sex, age, and nationality of both the parents of each participant. Two members of our team, who have proficient English language skills, collaborated to translate the English parts of the questionnaire to Italian. A member of the research team who did not participate in the translation reviewed the final version to assure fidelity with the original English version.

A member of our team brought the questionnaire to each class, and an explanation was provided to the school children regarding answering the questions. To ensure that all children filled out the questionnaire in the correct way he checked that students had not skipped questions or they had left some of them blank, in that case he reminded them to fulfill the blank questions. Questionnaires with ≥2 blank or illegible answers were excluded.

Statistical analysis

Continuous variables are reported as medians with Interquartile Ranges (IQRs), and categorical variables are reported as the frequency and percentage. χ^2 tests (or Fisher's exact test, where needed) were used to assess dependence between categorical variables.

The following variables were assessed using univariable logistic regression models to identify predictive factors for FGIDs prevalence: age (continuous), gender, parents nationality (Italian vs non-Italian), well-being (divided in four categories: well, quite well, not very good, and bad), eating habits (consumption of fried food, sodas, alcohol, milk, meat, fish, pasta, fruit, vegetables, sweet foods, salty snacks, breakfast, and afternoon snack), smartphone addiction, and frequency, and type of physical activity.

Two distinct analyses were performed, according to two different criteria of aggregation of answers related to eating habits: the first analysis assessed "Never" answers versus "At least once a week" (aggregation of "1–2 times a week," "3–4 times a week," and "Every day" answers); the second analysis assessed "Every day" answers versus "Less frequently" (aggregation of "Never," "1–2 times a week," and "3–4 times a week" answers).

Two different multiple logistic regression models were created; the variables considered in each model were selected through stepwise model selection by the Akaike Information Criterion and guided by clinical relevance (known results in scientific literature) and the results of the univariable analysis.

Likelihood Ratio Test approach was used to assess statistical significance of all possible interaction terms: no interaction term reached statistical significance ($p < 0.05$); therefore, models are additive.

Visual inspection of model residuals suggested the exclusion of polynomials terms (quadratic and cubic) of age (the only continuous variable).

The logistic regression results are presented in the form of odds ratio (ORs) with 95% confidence intervals and probability values. The results were considered statistically significant when p value was ≤ 0.05. All statistical analyses were performed using R version 3.5.3 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Study population

Of the 1,857 eligible school children, overall 1,706 children were initially enrolled. After excluding 112 questionnaires that did not meet our inclusion criteria, completed questionnaires from 1,594 school children were included. The mean (SD) age of the participants was 12.87 (1.92) years; 50.9% were boys (812 of 1,594), whereas 49.1% were girls (782 of 1,594), and 68.3% participants had both Italian parents (1,089 of 1,594). Well-being was reported by only 42.3% (674 of 1,594) school children.

FGIDs

Of all participants, 30.9% (493 of 1,594) met the Rome IV criteria for at least one FGID and 8.9% (142 of 1,594) experienced ≥2 disorders simultaneously (Table 1). FGIDs were more common in girls than in boys (36.3% *vs.* 25.7%, p < 0.001), with a 1.65 (95% CI, 1.33–2.04; p < 0.001) times higher odds of girls having FGIDs. Participants with FGIDs reported well-being less frequently compared with those who did not meet the criteria for FGIDs (29.0% *vs.* 48.2%; p < 0.001).

The proportion of patients presenting with FGID compared to those who did not present with disorders was significantly higher among children who said they felt sick (categories bad and not very good) than those who said they felt good (categories quite well and well) (OR, 2.71; 95% CI, 2.033.61; p = 0.013).

The difference in FGIDs prevalence among Italian and non-Italian participants was not significant (33.2% *vs.* 29.8%; p = 0.17). Children with FGIDs reported higher requests for medical attention than other children (42.0 *vs.* 17.4%, p < 0.001; OR, 3.44; 95% CI, 2.72–4.34; p < 0.001).

Univariable analysis of factors associated with FGIDs

Dietary habits

We determined the consumption frequency of various foods and calculated the OR for FGIDs and each food. From the diet recall, 28.1% (448 of 1,594) subjects consumed desserts daily, 18.3% (292 of 1,594) drank soft drinks daily, and 20.2% (323 of 1,594). The daily consumption of soda and desserts were the habits most associated with FGIDs, with ORs of 1.32 (95% CI, 1.01–1.72; p = 0.04) and 1.34 (95% CI, 1.06–1.68; p = 0.014), respectively. In contrary, eating vegetables never or less than once a week was not positively associated with FGIDs (OR, 1.09; 95% CI, 0.79–1.49; p = 0.607), on the other way, consuming vegetables every day did not appear to be negatively associated with FGIDs (OR, 1.15; 95% CI, 0.931.44; p = 0.198). Pasta appeared to be associated with a higher frequency of FGIDs with an OR of 1.32 (95% CI, 1.06–1.64; p = 0.011) for those who choose it daily. Having breakfast was the only lifestyle that is clearly associated with FGIDs in students who never had it or had it less than once a week (OR, 1.50; 95% CI, 1.09–2.05; p = 0.011) and appear negatively associated to FGIDs for those who consumed it every day (OR, 0.73; 95% CI, 0.57–0.90; p = 0.004; Table 2).

Physical activity

Overall, 20.6% (328 of 1,594) participants reported that they rarely performed or only performed some light physical activity during the week (defined as who practiced physical activity less than once a week or simply made the journey from home to school on foot); conversely, 46.4% (740 of 1,594) practiced physical activity ≥3 times per week. FGIDs prevalence was lower in those who performed physical activity ≥3 times per week (27.3% vs. 34.1%; p <

Table 1. Comparison of the prevalence of FGIDs in different studies using Rome IV criteria.

	Saps et al., 2018, Colombia (%)	Robin et al., 2018, USA (%)	Our study, 2019, Italy (%)
Sample	3567	959	1594
Prevalence of FGIDs	21.2 (755)	25.0	30.9 (493)
Functional nausea and vomiting disorders			
Cyclic Vomiting Syndrome	0.5 (16)	2.0 (19)	4.0 (64)
Functional Nausea	0.1 (3)	0.5 (5)	1.9 (31)
Functional Vomiting	0.6 (22)	1.4 (13)	0.9 (15)
Adolescent Rumination Syndrome	0.5 (16)	0.0 (0)	0.8 (13)
Aerophagia	0.5 (19)	2.6 (25)	0.9 (15)
Functional abdominal pain disorders			
Functional Dyspepsia	3.0 (108)	7.6 (73)	9.4 (150)
IBS	2.3 (83)	5.1 (49)	4.5 (71)
Abdominal Migraine	0.5 (18)	1.1 (11)	3.2 (51)
Functional Abdominal Pain-NOS	2.4 (85)	3.1 (30)	0.6 (9)
Functional defecation disorders			
Functional Constipation	10.7 (382)	14.1 (135)	17.6 (280)
Non-retentive Fecal Incontinence	0.1 (3)	0.2 (2)	0.26 (4)

Table 2. Effects of different foods on FGIDs.

Habits	OR Never or less than once a week (95% CI)	P-value	OR Every day (95% CI)	P-value
Fried food	1.06 (0.85–1.32)	0.596	1.34 (0.46–3.64)	0.569
Soda	0.94 (0.73–1.19)	0.596	1.32 (1.01–1.72)	0.040
Alcohol	0.76 (0.53–1.10)	0.141	0.96 (0.21–3.46)	0.949
Milk	1.15 (0.91–1.45)	0.227	0.90 (0.72–1.11)	0.320
Meat	0.98 (0.58–1.62)	0.944	1.14 (0.87–1.48)	0.336
Fish	1.16 (0.93–1.44)	0.183	1.12 (0.35–3.16)	0.840
Pasta	0.84 (0.40–1.66)	0.635	1.32 (1.06–1.64)	0.011
Fruits	1.63 (1.15–2.28)	0.005	0.90 (0.72–1.11)	0.312
Vegetables	1.09 (0.79–1.49)	0.607	1.15 (0.93–1.44)	0.198
Desserts	0.91 (0.64–1.28)	0.600	1.34 (1.06–1.68)	0.014
Salty snacks	1.01 (0.76–1.34)	0.927	1.01 (0.77–1.32)	0.950
Breakfast	1.50 (1.09–2.05)	0.011	0.73 (0.57–0.90)	0.004
Afternoon snack	1.17 (0.80–1.70)	0.412	0.93 (0.75–1.15)	0.478

0.001). The participants who performed only some light activities during the week had 1.47 times higher odds of experiencing FGIDs (95% CI, 1.06–2.03; p = 0.02).

Smartphone use

Overall 89.5% (1,427 of 1,594) school children owned a smartphone and received their first smartphone at a mean (SD) age of 10.22 (1.53) years. Based on the SAS-SV questionnaire, 22.4% participants were addicted (358 of 1,594) to smartphones, with no significant difference in prevalence between boys and girls (23.7% *vs.* 21.1%, p = 0.2). The percentage increased to 25.1% (358 of 1,427) when evaluating addicted students not compared to the total but compared to who owned the smartphone. Participants with FGIDs demonstrated a higher prevalence of smartphone addiction than those who did not meet the criteria for FGIDs (29.6% *vs.* 19.3%; p < 0.001; Figure 1). Children with smartphone addiction exhibited a 1.98 times higher chance of having FGIDs (95% CI, 1.47–2.68; p < 0.001).

Participants who reported the feeling of well-being had a lower prevalence of smartphone addiction than other participants (18.0% *vs.* 25.8%; p < 0.001).

Analysis of factors associated with FGIDs

The fitted multiple logistic regression model (Figure 2) shown that the non-consumption of fruit (OR, 1.66; 95% CI, 1.17–2.36; p = 0.005), consumption of pasta every day (OR, 1.41; 95% CI, 1.12–1.77; p = 0.003), female sex (OR, 1.64; 95% CI, 1.31–2.05; p < 0.001), and smartphone addiction (OR, 2.02; 95% CI, 1.49–2.76; p < 0.001) are associated with the presence of FGIDs. The values were adjusted for age, nationality of the parents, and physical activity.

Discussion

To our knowledge, this is the first study to present a series of original results regarding the association between FGIDs, lifestyle habits, and smartphone addiction. The first important result was

the high prevalence of pediatric FGIDs in our population as determined according to the Rome IV criteria. Studies with prevalence of >30.0% have not been previously published; our sample reported a prevalence of 30.9%. The prevalence in our study is higher; however, the possible differences in lifestyle, socioeconomic factors, and dietary habits between Italy and the other countries where studies have been conducted should be considered. A large study[14] performed in the Mediterranean region found a lower prevalence (26.6%) of FGIDs than our that found in our sample; however, that study used the Rome III criteria. It is difficult to determine whether an overall increase or decrease in FGID diagnoses occurred using the Rome III criteria compared with the use of the Rome IV criteria because previous studies failed to establish certain conclusions; however, the difference in terms of prevalence between the two
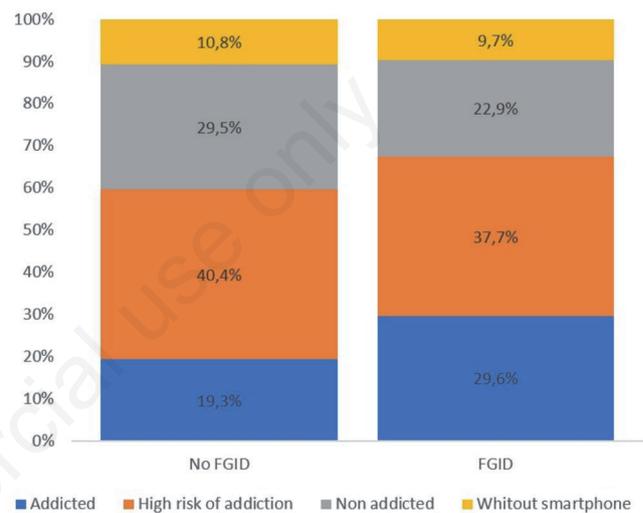

Figure 1. Distribution of smartphone use based on presence or absence of FGIDs.
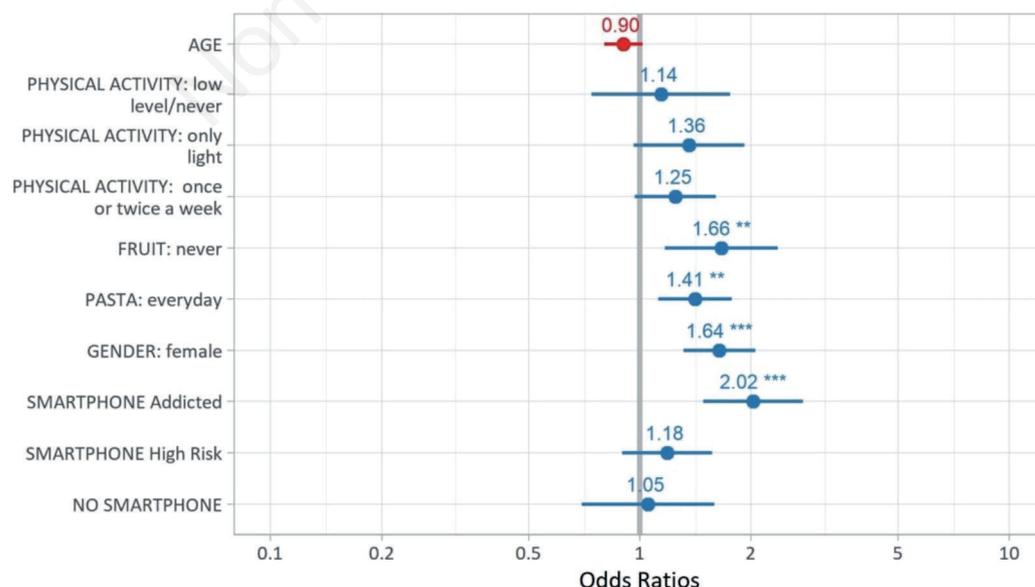

Figure 2. Multiple logistic regression model estimates for FGIDs.

OPEN ACCESS

criteria appears minimal.[5,6] Our results should be considered by pediatricians in their daily clinical practice as well as for public health in general because FGIDs can influence the psychosocial life of people affected by these disorders.[15]

FGIDs prevalence was higher in females than in males (36.3% *vs.* 25.7%); this result is consistent with those of other studies conducted in children.[16] Studies on adult women have helped in elucidating some of the possible causes of this difference.[17]

The impact of FGIDs on QoL, as reported in literature,[18] is evident because children with FGIDs reported the feeling of well-being less frequently (29.0% *vs.* 48.2%), suggesting that FGIDs prevalence is associated with a personal belief of a lack of well-being; this is another aspect wherein further research can be attempted to determine the multiple causes of FGID and to eliminate these causes.

Our study has highlighted particular associations between FGIDs and physical activity, some eating habits, and smartphone use.

Previous studies have associated physical activity with FGIDs, albeit with conflicting data. Some of these studies have reported physical activity as a risk factor,[19] whereas others have reported it to be a protective factor.[20] In our study, the practice of physical activity ≥3 times per week was associated with a reduced prevalence of FGIDs. Our data did not allow us to reach unequivocal conclusions; however, it seems that frequent physical activity (≥3 times per week) tended to be associated with a lower prevalence of these disorders considering that physical activity appears to be a dependent factor with regard to association with FGIDs. Thus, it should be considered that the agonist activity (not investigated by us) of the children could lead to stress instead of adequate performance. This factor could eliminate the protective effect of physical activity per se.[19]

There is a link between soft drinks and FGIDs.[8] In our study, the high consumption of soft drinks, pasta, and sweets was associated with FGIDs. For these dietary habits, based on sugar intake, a possible link could be speculated between FGIDs and the presence of high concentrations of fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols; FODMAPs) in these foods.[9,21] Two studies have demonstrated the association between these disorders and skipping breakfast.[20,22] Another study showed that breakfast has lesser FODMAPs than other meals.[8] Based on our study results, although not an independent factor, breakfast appears to be a factor associated with FGIDs. This reinforces the indication for the daily intake of this meal, which if avoided result in metabolic imbalance.

Finally, the most significant element of our investigation is the association between smartphone use and FGID prevalence. Smartphone addiction was initially investigated in South Korea in 2013.[23] The prevalence of this disorder has increased in recent years.[24] In our study sample, almost one-fourth of the participants (22.4%) demonstrated smartphone addiction; this is already a cause for concern. Although data in the literature report a greater use of media devices among girls with a consequent greater risk of addiction (so much so that the SAS-SV had different scores for males and females),[25] there were no statistical significance differences between girls and boys in our study. For the first time, our data showed that smartphone addiction is associated with a higher FGID prevalence and that it is an independent factor associated with FGIDs.

A potential explanation is that smartphone use can be a source of anxiety and depression.[26–28] Conversely, FGIDs recognize anxiety and depression as risk factors;[29–31] therefore, smartphone use may be a potential risk factor of FGIDs.

Thus, we believe that the danger of excessive smartphone use must be highlighted. Excessive smartphone use creates a series of psycho-behavioral disorders; but our results suggested also that it appears associated with FGIDs prevalence.

Limitations

In prevalence studies that use questionnaires, the information provided by individual students may be inaccurate despite the fact that the children were assisted in completing the questionnaire. We didn't collect any information regarding weight and BMI of the students, related to socio-economic such as parental income or level of education and family history of functional gastrointestinal disorders. Another possible limitation is that the survey by questionnaire does not consider any organic disturbance underlying the reported gastrointestinal symptoms. Because data on each participant were recorded only once, it would be difficult to infer the temporal association between a risk factor and FGIDs. Therefore, only an association and not causation can be inferred from our study. The results may inform the hypotheses for a more complex investigation, such as a cohort study. If casual relationships are present within the population, then this type of study cannot provide any information about that relationship.

Conclusions

FGIDs were common among our participants according to the new Rome IV criteria, and they could affect the QoL of children. These disorders could affect them in their extra-curricular activities, such as physical activity, worsening their QoL. In addition, these children have a greater request for medical attention, resulting in numerous medical resources to be invested on them, with all the possible costs that derive from a large number of tests to search for a possible organic cause.

FGIDs are associated with several risk factors such as dietary habits and physical activity. These findings have public health relevance with regard to the global increase in consumption of unhealthy foods and sedentary behavior. Therefore, initiatives aimed at promoting healthier lifestyles among students should be encouraged and planned.

Another worrisome aspect that emerged from our study is the excessive and early use of smartphones. A new data, never investigated in the literature, were the association between FGIDs and smartphone addiction. As the number of smartphone users increases, problems related to smartphone use also become more serious. This phenomenon can have negative consequences on a psychological and social level and could result in health issues. It would be appropriate that children were educated to use the smartphone starting from their families, following the recommendations of the Italian Society of Pediatrics.

References

1. Boronat AC, Ferreira-Maia AP, Matijasevich A, Wang Y-P. Epidemiology of functional gastrointestinal disorders in children and adolescents: A systematic review. World J Gastroenterol 2017;23:3915-27.
2. Talley NJ. Functional gastrointestinal disorders as a public health problem. Neurogastroenterol Motil 2008; 20:121-9.
3. Drossman DA, Hasler WL. Rome IV-Functional GI Disorders:

Disorders of gut-brain interaction. Gastroenterology 2016;150:1257-61.

4. Drossman DA. Functional gastrointestinal disorders: history, pathophysiology, clinical features, and Rome IV. Gastroenterology 2016;150:1262-79.E2.

5. Robin SG, Keller C, Zwiener R, et al. Prevalence of pediatric functional gastrointestinal disorders utilizing the Rome IV Criteria. J Pediatr 2018;195:134-9.

6. Saps M, Velasco-Benitez CA, Langshaw AH, Ramírez-Hernández CR. Prevalence of functional gastrointestinal disorders in children and adolescents: comparison between Rome III and Rome IV criteria. J Pediatr 2018;199:212-6.

7. Xu J-R, Shang L, Si W-L, et al. A population-based study of associations between functional gastrointestinal disorders and psychosocial characteristics in Xi'an, China. Neurogastroenterol Motil 2013;25:617-e467.

8. Shau J-P, Chen P-H, Chan C-F, et al. Fast foods—are they a risk factor for functional gastrointestinal disorders? Asia Pac J Clin Nutr 2016;25:393-401.

9. Moding M, Ohlsson B. The role of fermentable carbohydrates and beverages in the symptomatology of functional gastrointestinal disease. Scand J Gastroenterol 2017;52:1224-34.

10. Pasquale CD, Sciacca F, Hichy Z. Italian validation of smartphone addiction scale short version for adolescents and young adults (SAS-SV). Psychology 2017;08:1513.

11. Rockett HRH, Breitenbach M, Frazier AL, et al. Validation of a youth/adolescent food frequency questionnaire. Prev Med 1997;26:808-16.

12. Topolski TD, LoGerfo J, Patrick DL, et al. The rapid assessment of physical activity (RAPA) among older adults. Prev Chronic Dis 2006;3:A118.

13. Brazier JE, Harper R, Jones NM, et al. Validating the SF-36 health survey questionnaire: new outcome measure for primary care. BMJ 1992;305:160-4.

14. Scarpato E, Kolacek S, Jojkic-Pavkov D, et al. Prevalence of functional gastrointestinal disorders in children and adolescents in the Mediterranean Region of Europe. Clin Gastroenterol Hepatol 2018;16:870-6.

15. Varni JW, Bendo CB, Nurko S, et al. Health-related quality of life in pediatric patients with functional and organic gastrointestinal diseases. J Pediatr 2015;166:85-90.

16. Peralta-Palmezano JJ, Guerrero-Lozano R. Prevalence of functional gastrointestinal disorders in school children and adolescents. Korean J Gastroenterol 2019;73:207-12.

17. Adeyemo MA, Spiegel BMR, Chang L. Meta-analysis: do irritable bowel syndrome symptoms vary between men and women? Aliment Pharmacol Ther 2010;32:738-55.

18. Varni JW, Shulman RJ, Self MM, et al. Gastrointestinal symptoms predictors of health-related quality of life in pediatric patients with functional gastrointestinal disorders. Qual Life Res 2017;26:1015-25.

19. Strid H, Simrén M, Störsrud S, et al. Effect of heavy exercise on gastrointestinal transit in endurance athletes. Scand J Gastroenterol 2011;46:673-7.

20. Ohlsson B, Manjer J. Physical inactivity during leisure time and irregular meals are associated with functional gastrointestinal complaints in middle-aged and elder subjects. Scand J Gastroenterol 2016;51:1299-307.

21. Varney J, Barrett J, Scarlata K, et al. FODMAPs: food composition, defining cutoff values and international application. J Gastroenterol Hepatol 2017;32:53-61.

22. Vakhshuury M, Khoshdel A. The relation between dietary patterns and functional gastrointestinal disorders among Iranian military men. Adv Biomed Res 2019;8:2.

23. Kwon M, Lee J-Y, Won W-Y, et al. development and validation of a smartphone addiction scale (SAS). PLoS One 2013;8:e56936.

24. Sohn S, Rees P, Wildridge B, et al. Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: a systematic review, meta-analysis and GRADE of the evidence. BMC Psychiatry 2019;19:356.

25. Choi S-W, Kim D-J, Choi J-S, et al. Comparison of risk and protective factors associated with smartphone addiction and Internet addiction. J Behav Addict 2015;4:308-14.

26. Kim Y-J, Jang HM, Lee Y, et al. Effects of internet and smartphone addictions on depression and anxiety based on propensity score matching analysis. Int J Environ Res Public Health 2018;15.

27. Elhai JD, Dvorak RD, Levine JC, Hall BJ. Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology. J Affect Disord 2017;207:251-9.

28. Vahedi Z, Saiphoo A. The association between smartphone use, stress, and anxiety: A meta-analytic review. Stress Health 2018;34:347-58.

29. Koloski NA, Jones M, Kalantar J, et al. The brain—gut pathway in functional gastrointestinal disorders is bidirectional: a 12-year prospective population-based study. Gut 2012;61:1284-90.

30. Wouters MM, Boeckxstaens GE. Is there a causal link between psychological disorders and functional gastrointestinal disorders? Expert Rev Gastroenterol Hepatol 2016;10:5-8.

31. Bulut Çakmak B, Özkula G, Işıklı S, et al. Anxiety, depression, and anger in functional gastrointestinal disorders: A Cross-sectional observational study. Psychiatry Res 2018;268:368-72.

OPEN ACCESS