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Addictive Behaviors 141 (2023) 107660

Contents lists available at ScienceDirect

Addictive Behaviors

journal homepage: www.elsevier.com/locate/addictbeh

Moderating the impact of the COVID-19 pandemic on children's and adolescents' substance use, digital media use, and mental health: A randomized positive psychology addiction prevention program

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ARTICLE INFO

Keywords:
Adolescents
COVID-19
Drug use
Media use
Mental health
Prevention

ABSTRACT

Objective: Previous research suggests that well-being interventions are effective in moderating substance and digital media use and improving mental health. This study evaluated the feasibility and preliminary efficacy of a school-based Positive Psychology Addiction Prevention (PPAP) intervention aimed at reducing substance and digital media use and increasing the mental health of school children during the COVID-19 pandemic.
Methods: The sample was composed of 1,670 children and adolescents (Mean age = 12.96, *SD* = 2.01) from six elementary and secondary schools in Israel who were randomly assigned to the PPAP intervention (n = 833) or the waiting-list control conditions (n = 837). A three-year longitudinal repeated-measures randomized control design was used to examine modifications in substance use, digital media use, and psychological symptoms in the intervention and control groups assessed on the pre-test (before the outbreak of COVID-19, September 2019), the post-test (May 2021), and the 12-month follow-up (May 2022).
Results: The 12-month prevalence of tobacco use, alcohol use, and cannabis use decreased significantly from the pre- to the follow-up period in the intervention group, and increased significantly in the control group. Daily digital media use increased during the pandemic period in both groups, with a significantly higher increase in the control group. The intervention group reported significantly lower psychological symptoms and negative emotions, and greater positive emotions and life satisfaction after the intervention and at follow-up compared to the control group.
Conclusions: The COVID-19 pandemic has profoundly disrupted the lives of children and adolescents. Well-being and addiction prevention interventions may be effective in improving the mental health of school children during pandemics and crisis periods.

1. Introduction

The COVID-19 pandemic has affected the lives of children and adolescents around the world. The major disruptions in the everyday routines and life settings in which children and adolescents live, learn, and develop have resulted in greater loneliness, distress, social isolation, lower psychological well-being, and a rise in symptoms of anxiety, depression, and stress (Pancani et al., 2021; Racine et al., 2020; Salari et al., 2020; Shoshani & Kor, 2021).

The lengthy periods of quarantine and isolation have also been conducive to more substance use (Masaeli & Farhadi, 2021; Nagata et al., 2022). Although drug use during adolescence is often associated with social situations which to some extent have been curtailed by the COVID-19 pandemic, recent studies have reported significantly increased rates of alcohol, cigarette, and marijuana use among adolescents (Amram et al., 2021; Chaffee et al., 2021; Lundahl & Cannoy, 2021; Pigeaud et al., 2021; Villanti et al., 2022). A rise in children's and adolescents' technological addictions to the internet, social networks, video games, and mobile phones has also been documented (Bećirović & Pajević, 2020).

Although many recent cross-sectional studies have investigated child and adolescent mental health and substance use during the COVID-19 pandemic, more studies are vitally needed to understand not only how the pandemic has affected young people, but how to best support

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https://doi.org/10.1016/j.addbeh.2023.107660
Received 28 August 2022; Received in revised form 7 February 2023; Accepted 9 February 2023
Available online 12 February 2023

children and adolescents as they navigate the next phases of the pandemic. Primary prevention programs during this period that are aimed at reducing addictive behaviors and enhancing mental health in general population of children and adolescents are critical (Singh et al., 2020).

This study examined the efficacy of a school-based Positive-Psychology Addiction Prevention (PPAP) program that had begun a few months before the outbreak of the COVID19 pandemic, and followed a large sample of children and adolescents in Israel from the beginning of the pandemic for three school years. It examined pre- to post-test modifications in mental health symptoms, subjective well-being, substance use, and digital addictive behaviors during the pandemic. Thus, it is uniquely positioned to shed light on changes in children's and adolescents' substance and digital media use patterns and mental health during different phases of the COVID-19 pandemic and suggest preventive intervention strategies for these changes.

1.1. Positive psychology and the prevention of substance use

Recent reviews of programs to reduce adolescent tobacco, alcohol and illicit substance use have found little evidence for the effectiveness of several common school-based intervention approaches. In particular, providing knowledge about the physical and psychological effects of addiction, or focusing on values and attitudes towards substance use have not been found to be effective (Hennessy & Tanner-Smith, 2015; Stockings et al., 2016; Tremblay et al., 2020). By contrast, a number of psychosocial interventions, including those that focus on the development of social competence and influence, have been more successful. These interventions have been expanded to include a broader spectrum of life skills such as goal setting, decision-making, stress management, communication skills, and assertiveness (Stockings et al., 2016; Tremblay et al., 2020). Many of these skills form the backbone of the positive psychology approach.

Positive psychology interventions are defined as intentional activities or treatment methods that aim to cultivate positive emotions, behaviors, and cognitions (Sin & Lyubomirsky, 2009). These validated activities can be classified into categories such as positive emotions, character strengths, gratitude, kindness, optimism, empathy, flow, engagement, and meaning in life (Parks & Titova, 2016) and have been shown to be effective in enhancing happiness and well-being, but also in reducing anxiety, depressive symptoms, stress and substance use among teens over long-term follow-ups (Gander et al., 2016; Krentzman, 2013; Lambert et al., 2019; Sin & Lyubomirsky, 2009; Akhtar & Boniwell, 2010).

Harris et al. (2012) posited that addictions result from a lack of protective factors that contribute to effective coping with pain (i.e., turmoil and discomfort), but that inner strengths and the resources that support effective coping can lead to resiliency and recovery from addictions. Several studies that have integrated positive psychology constructs and substance use treatment lend weight to this assumption. For example, positive emotions were found to have a protective role in buffering stress and enhancing abstinence-related tendencies in clinical samples of substance-dependent individuals (Carrico et al., 2013; McHugh et al., 2013). Facets of well-being were shown to be related to fewer relapses in a treatment program for substance abusing patients (Zand et al., 2017). In addition, higher life satisfaction was associated with longer remissions of one to two years among adults recovering from chronic dependence on heroin and crack (Laudet et al., 2009).

In a small pilot study among alcohol-misusing adolescents who received eight weekly positive psychology-based workshops including sessions on strengths, happiness, gratitude, and optimism, the participants showed significant increases in optimism, positive emotions, and happiness, and a significant decline in alcohol dependence, compared to no significant change in the no-treatment control group (Akhtar & Boniwell, 2010). In a more recent large, randomized study of adults that sought or were in recovery from problematic substance use, engaging in brief, positive psychology self-administered thought exercises increased in-the-moment happiness compared to a decrease in the control groups that engaged in neutral exercises (Hoeppner et al., 2019). These studies suggest that positive psychology concepts and practices may be effective in clinical samples of substance users. They are limited, however, in their generalizability to prevention efforts, and to children and adolescents in particular during the pandemic.

1.2. Positive psychology interventions targeting digital media addictive behaviors

In contrast to substance use treatment, the use of positive psychology techniques to counter problematic digital media use is relatively novel and recent. There is growing evidence that social adjustment problems are associated with the onset of addictive digital media behaviors (Engelberg & Sjöberg, 2004; Lee & Stapinski, 2012). Research has also indicated that problematic digital media use may reflect a dysfunctional way of coping with life's difficulties that takes the form of avoidance, reassurance, and relief-seeking from dysphoric symptoms (Caplan & High, 2007; Wan & Chiou, 2006). From this perspective, digital media overuse constitutes a maladaptive self-regulatory strategy implemented to distract individuals from negative affective states (Spada et al., 2008).

A study applying a positive psychology intervention approach to internet addiction in university students that emphasized social adjustment and enhanced coping with negative life events was reported to reduce the severity of digital media addictive behaviors (Khazaei et al., 2017). Ke and Wong (2018) delivered a manualized cognitive behavioral and positive psychology intervention to secondary school students with problematic internet use in Malaysia. They reported that the intervention produced significant improvements in mental health and stress symptoms and a marked decline in internet use.

Nevertheless, there is scant research on school-based integrative positive psychology programs for mental health and addictive behaviors, in particular during the COVID-19 pandemic. To address this need, the current study followed children and adolescents in schools in Israel to evaluate the effects of a school-based PPAP program on mental health symptoms, subjective well-being, substance use, and daily digital media. It was initiated prior to the outbreak of COVID-19 and lasted for three school years.

We predicted that participants in the intervention group would exhibit a decrease from pre- to post-intervention in psychological distress and mental health symptoms and increases in subjective well-being (i.e., positive emotions and life satisfaction), whereas the randomized control waiting-list group participants would show an increase in mental health symptoms and decrease in subjective well-being related to the COVID-19 pandemic. We also hypothesized that students receiving the intervention would report a reduction in substance use (cigarettes, alcohol, and illicit drugs) and digital media use whereas the control group participants would show an increase in these indices during the COVID-19 period.

2. Method

2.1. Participants

The sample was composed of 1,670 fifth to tenth grade students aged 10 to 16 at the beginning of the study ($M = 12.96$, $SD = 2.01$) from six demographically similar elementary and secondary schools throughout Israel. A two-stage random sampling method was used. Two supervisors from the local Education Departments presented the program to the school principals in their cities. Twenty-two principals who consented to participation and the random assignment to intervention or waiting-list control group continued to the second stage. The exclusion criteria were ultra-orthodox religious schools (schools catering to the highly religious sector in Israel that have their own education system that provides a curriculum of intensive religious education), special education schools,

and demographically non-comparable schools. Blind randomization was performed by running a randomization script over the list of the schools' encrypted codes. Of the 22 eligible schools, six schools were randomly selected and assigned to the intervention or control groups by an independent researcher.

G-Power software was used to determine the appropriate sample size for the repeated measure MANOVA design. A sample size of 289 was required to achieve power of 0.80 for a medium effect size of 0.25 and an alpha of 0.05. A larger sample size was used to achieve greater statistical power.

2.2. Procedure

After obtaining ethical approval from the Ethics Committee of Reichman University, parents were sent parental consent forms for their children's participation. The students were informed that their participation in the study was voluntary and anonymous and were asked for their active consent. The data were collected in three waves: before the beginning of the intervention (September 2019), at the end of the intervention (May 2021), and a year after the completion of the program (May 2022), during the school day on tablets in the presence of research assistants who were blind to group assignment. To minimize performance bias, the intervention and control group students were blind to the purposes of the study. The students were not exposed to other school prevention interventions than the PPAP program.

2.3. Intervention program: Positive psychology addiction prevention (PPAP)

The PPAP is a two-year school-based program consisting of 30 units lasting two hours each, delivered by trained classroom teachers to children and adolescents during the school year. The program integrates addiction evidence-based prevention strategies along with facets of well-being and validated positive-psychology constructs. It consists of highly interactive training in self-awareness, addiction resistance skills, normative beliefs, information about the harmful effects of substance use and digital media overuse, motivational dialogue, problem solving, decision making, emotion regulation, positive emotions, character strengths, resilience and coping with stress, social support, healthy interpersonal relationships, flow and engagement, goal setting, and meaning in life. The program's main features are presented in Table 1.

Clinical psychologists delivered the preparatory training program to 30 teachers in the intervention schools. The teachers then implemented an age-appropriate program in their classrooms. The teacher training and the student program were composed of 30 two-hour sessions that were implemented every-two weeks during two school years, such that the teachers' training preceded the students' lessons on the same topic that the teachers implemented in their classrooms. The students' program lessons were delivered during the school day as part of the school curriculum. Throughout the two years of the program, there were four lockdowns, in which the sessions were conducted via Zoom.

The teachers were provided an in-depth manual including detailed lesson plans and class activities for each of the 30 sessions, to ensure standardization of the program. In addition, the teachers received PowerPoint presentations and supporting multi-media materials for each lesson. Throughout their training, the teachers shared their reflections on the lessons they delivered in their classes and received guidance from their training instructor for future implementation.

Implementation fidelity. The training instructors and the school psychological counselors conducted observations throughout the study to assess the fidelity of implementation of the intervention program. The school counselors were also responsible for monitoring the frequency and quality of the PPAP implementation. The teachers completed a validated competence and adherence measure after each lesson (Shoshani et al., 2016) and submitted it to their school counselor for follow-ups. On average, the teachers delivered 29 of the 30 lessons during the two years ($M = 29.14$, $SD = 0.63$), and reported feelings of success in implementing the subjects of each lesson ($M = 4.32$, $SD = 0.57$). High adherence to the lesson plan was reported by the teachers ($M = 4.61$, $SD = 0.67$) and school counselors ($M = 4.57$, $SD = 0.73$).

2.4. Control group

The waiting-list control group continued with the regular school curricula. The control group did not take part in any mental health or addiction prevention program during the study and only started the program after the completion of the study.

2.5. Measures

2.5.1. The Brief Symptom Inventory (BSI-18; Derogatis, 2001)

The BSI-18 measures mental health symptoms in children and adolescents. This 18-item instrument generates four subscale scores (anxiety, depression, somatization, and panic) as well as a global score (The Global Severity Index, GSI). The items are rated on a 5-point Likert scale ranging from "not at all" to "very strong". The Cronbach's alphas for the GSI were 0.94 at Time 1, 0.89 at Time 2, and 0.92 at Time 3.

2.5.2. The Brief Multidimensional Students' Life Satisfaction Scale (BMSLSS; Seligson et al., 2003)

The BMSLSS assesses satisfaction with life of children and adolescents in different life domains (friendships/ school/ family life / where I live/ myself as…). Items are rated on a 7-point Likert-type scale from 1="terrible" to 7= "delighted". Items are summed to yield a total life satisfaction score. The Cronbach's alpha was 0.082 at Time 1, 0.84 at Time 2, and 0.83 at Time 3.

2.5.3. The Positive and Negative Affect Schedule for Children (PANAS-C; Ebesutani et al., 2012)

The PANAS-C is a self-report questionnaire for children and adolescents that rate the levels of their positive and negative emotions during the previous month as indicators of their emotional well-being. The questionnaire includes five negative emotions (e.g., afraid, upset) and five positive emotions (e.g., enthusiastic, proud) that are rated on a 5-point Likert scale ranging from 1="not at all or very slightly" to 5="extremely". Total scores for Positive and Negative Affect are summed. The alpha coefficients were 0.80-0.83 and 0.78-0.82 for the positive affect and negative affect scales respectively.

2.5.4. Screen Time Scale (Mark & Janssen, 2008)

The Screen Time Scale examines the daily duration of internet and television use, social media use, and video game play. Participants report the number of hours per day in the past month of media and -screen use (watching television/using the internet, playing video games, and using social media). Response categories range from 0 h to 7 or more hours per day. Television/internet, social media, and gaming time are summed to create an overall recreational screen time score.

2.5.5. Adolescent Alcohol and Drug Involvement Scale (AADIS; Moberg, 2003)

The AADIS is a two-part scale that measures the history and the current use of licit and illicit substances. In the screening part, participants indicate their lifetime use of alcohol, cigarettes and drugs (e.g., "Have you ever tried smoking cigarettes?"). The second 12-item section on substance use behaviors was completed if participants reported any lifetime substance use (e.g., "have you ever tried marijuana or hashish -weed, grass?"). The items are rated on an 8-point Likert-type scale ranging from 0 (never used) to 7 (use several times a day).

Current substance use was determined by the percentage of students who reported monthly, weekly, or daily use of each category of substances used during the previous twelve months (0 = no use, 1 = used). Due to negligible number of participants who reported using illicit drugs

Table 1
The PPAP Core Components, Skills, and Course Content.

	Positive Emotions	Substance Use Prevention	Resilience and Health	Prevention of Problematic Digital Media Use	Positive Relationships	Character Strengths and Perseverance
Program Components	• Enhancing positive emotions and management of negative emotions • Fostering gratitude and appreciation • Developing effective emotion regulation strategies	• Enhancing awareness of social influences on engaging in substance use • Enhancing skills for effectively resisting social pressures for substance use • Conducting a motivational dialogue on alcohol, tobacco, cannabis, and other drugs and their effects • Suggesting alternatives to use • Enhancing positive attitudes towards non-use	• Cultivating flow experiences, interest, and engagement • Cultivating resilience in the face of painful experiences and difficulties • Increasing self-control and self-esteem • Promoting positive and healthy lifestyle choices	• Enhancing awareness of the relationship between digital media use and mental and physical health • Increasing self-reflection on use patterns • Encouraging self-monitoring of screen time • Developing a critical perception and interpretation of online information	• Fostering healthy interpersonal relationships and social support • Engaging in acts of kindness, acting with care and compassion towards oneself and others	• Identifying and pursuing personal strengths • Setting meaningful and self-concordant goals
Program Lessons	1. Introduction to positive psychology 2. Positive emotions 3. Permission to be human 4. Gratitude	5. The adolescent brain and addictions 6. Social influences and resistance skills 7. Misconceptions about substance use 8. Smoking and vaping 9. Cannabis and the developing brain 10. Effects of alcohol on the mind, body, and mood 11. "Synthetic" vs natural happiness	12. Flow 13. Resilience 14. Stress and coping 15. Mind and body	16. Digital media, flow, and happiness 17. The harmful effects of digital media overuse 18. The social dilemma 19. Digital media and social relationships 20. Pornography and love distortions 21. Gaming: psychological needs and addictive behaviors 22. Prosocial video game, internet, and social media use	23. Relationships and social support 24. Positive communication 25. Kindness, empathy, and compassion	26. Change: from theory to practice 27. From beliefs to reality 28. Goal setting and grit 29. Character strengths 30. Finding meaning
Skills	• Emotional awareness • Acceptance of emotions • Positive thinking (optimism, gratitude, positivity) • Self-management (effective regulation of emotions, behaviors, and thoughts).	• Self-awareness • Addiction resistance skills • Information on the harmful effects of substances • Problem solving • Decision making	• Self-awareness of personal flow and healthy experiences • Stress and anxiety management • Resilience	• Self-reflection on digital media use patterns • Self-monitoring of screen time • Critical online information processing • Prosocial online behavior	• Relationship-building • Social engagement • Empathy • Compassion • Care for others • Perspective-taking • Respect for others	• Recognizing and leveraging strengths • Goal setting • Grit • Self-efficacy • Discovering meaning • Growth mindset

Note. Lesson numbers reflect their order in the PPAP intervention.

other than cannabis, only cannabis use data are presented in the current study. The Cronbach's alpha was 0.94 at Time 1, 0.95 at Time 2, and 0.93 at Time 3.

2.6. Statistical analysis

Baseline characteristics of the intervention and control groups were summarized and compared with a 2-sample independent *t*-test or χ^2 test, as appropriate. The changes in the outcome variables from pre-intervention to May 2022 were analyzed using mixed model growth curve analyses. The patterns of change over time were examined with a trend analysis that indicated that linear trend models were the best fit for the outcome variables.

The curve models were applied to the different outcome measures with the intercept and slope as parameters. For the substance use measures, binary outcomes were used. The intercept represented the level of each outcome at Time 1 (baseline) and the slope represented the changes in the outcome variables from Time 1 to Time 3. An unstructured variance–covariance matrix was specified.

Several demographic and school- and classroom-level indicators were considered as covariates, such as teacher effects, school size and school socioeconomic composition, but only those effects that were - significant were retained in the final models. The level 1 models examined growth trajectories based on Time and captured within-subject changes over the different assessment points. The level 2 models examined how between-subject demographic variables accounted for the growth parameters in the Level 1 models. Gender (girl = 0, boy = 1) and condition (control = 0, intervention = 1) were entered with dummy coding, and age was centered on the average participants' age. Other demographic variables were not significant predictors. The level 3 models included the school level (primary school = 0, secondary school = 1) and the number of students in the classroom to determine the influence of the school and classroom contexts on the outcome variables.

In addition to the growth models, statistically significant mean differences within and between groups were assessed using t-tests and chi-square tests. Cohen's d was used to calculate effect sizes for differences. Maximum likelihood estimation was used to account for missing data, which amounted to less than 3 % across the study variables.

3. Results

3.1. Sample characteristics

The original sample consisted of 1782 students. In the intervention group, 53 students did not complete the study due to absence or dropping out (n = 47) or incomplete questionnaires (n = 6). In the control group, 59 students did not complete the study, due to absence or dropping out (n = 52) or incomplete questionnaires (n = 7). The final sample comprised 833 students in the intervention group, and 837 students in the control group, approximately evenly divided by age and gender in each condition. A participant flow diagram is presented in Fig. 1. The participants were predominantly Jewish (98 %). In addition,

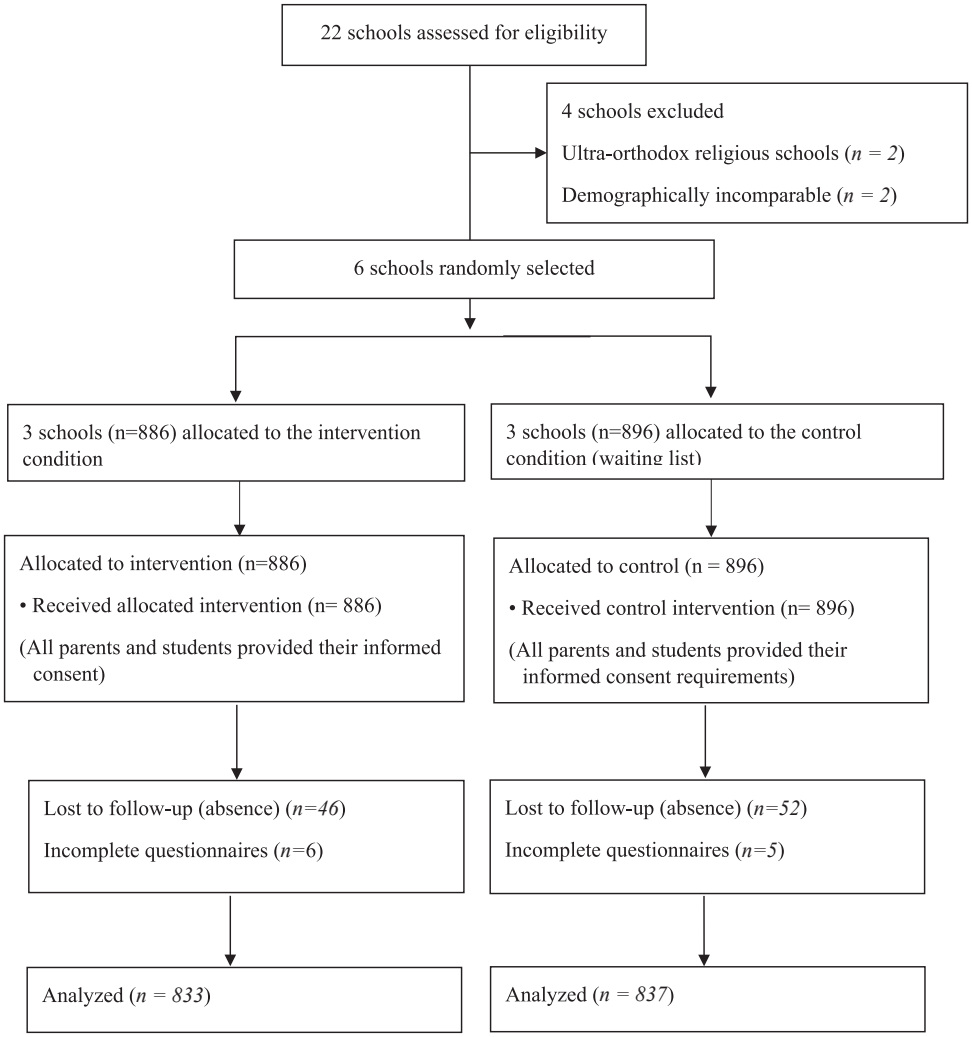

Fig. 1. Participant Flow Diagram.

64.4 % of the sample self-reported middle socioeconomic status (SES), 21.4 % high SES, and 14.2 % low SES.

3.2. Substance and screen Use: Prevalence, Onset, and sociodemographic correlates

There were no statistically significant baseline differences between the intervention and control groups in terms of demographic characteristics and outcome variables. The means and standard deviations for the variables at baseline are shown in Table 2. The skewness and kurtosis values indicated that the data satisfied the normality assumption.

Prevalence at baseline of the 12-month use of tobacco, alcohol, and cannabis were 7.6 %, 9.5 %, and 8.2 %, respectively. Of these, the 12-month prevalence of moderate use (several times a week or daily use) was 3.6 % for tobacco, 3.4 % for alcohol, and 1 % for cannabis. The mean age of onset of substance use among the students was 11 for tobacco and alcohol, and 15 years for cannabis. Boys reported more tobacco and alcohol use than girls.

At baseline, children and early adolescents aged 10 to 12.9 spent 7 h a day on average on gaming, the internet, and social media, whereas middle adolescents aged 13 to 16 spent 7.76 h a day on average on these media. About 55 % of the students spent more than 5 h a day on screen media, and 39 % spent more than 7 h a day on screen. Boys spent more hours a day on video games (1.86 h, $SD = 1.89$) than girls (1.48 h, $SD = 1.80$), and girls spent more hours on the internet (3.21 h, $SD = 2.03$) and social media (3.05 h, $SD = 2.27$) than boys (internet: 2.77 h, $SD = 1.98$; social media: 2.31 h, $SD = 2.08$; $ps < 0.001$).

3.3. Intervention effects

Table 3 shows the means, standard deviations, and effect sizes for the variables in the intervention and control groups on the pre-, post-intervention, and follow-up assessments. Tables 4-6 present the

Table 2
Demographic and Sample Characteristics at Baseline.

	Control Group ($n = 837$)	Intervention Group ($n = 833$)	Statistic	*p Value*
	Mean (*SD*)	Mean (*SD*)		
Age (years)	13.05 (1.99)	12.87 (2.01)	$t = 1.77$	0.08
Gender				
Girls, *n* (%)	405 (48 %)	404 (48 %)	$\chi^2 = 0.01$	0.96
Ethnicity				
Jewish, n (%)	819 (98 %)	815 (98 %)	$\chi^2 = 0.01$	0.99
Socioeconomic status				
Low SES *n* (%)	114 (14 %)	123 (15 %)	$\chi^2 = 0.65$	0.72
Middle SES	546 (65 %)	529 (64 %)		
High SES	177 (21 %)	181 (21 %)		
Psychological symptoms (GSI)	16.36 (10.42)	17.23 (12.67)	$t = 1.78$	0.08
Positive emotions	18.17 (3.57)	17.97 (4.08)	$t = 1.02$	0.31
Negative emotions	9.68 (3.02)	9.61 (3.61)	$t = 0.45$	0.66
Life satisfaction	5.52 (1.04)	5.52 (1.08)	$t = 0.06$	0.95
Gaming (hours per day)	1.74 (1.78)	1.62 (1.84)	$t = 1.35$	0.18
Internet use (hours per day)	3.06 (2.07)	2.91 (1.96)	$t = 1.55$	0.12
Social media use (hours per day)	2.73 (2.20)	2.61 (2.21)	$t = 1.02$	0.31
Tobacco; n (%)	62 (7.4 %)	65 (7.8 %)	$\chi^2 = 0.09$	0.76
Alcohol; n (%)	77 (9.2 %)	81 (9.7 %)	$\chi^2 = 0.01$	0.98
Cannabis; n (%)	69 (8.2 %)	68 (8.2 %)	$\chi^2 = 0.01$	0.95

Table 3
Means and Standard Deviations of Outcome Measures at Pre- and Post-Intervention for the Control and Intervention Groups.

	Control						Within-group comparisonsT1 vs T3		Intervention						Within-group comparisonsT1 vs T3		Between-group (time × condition) comparisons	
	T1		T2		T3		t / χ^2	d	T1		T2		T3		t / χ^2	d	F/ χ^2	*partial η2*
	Mean	*SD*	Mean	*SD*	Mean	*SD*			Mean	*SD*	Mean	*SD*	Mean	*SD*				
Psychological symptoms (GSI)	16.36	10.42	19.85	12.66	21.04	15.71	$t = 7.78^{***}$	0.36	17.23	12.67	14.20	11.50	15.06	12.57	$t = 3.98^{***}$	0.17	$F = 67.62^{***}$	0.04
Depression	6.09	4.47	7.90	5.73	7.99	6.05	$t = 7.78^{***}$	0.36	6.39	5.11	5.35	4.45	5.57	4.97	$t = 3.69^{***}$	0.16	$F = 63.63^{***}$	0.04
Anxiety	3.89	2.60	4.92	3.33	4.41	3.22	$t = 3.78^{***}$	0.18	4.11	2.80	3.53	2.77	3.18	2.84	$t = 7.30^{***}$	0.33	$F = 58.36^{***}$	0.03
Somatization	4.84	3.89	5.06	4.38	6.37	5.86	$t = 6.74^{***}$	0.31	4.97	4.40	3.91	4.28	4.73	4.74	$t = 1.12$	0.05	$F = 30.33^{***}$	0.02
Panic	1.55	2.08	1.96	2.40	2.27	2.94	$t = 6.03^{***}$	0.29	1.77	2.65	1.41	2.21	1.60	2.33	$t = 1.48$	0.07	$F = 27.83^{***}$	0.02
Positive emotions	18.17	3.57	15.47	3.86	17.09	4.05	$t = 5.81^{***}$	0.28	17.97	4.08	16.87	3.80	18.64	17.97	$t = 3.55^{***}$	0.06	$F = 49.73^{***}$	0.03
Negative emotions	9.68	3.02	10.10	3.53	10.71	4.00	$t = 6.21^{***}$	0.29	9.61	3.61	9.03	2.98	9.49	9.61	$t = 0.66$	0.02	$F = 48.42^{***}$	0.03
Life satisfaction	5.52	1.04	5.22	1.16	5.34	1.03	$t = 3.79^{***}$	0.17	5.52	1.08	5.61	1.03	5.76	0.99	$t = 5.07^{***}$	0.23	$F = 53.09^{***}$	0.03
Daily screen use	7.52	4.28	8.72	4.51	8.93	4.08	$t = 7.06^{***}$	0.34	7.14	4.55	7.15	4.03	7.34	3.68	$t = 0.88$	0.05	$F = 20.64^{***}$	0.01
Gaming	1.74	1.78	2.54	2.23	2.94	2.22	$t = 12.2^{***}$	0.60	1.62	1.84	1.78	1.98	2.37	1.99	$t = 7.93^{***}$	0.39	$F = 13.63^{***}$	0.01
Internet use	3.06	2.07	3.49	2.24	2.99	2.03	$t = 0.71$	0.03	2.91	1.96	3.09	2.13	2.74	2.02	$t = 1.73$	0.09	$F = 3.51$	0.002
Social media use	2.73	2.20	2.69	2.20	3.00	2.11	2.74^{**}	0.13	2.61	2.21	2.28	1.78	2.22	1.87	$t = 4.08^{***}$	0.19	$F = 24.08^{***}$	0.01
Tobacco; n (%)	62	7.4 %	69	8.2 %	93	11.1 %	$\chi^2 = 6.83^{**}$		65	7.8 %	45	5.4 %	42	5 %	$\chi^2 = 5.28^{*}$		$\chi^2 = 20.7^{***}$	
Alcohol; n (%)	77	9.2 %	117	14 %	142	17 %	$\chi^2 = 22.2^{***}$		81	9.7 %	64	7.7 %	67	8 %	$\chi^2 = 1.45$		$\chi^2 = 13.8^{***}$	
Cannabis; n (%)	69	8.2 %	87	10.4 %	97	11.6 %	$\chi^2 = 5.24^{*}$		68	8.2 %	54	6.5 %	44	5.3 %	$\chi^2 = 5.51^{*}$		$\chi^2 = 21.48^{***}$	

Note: N control = 837; N intervention = 833; T1- Pre-Intervention, September 2019; T2 - Post-Intervention, May 2021; T3 – Follow-up, May 2022; digital media use measures represent the mean hours of use per day; substance use measures represent past 12-month use. $p < .05^{*}$, $p < .01^{**}$, $p < .001^{***}$.

Table 4
Changes in Students' Mental Health Symptoms from Baseline to Post-Intervention.

		GSI		Depression		Anxiety		Somatization		Panic	
	Fixed effects	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*
	Intercept	−0.22 (-3.93–3.49)	1.89	0.19 (-1.32–1.70)	0.77	0.76 (-0.05–1.57)	0.41	−0.13 (-1.45–1.19)	0.68	−0.72* (-1.41- −0.02)	0.35
Level 1	Time	1.45*** (0.75–2.14)	0.35	0.57*** (0.29–0.86)	0.14	0.13 (-0.03–0.29)	0.08	0.50*** (0.23–0.76)	0.13	0.25*** (0.10–0.39)	0.07
Level 2	Age	−0.13 (-0.70–0.45)	0.29	−0.12 (-0.36–0.11)	0.12	0.07 (-0.06–0.20)	0.07	−0.16 (-0.37–0.05)	0.11	0.09 (-0.02–0.21)	0.06
	Gender (Boys)	−6.19*** (-7.91- −4.48)	0.88	−2.70*** (-3.42- −1.98)	0.37	−0.86*** (-1.26- −0.45)	0.21	−1.73*** (-2.37–1.09)	0.33	−0.91*** (-1.27- −0.55)	0.18
	Intervention (PPAP)	3.05*** (1.33–4.78)	0.88	1.05** (0.32–1.77)	0.37	0.63** (0.23–1.04)	0.21	0.81* (0.17–1.45)	0.33	0.56** (0.20–0.92)	0.18
	Age * Time	0.15 (-0.04–0.35)	0.10	0.06 (-0.02–0.14)	0.04	0.01 (-0.05–0.05)	0.02	0.12** (0.04–0.20)	0.04	−0.02 (-0.06–0.02)	0.02
	Gender * Time	1.70*** (0.91–2.49)	0.40	0.72*** (0.40–1.04)	0.16	0.25** (0.07–0.43)	0.09	0.50*** (0.20–0.80)	0.15	0.23** (0.06–0.39)	0.08
	Intervention * Time	−3.39*** (-4.19- −2.60)	0.40	−1.35*** (-1.67- −1.03)	0.16	−0.72*** (-0.91- −0.54)	0.09	−0.86*** (-1.16- −0.56)	0.15	−0.45*** (-0.62- −0.29)	0.08
Level 3	School level (secondary)	−0.87 (-2.62–0.88)	0.89	0.05 (-0.66–0.76)	0.36	−0.28 (-0.65–0.10)	0.19	−0.46* (-1.08- −0.16)	0.32	−0.20 (-0.52–0.12)	0.16
	Classroom size	0.59*** (0.48–0.69)	0.05	0.21*** (0.17–0.26)	0.02	0.12*** (0.10–0.14)	0.01	0.17*** (0.13–0.20)	0.02	0.08*** (0.06–0.10)	0.01
Variance components	Within person	73.77***		13.45***		6.65***		11.82***		3.49***	
	Between person	146.23***		24.39***		2.24**		16.59***		5.77***	
Proportion explained	R^2 within	0.32		0.28		0.07		0.26		0.26	
	R^2 between	0.14		0.13		0.28		0.12		0.08	
	ICC	0.35		0.33		0.20		0.27		0.23	

Note: $N = 1{,}670$; $p < .05$*, $p < .01$**, $p < .001$***.

Table 5
Changes in Students' Subjective Well-being from Baseline to Post-Intervention.

		Positive Emotions		Negative Emotions		Life Satisfaction	
	Fixed effects	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*
	Intercept	20.13*** (19.03–21.23)	0.56	6.65*** (5.69–7.62)	0.49	6.28*** (5.97–6.58)	0.16
Level 1	Time	−0.48*** (-0.71- −0.25)	0.12	0.22* (0.01–0.42)	0.10	−0.07* (-0.13- −0.01)	0.03
Level 2	Age	−0.13 (-0.31–0.05)	0.09	−0.10 (-0.26–0.06)	0.08	−0.07** (-0.12- −0.02)	0.03
	Gender (Boys)	0.72* (0.13–1.32)	0.30	−1.72*** (-2.23- −1.22)	0.26	0.19* (0.03–0.35)	0.08
	Intervention (PPAP)	−0.80** (-1.40- −0.21)	0.30	0.32 (-0.19–0.82)	0.26	−0.15 (-0.32–0.01)	0.08
	Age * Time	0.02 (-0.04–0.09)	0.03	0.06* (0.01–0.12)	0.03	0.03** (0.01–0.04)	0.01
	Gender * Time	−0.11 (-0.37–0.15)	0.13	0.57*** (0.34–0.81)	0.12	−0.05 (-0.11–0.02)	0.03
	Intervention * Time	0.88*** (0.62–1.14)	0.13	−0.56*** (-0.80- −0.33)	0.12	0.22*** (0.15–0.29)	0.03
Level 3	School level (secondary)	−0.15 (-0.65–0.35)	0.26	−0.25 (-0.69–0.20)	0.23	−0.10* (-0.24- −0.04)	0.07
	Classroom size	−0.08*** (-0.11–0.05)	0.02	0.11*** (0.09–0.14)	0.01	−0.03*** (-0.03- −0.02)	0.00
Variance components	Within person	12.23***		7.69***		0.70***	
	Between person	9.57***		9.73***		1.28**	
Proportion explained	R^2 within	0.10		0.23		0.18	
	R^2 between	0.06		0.11		0.05	
	ICC	0.16		0.19		0.25	

Note: $N = 1{,}670$; $p < .05$*, $p < .01$**, $p < .001$***.

estimated fixed effects for the final growth models.

A series of unconditional models were examined for all dependent variables. For all variables the intraclass correlation (ICC) scores were low (0.20–0.35), indicating that substantial amount of variance in mental health, addictive behaviors, and subjective well-being resulted from within-person variability across the study time period.

The unconditional models of mental health symptoms and addictive behaviors revealed significant positive values for the linear slope

Table 6
Changes in Students' Addictive Behaviors from Baseline to Post-Intervention.

		Daily screen use		Gaming		Internet use		Social media use		Tobacco		Alcohol		Cannabis	
	Fixed effects	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*	Coefficient (95 % CI)	*SE*
	Intercept	6.66*** (5.45–7.86)	0.61	1.36*** (0.80–1.92)	0.28	3.22*** (2.65–3.78)	0.29	2.16*** (1.57–2.75)	0.30	−0.10** (-0.17–0.02)	0.04	−0.06 (-0.14–0.02)	0.04	0.07 (-0.01–0.14)	0.04
Level 1	Time	0.54*** (0.29–0.78)	0.12	0.64*** (0.53–0.76)	0.06	−0.15* (-0.27- −0.03)	0.06	0.04 (-0.08–0.16)	0.06	0.03*** (0.01–0.04)	0.01	0.04*** (0.03–0.06)	0.01	0.02* (0.004–0.03)	0.01
Level 2	Age	0.38*** (0.17–0.59)	0.11	0.14** (0.04–0.23)	0.05	0.15** (0.05–0.25)	0.05	0.11* (0.01–0.21)	0.05	0.04*** (0.03–0.05)	0.01	0.05*** (0.03–0.06)	0.01	0.05*** (0.04–0.06)	0.01
	Gender (Boys)	−1.12*** (-1.81- −0.44)	0.35	0.58*** (0.28–0.88)	0.15	−0.74*** (-1.06- −0.42)	0.16	−0.96*** (-1.30–0.63)	0.17	0.04* (0.01–0.08)	0.02	0.02 (-0.02–0.07)	0.02	−0.01 (-0.04–0.03)	0.02
	Intervention (PPAP)	0.10 (-0.58–0.79)	0.35	0.01 (-0.29–0.31)	0.15	−0.14 (-0.46- −0.18)	0.16	0.24 (-0.10–0.57)	0.17	0.04* (0.01–0.08)	0.02	0.05* (0.01–0.10)	0.02	0.04* (0.01–0.08)	0.02
	Age * Time	−0.09* (-0.16- −0.02)	0.04	−0.03 (-0.06–0.01)	0.02	−0.03 (-0.07–0.01)	0.02	−0.03 (-0.06–0.01)	0.02	−0.01*** (-0.01–0.01)	0.00	−0.01** (-0.01–0.01)	0.00	0.01 (-0.01–0.01)	0.00
	Gender * Time	0.34* (0.06–0.62)	0.14	−0.07 (-0.20–0.06)	0.07	0.22** (0.09–0.36)	0.07	0.19** (0.05–0.33)	0.07	−0.02 (-0.03–0.01)	0.01	−0.01 (-0.03–0.01)	0.01	0.01 (-0.02–0.01)	0.01
	Intervention * Time	−0.62*** (-0.90–0.35)	0.14	−0.23*** (-0.37- −0.10)	0.07	−0.05 (-0.19–0.09)	0.07	−0.34*** (-0.48–0.20)	0.07	−0.03*** (-0.05- −0.02)	0.01	−0.05*** (-0.07–0.03)	0.01	−0.03*** (-0.05–0.01)	0.01
Level 3	School level (secondary)	−0.33 (-0.87–0.21)	0.28	−0.20 (-0.45–0.05)	0.13	−0.17 (-0.43–0.09)	0.13	−0.01 (-0.28–0.25)	0.14	0.01 (-0.04–0.02)	0.02	0.03* (0.01–0.07)	0.02	0.02* (0.01–0.05)	0.02
	Classroom size	0.03 (0.01–0.07)	0.02	−0.01 (-0.03–0.01)	0.01	0.02 (0.01–0.03)	0.01	0.03*** (0.01–0.04)	0.01	0.01*** (0.002–0.01)	0.00	0.00** (0.001–0.01)	0.00	0.00 (-0.01–0.01)	0.00
Variance components	Within person	10.75***		3.01***		3.45***		2.50***		0.05***		0.07***		0.07***	
	Between person	24.90***		2.66***		2.75***		6.18***		0.07***		0.05***		0.05***	
Proportion explained	R^2 within	0.23		0.18		0.08		0.25		0.19		0.12		0.04	
	R^2 between	0.02		0.04		0.07		0.03		0.07		0.11		0.32	
	ICC	0.23		0.15		0.13		0.24		0.17		0.13		0.20	

Note: $N = 1{,}670$; $p < .05$*, $p < .01$**, $p < .001$***.

parameter (time), indicating a significant linear growth rate in symptomatology (depression, somatization, and panic) and addictive behaviors (gaming, internet use, and tobacco, alcohol, and cannabis use) among children and adolescents during the pandemic. In addition, time was associated with a reduction in subjective well-being (increase in negative emotions and decrease in positive emotions and life satisfaction) during the study period.

Next, the demographic variables (age and gender) and the intervention variable were entered into the model to test their moderation effect on the changes over time in mental health, well-being, and addictive behaviors. The cross-level interaction between intervention and time was significant for all the mental health symptom scales (βs ranged between −0.45 to −3.39; *p*s < 0.001; see Table 4). As hypothesized, students in the intervention program reported a significant decrease in depression, anxiety, somatization, and panic symptoms from baseline to the post-intervention evaluation and the follow-up, whereas students in the control condition reported a significant increase in psychological symptoms throughout the study period (see Fig. 2).

Significant moderation by gender was also found. Girls reported more symptoms than boys, but boys exhibited greater increases in mental health symptoms over time than girls. The interactions between the intervention and the demographic variables were - not significant. This indicates that the effect of the intervention was not significantly different between children and adolescents or between genders. The effect size for the intervention on mental health was low to moderate (Cohen's d = 0.16–0.39).

The results also demonstrated that the intervention moderated the effect of time on subjective well-being and had beneficial effects on emotional well-being and life satisfaction (see Table 5). In both groups there was a reduction in positive emotions on the second measurement during the lockdown periods, but an improvement in the follow-up year where positive emotions were higher in the intervention group than in the control group. In addition, the intervention reduced levels of negative emotions and increased life satisfaction. By contrast, the control group experienced significant increases in negative emotions and decreases in life satisfaction at both post intervention and follow-up. The effect size of the intervention on positive emotions and life satisfaction was in the low range (Cohen's d = 0.06–0.23). Boys reported better subjective well-being than girls, in terms of greater life satisfaction and positive emotions, and fewer negative emotions but experienced greater increases over the study period in negative emotions as compared to girls.

The intervention also moderated the increases in digital media use and substance use.

The interaction between intervention and time was significant for daily screen use, gaming, social media use, as well as for tobacco, alcohol, and cannabis use (βs ranged from −0.23 to −0.62 for digital media use, and from −0.03 to −0.05 for substance use; *p*s < 0.001; see Table 6).

Daily video game use increased during the study period in both groups, but with a significantly higher increase in the control group (from 1.74 to 2.94 h) than in the intervention group (from 1.62 to 2.37 h). Social media use decreased in the intervention group from 2.61 to an average of 2.22 h per day and increased in the control group from 2.73 to 3 h from baseline throughout the follow-up period. No significant differences were found for the change in daily internet use time between the intervention and control conditions (p =.44). At follow-up, 65 % of the intervention group students and 78 % of the control group students spent more than 5 h per day on screen..The effect size for the intervention on digital media use was low to moderate (Cohen's d = 0.05–0.39).

In the control group, the 12-month prevalence of tobacco use increased from 7.4 % to 11.1 %, whereas in the intervention group tobacco use declined from 7.8 % to 5 % during the study period (χ^2 = 20.70; *p* <.001). Prevalence rates of alcohol use increased from 9.2 % to 17 % from the pre- to the follow-up period in the control group and decreased from 9.7 % to 8 % in the intervention group (χ^2 = 13.82; *p* <.001). Rates of 12-month cannabis use increased from 8.2 % at baseline to 11.6 % in the control group and decreased to 5.3 % in the intervention group (χ^2 = 21.48; *p* <.001). Age was significantly associated with digital media use and substance use, and boys reported greater increases in digital media use from Time 1 to Time 3. Pearson correlation analyses revealed that the participants' mental health symptoms at follow-up were positively associated with substance use and more screen use (*p*s < 0.001) whereas positive emotions and life satisfaction where negatively related to daily screen use (*p*s < 0.001) and substance use (*p*s < 0.04).

In the final stage, the school- and classroom-level variables were added to the model to examine their effects on the outcome variables. Secondary school students reported fewer symptoms of somatization, life satisfaction, and more cannabis and alcohol use than primary school students. The number of students in the classroom was associated with

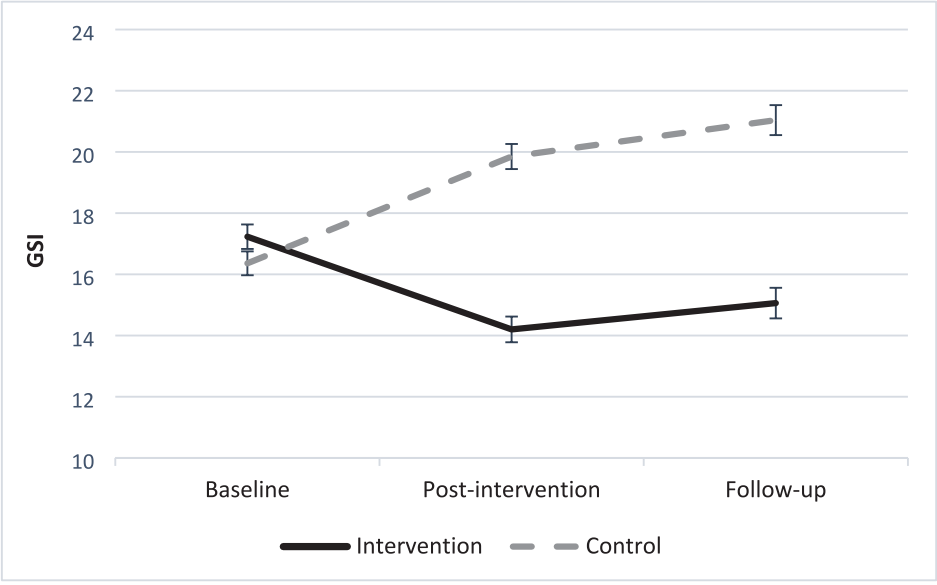

Fig. 2. Changes in the mean scores for psychological symptoms from baseline to post-intervention (21 months after baseline) and follow-up assessment (12 months after the end of the intervention), with corresponding 95 % confidence intervals; GSI = General severity index of the BSI-18.

higher levels of psychological symptoms, social media and substance use, and lower levels of subjective well-being. However, these factors had no significant effect on intervention effectiveness.

4. Discussion

This study integrated the principles of positive psychology with addiction prevention strategies to advocate a comprehensive approach to children's and adolescents' mental health. The findings indicate that the intervention boosted the students' mental health and well-being during a period of heightened risk for the development of behavioral addictions and psychological difficulties.

The intervention group participants reported decreases in smoking, alcohol consumption and cannabis use, and significantly lower increases in digital media use during the COVID-19 period in contrast to the control group participants, who showed negative trends on all these indices. The intervention was effective in reducing mental health symptoms and psychological distress and increasing subjective well-being as compared to the control group that reported increases in mental health symptoms and a reduction in subjective well-being.

While it is difficult to determine causation in a multi-dimensional program, the preventive intervention stimulated a variety of facets of well-being, most of which have been identified as protective factors - that buffer the impact of stressful events, enhance coping, and can shield against symptoms. These include problem-solving skills, positive emotions, social support, and goal setting. Increasing the students' awareness of the links between mental health and addictive behaviors, and the provision of healthy alternatives to substance and screen use were also important aspects of the program.

The control group participants showed high levels of general psychological distress and mental health symptoms over the three years of the study, confirming the literature on the negative psychological effects of the pandemic on the general population of children and adolescents. Interestingly, both externalizing and internalizing symptoms were elevated, including anxiety, panic, somatization, and depression, thus demonstrating the wide variation in the psychological responses of children and adolescents to stressful experiences during the pandemic.

These negative effects emerged not only for mental health symptoms but also for addictive behaviors. The findings showed that about 80 % of the sample at the end of the study spent more than 5 h a day playing video games, surfing the internet, and using social media compared to 55 % of the students at the beginning of the study, prior to the outbreak of the COVID-19 pandemic. Overall screen use increased to an average of almost 9 h per day in the control group including significant increases in video games and social media use. Daily internet usage increased significantly during the lockdown periods in both groups but returned to pre-COVID-19 levels in the follow-up year. The prevalence of alcohol use in the control group increased significantly from 9 % to 17 % at the end of the study, and tobacco and cannabis use also progressively increased by 2 % and 4 % respectively.

The mental health symptoms and the decline in psychological well-being in this study were significantly associated with addictive behaviors, such that students who reported higher levels of general distress also reported higher levels of tobacco, alcohol, cannabis, and digital media use. These findings are consistent with the literature suggesting that people turn to psychoactive substances and digital devices as a self–regulation strategy to alleviate psychological distress (Smith et al., 2017). However, the consequences of such self-medicating behaviors for children and adolescents are complex, because of their developing brains and limited judgment, which increase the risk of continued use, overuse, and negative health and social outcomes into adulthood (Tucker et al., 2005). However, the findings also point to the preventive role of positive emotions and psychological well-being as self-protecting aspects for better mental health and lower addictive behaviors.

4.1. Limitations

This study also has several limitations. Although anonymity was guaranteed, the sensitive nature of the questionnaires could have had an impact on the students' responses. We cannot rule out that students underreported substance use as a result of social desirability bias, recall bias, and reporting bias. In addition, there were low reports of heroin, cocaine, and other illicit drug use, except for cannabis which was reported more frequently. This may be attributed to the young age of the participants or underreporting. Other measures and methods need to be implemented in future studies to provide a more accurate estimation of addictive behaviors. Another limitation is that the data were based solely on self-report methods, which may raise validity issues. However, considering the practical and ethical concerns and the sensitivity of the topic, especially for young children and adolescents, the use of self-report questionnaires is not unreasonable.

The students in this study were not blind to their allocation to the intervention program or the control group, and there is a possibility of bias in their reports. In addition, participants on the waiting-list control group did not complete the PPAP intervention prior to the publication of the findings, and more validation studies are needed to determine the efficacy of the intervention in different populations and contexts. Furthermore, the study sought to assess problematic digital media usage but did not include internet addiction-related measures. Future research should include these measures to evaluate the pertinence of the program for internet-addicted populations. Finally, the program was situated and examined within the unique context of the COVID-19 pandemic. Future studies should examine whether the findings can be generalized to other contexts.

5. Conclusion

The return to routine after the turmoil and stress of the pandemic inevitably produced a sense of relief but can mask the need to restore children's and adolescents' well-being and mental health in the wake of the crisis. Here we presented an evidence-based prevention intervention integrating mental health promotion and addiction prevention strategies to help cope with the stressful context of the pandemic.

Tailoring preventive school-based interventions to the entire population of children and teens based on their specific needs can allow policy makers to effectively direct limited resources to alleviate the significant mental health impact of the pandemic on young people. Because of the key role of schools in students' lives, they are the optimal setting for preventive interventions that are cost-effective, scalable, and can reach a large population of children and adolescents in their natural environment (Slone & Shoshani, 2014). Integrative well-being and addiction prevention curricula can thus pair mental health with positive attitudes and skills that can scaffold a future of healthy development and behaviors in the younger generation.

CRediT authorship contribution statement

Ariel Kor: Project administration, Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft. **Anat Shoshani:** Project administration, Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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