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ORIGINAL CONTRIBUTION

Risk-behaviour screening for identifying adolescents with mental health problems in Europe

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Abstract Indicated prevention of mental illness is an important public health concern among youth. The aim of this study was to establish a European school-based professional screening among adolescents, which included variables on both a broad range of risk-behaviours and psychopathology; and to investigate the indicative value of adolescent risk-behaviour and self-reported psychopathology on help-seeking and psychological problems that required subsequent mental healthcare. A two-stage professional screening approach was developed and performed within the multi-centre study "Saving and Empowering Young Lives in Europe" (SEYLE). The first stage of screening comprised a self-report questionnaire on a representative sample of 3,070 adolescents from 11 European countries. In the second stage, students deemed at-risk for mental health problems were evaluated using a semi-structured clinical interview performed by healthcare professionals. 61 % of participants ($n = 1{,}865$) were identified as being at-risk in stage one. In stage two, 384 participants (12.5 % of the original sample) were found to require subsequent mental healthcare during semi-structured, clinical assessment. Among those, 18.5 % of pupils were identified due to screening for psychopathology alone; 29.4 % due to screening for risk-behaviours alone; and 52.1 % by a combination of both. Young age and peer victimization increased help-seeking, while very low body

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mass index, depression, suicidal behaviour and substance abuse were the best predictors of referral to mental healthcare. Screening of risk-behaviours significantly increased the number of detected students requiring subsequent mental healthcare. Screening of risk-behaviours added significant value in identifying the significant amount of European pupils with mental health problems. Therefore, attention to adolescent risk-behaviours in addition to psychopathology is critical in facilitating prevention and early intervention. Identifying factors that increase compliance to clinical interviews are crucial in improving screening procedures.

Keywords SEYLE · Adolescence · Psychopathology · Risk-behaviour · Mental health · Self-injury · Depression · Substance abuse · Peer victimization · Screening · Help-seeking · Health-care

Introduction

A review by Gore et al. [8] reported that neuropsychiatric disorders were the most common causes of disability (45 %) in individuals aged 10–24 years and were strongly associated with several risk-behaviours. However, there is evidence showing that only 20–40 % of those with mental health problems are detected by health services and only 25 % receive appropriate professional treatment [29]. Adolescents with psychological problems often do not receive treatment due to low help-seeking behaviour [9, 14], which could potentially be explained by barriers in accessing mental health services [33]. Additionally, severe psychological problems, such as suicidal behaviour, have been reported to be associated with a decrease in help-seeking behaviour among young people [14]. Early detection of at-risk adolescents increases the chance of early treatment and diminishes the risk of recurrence and/or serious long-term consequences, thereby, providing an opportunity to improve psychosocial outcomes among adolescents with mental health problems [12, 26].

Professional screening is a strategy that is often used in school-based prevention programmes [23]. It generally involves an initial assessment of all pupils by using a self-report questionnaire. If specified cut-off values are exceeded, positive cases are further investigated and confirmed by a clinical interview conducted by mental health professionals. To date, the Columbia SuicideScreen and its successor, the TeenScreen Program, are the most well-known, two-stage screening procedures, which have been extensively evaluated and established in the United States (US) [31, 32]. Studies on the TeenScreen concluded that help-seeking and treatment engagement could be significantly improved by screening interventions [9]. However, one limitation of the Teen Screen is that it was particularly designed for suicide screening, and only comprises topics such as suicidal behaviour, emotional problems (anxiety, depression, irritability and social withdrawal) and substance abuse.

According to the "problem-behaviour-theory" [18], risk-behaviours are defined as behaviours that may compromise the physical or psychosocial adolescent development, and include a broad range of behaviours that often accompany adolescent development including substance abuse, withdrawal from school or unprotected sexual intercourse as a few examples [18]. A strong correlation between adolescent risk-behaviours and psychological problems has previously been reported; for example, adolescents presenting depressive symptoms are more likely to be involved in several risk-behaviours [19]. Moreover, there is evidence indicating that engaging in risk-behaviours during adolescence is associated with ensuing suicidal behaviour [1, 21] and psychiatric disorders in adulthood [24]. Therefore, risk-behaviours could potentially be a marker for early identification of psychiatric disorders [21].

This study describes the implementation and evaluation of a two-stage professional screening programme, the "ProfScreen", among a large, representative sample of European adolescents. Unlike previous programmes, the respective screening procedure was aimed at detecting all pupils requiring mental healthcare by screening for a broad range of risk-behaviours in addition to emotional problems, substance abuse and suicidality. The objectives of the study were to: investigate which screening items predict help-seeking behaviour in terms of attendance in the clinical interview; investigate which screening items predict psychological problems requiring mental healthcare; and determine the added value of screening for risk-behaviours.

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Methods

Study sample and procedure

The study sample was recruited within the multi-centre study "Saving and Empowering Young Lives in Europe" (SEYLE). During this study, prevention programmes concerning adolescent risk-taking and self-destructive behaviours were developed, implemented and consequently evaluated. The detailed protocol for the SEYLE study [registered at the US National Institute of Health (NIH) clinical trial registry (NCT00906620), and the German Clinical Trials Register (DRKS00000214)] has been published elsewhere [35]. SEYLE comprises a representative sample of 12,395 adolescents from 179 randomly selected schools in 11 different European countries (Austria, Estonia, France, Germany, Hungary, Ireland, Israel, Italy, Romania, Slovenia and Spain). Permission from local ethical committees was granted in each participating centre. Baseline assessment and subsequent interventions took part between October 2009 and December 2010. The ProfScreen was one of four interventions implemented during the SEYLE study; each school was randomly assigned one treatment arm in order to ensure that the treated subsamples were still representative. A quarter of the total sample ($n = 3{,}070$) took part in the professional screening arm in SEYLE. Sociodemographic characteristics of the sample are presented in Table 1. Because some analyses were calculated on the German subsample only, the characteristics are presented for both the European and the German sample.

Table 1 Sociodemographic characteristics of the total European ProfScreen sample as well as the German subsample

Sociodemographic characteristics	European sample		German sample	
	n	%	*n*	%
Gender				
Female	1,752	57.39	225	52.96
Male	1,301	42.61	199	47.04
Living situation				
Both parents	2,377	77.81	306	72.51
One parent	637	20.85	108	25.59
Other	41	1.34	8	1.90
Born in the country				
Yes	2,871	94.19	395	93.60
No	172	5.64	27	6.40
Don't know	5	0.16	0	0
Sociodemographic characteristics	European sample		German sample	
	m	SD	*m*	SD
Age	14.93	0.86	14.66	0.79

Screening procedure

The "ProfScreen" was developed in a collaborative effort between Heidelberg University and the SEYLE Steering Group in order to identify pupils who are at-risk for mental health problems through the detection of risky and self-destructive behaviours, as well as psychopathological features.

The first stage of the screening programme took part during the baseline assessment of the SEYLE study. The baseline questionnaire comprised questions on pupils' socio-demographics, mental health, lifestyles, values and risk-behaviours [35], and included well-known instruments such as the Global School-Based Student Health Survey (GSHS) [36] for the assessment of risk-behaviours (substance abuse, sensation seeking and delinquent behaviours, excessive use of media, truancy), the Beck Depression Inventory (BDI-II) [2]; the Zung Self-Rating Anxiety Scale (SAS) [38], the Paykel Suicide Scale (PSS) [27], and a modified version of the Deliberate Self-Harm Inventory (DSHI) [4, 10]. Defined cut-offs for all measures were ascertained to detect at-risk pupils with a high degree of sensitivity. These cut-offs were established during a consensus conference among the steering group and several child and adolescent psychiatrists and psychologists within the SEYLE consortium. Cut-off criteria in Stage 1 of the screening programme are presented in Table 2, divided into those representing adolescent risk-behaviour, and those representing psychopathology. For further information on the psychometric properties of the instruments used, please see supplemental table A. Detailed descriptions of the study protocol, assessment tools and participants characteristics can be found in previous publications from the SEYLE study [5, 34].

In Stage 2, pupils who exceeded one or more of the cut-offs in the initial screening questionnaire, were invited to a semi-structured clinical interview, which was developed on the basis of the Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS) [20]. This interview was performed by experienced mental healthcare clinicians (psychologists or psychiatrists), and was used to distinguish between pupils indicating psychological problems that required referral to mental healthcare and those who did not (i.e. false positives). Wherever possible, cut-offs were defined according to the DSM-IV diagnostic criteria. For domains that lacked established criteria, cut-offs were determined, based on a previous pilot study at the German study centre (which aimed to ensure sufficient sensitivity of our cut-offs), and in accordance to the previously mentioned consensus conference within the SEYLE consortium. The ProfScreen clinical interview was developed to assess the need for mental healthcare, rather than to determine a psychiatric diagnosis.

Table 2 Cut-off criteria in Stage 1 of the screening

Topics	Assessment of thresholds/cut-offs	Invited to clinical interview when …
Risk-behaviour		
Self-injury	Shortened Deliberate Self-Harm Inventory (DSHI)	…pupil reported a life-time history of 2 or more incidents of intentional self-injury
Substance abuse		
Tobacco	Tobacco use (lifetime measure)	…pupil reported using tobacco with a frequency between 2 and 10 cigarettes or more per day[a]
	Tobacco consumption frequency	
Alcohol	Alcohol consumption frequency	…pupil reported consuming alcohol (e.g. a bottle of beer, a glass of wine or 4 cl of hard liquor) 2 times per week or more
	Alcohol consumption amount	…pupil reported consuming 3 or more drinks (e.g. a bottle of beer, a glass of wine or 4 cl of hard liquor) in a typical drinking day
	Alcohol intoxication	…pupil reported a life-time history of being clearly drunk 3 times or more
	Alcohol hangover	…pupil reported a life-time history of having a hangover 3 times or more
Illegal drugs	Illicit drug consumption	…pupil reported a life-time history of illegal drug consumption 3 times or more
Sensation seeking and delinquent behaviours	Riding with someone who has been drinking*	
	Skateboarding or riding roller-blades in traffic and without a helmet*	
	Subway cart jumping, or held on the back of a moving vehicle*	…pupil gave a sum of ≥3 affirmative answers to the respective questions*
	Visiting known areas that are dangerous during night*	
	Sexual promiscuity (more than 5 sexual partners in life)*	
	Several experiences of unprotected sex*	
Excessive use of media	Media exposure frequency	…pupil reported spending of at least 5–6 h per day watching television, playing computer games etc.
Truancy	Truancy	…pupil reported missing 3 or more days of school or class without permission in the last 2 weeks
Psychopathology		
Suicidal ideation and attempts (PSS)	Paykel-Scale was calculated based on the pupils' self-report	…pupil reported any suicidal thoughts or attempts in the last 2 weeks
	Question about previous suicide attempt	…pupil reported a life-time history of suicide attempts
Depression (BDI)	BDI score was calculated based on the pupils' self-reports	…pupil presented with a BDI score of ≥14 (mild depression)
Anxiety (SAS)	SAS-score was calculated based on the pupils' self-reports	…pupils presented with a SAS-score of ≥45 (mild anxiety)
Loneliness/social relationship problems	Loneliness frequency	…pupils reported feeling lonely at least most of the time within the last 12 months
Peer victimization	Frequency of experiences of peer victimization	…pupils reported ≥5 incidents of being bullied within the last 12 months
Eating behaviour	Calculation of the BMI score	…pupils presented with a BMI score less than 16·5

[a] Due to the intercultural differences in tobacco consumption, each country was allowed to define an individual cut-off for smoking. The cut-offs were: ≥2 cigarettes per day in Estonia, Germany, Hungary, Ireland, and Romania; ≥5 cigarettes per day in Italy and Slovenia; ≥7 cigarettes per day in France; and ≥10 cigarettes per day in Austria, Israel, and Spain

Data analyses

Descriptive statistics regarding the screening participants were calculated for each stage of the procedure. Interview attendees (IA) and non-attendees (NA) at Stage 2 were compared using *t* tests for dimensional and χ^2 tests for categorical variables. All screenings were dichotomized as exceeding or not-exceeding established cut-offs. Logistic regressions were performed to calculate the predictive value of the cut-offs concerning attendance to the clinical interview (Model 1) and referral of positive cases after the interview (Model 2). In a stepwise procedure, the best predictors for both models were extracted using the Bayes Information Criterion (BIC). The BIC allows the comparison of models according to their estimated ability to predict new data [30]. The model with the minimum BIC is the best predictive model.

To investigate the influence of risk-behaviours within the model, regression coefficients of risk-behaviour parameters were tested for significance with the Wald test. Finally, in order to compare screening of risk-behaviours to screening of psychopathology, tests of proportions were used to compare true-positive and false-positive referral rates of screening procedures that would include only psychopathology or include only risk-behaviours.

Results

Participation in different screening stages and sample characteristics

Figure 1 shows the number and percentages of pupils that participated in Stage 1 and Stage 2 of the screening. Of the 3,070 pupils who entered the initial screening at Stage 1, almost two-thirds were screened as being at-risk, and one-third ($n = 712$) of them participated in the Stage 2 clinical interview. Over half of the Stage 2 attendees ($n = 384$), which means 12.5 % of the entire sample ($n = 3{,}070$), required referral to the mental healthcare system for treatment of severe psychological problems. Of those, 71 pupils (18.5 %) were initially screened due to psychopathology alone, 113 pupils (29.4 %) due to risk-behaviours alone, and 200 (52.1 %) by a combination of both.

Significant age differences were found in IA ($M = 14.9$; $SD = 0.86$) and NA ($M = 15.1$; $SD = 0.84$) ($t = 5.96$, $df = 1{,}851$, $p < 0.001$), but not for gender [$\chi^2(1) = 0.005$, $p = 0.94$].

Predictors for participation in the clinical interview (Stage 1)

Frequency of scores exceeding established cut-offs at Stage 1, as well as their predictive value for interview attendance

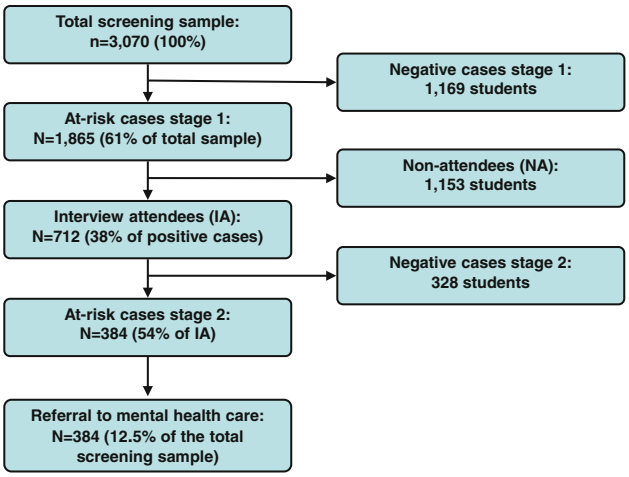

Fig. 1 Participation rates and samples of the different screening stages. 'At-risk cases of Stage 1' refers to students who scored above the cut-offs included in the SEYLE baseline questionnaire. 'At-risk cases of Stage 2' refers to students who scored above the cut-offs in the clinical interview. 'Negative cases' refers to students who did not score above the cut-offs in the respective stages

at Stage 2, are presented in Table 3. The regression model significantly predicted interview participation [LR $\chi^2(15) = 111.02$; $p < 0.001$]. After applying stepwise regression to minimize the BIC, four predictors were retained in the regression model: age, nonsuicidal self-injury, tobacco use and peer victimization.

A qualitative analysis (data not shown here) revealed that an important contributing factor for adolescent help-seeking behaviours and compliance was the proximity and short waiting times for the clinical interview and positive attitudes among parents. Secondary analysis was conducted on the German subsample only, because data were not available for the other study centres. IA differed from NA in terms of travel time and distance from the respective school to the study centre. On average, IA had a significantly shorter distance ($t = 3.14$, $df = 289$, $p = 0.002$) and significantly less travel time ($t = 3.01$, $df = 289$, $p = 0.003$) to get to the interview at the study centre.

Predictors for referral to mental health care (Stage 2)

Frequency of scores exceeding established cut-offs in the baseline questionnaire at Stage 1, as well as their predictive value for identifying cases for referral to mental healthcare, are presented in Table 4. The regression model did significantly predict referral to mental healthcare due to severe psychological problems that required treatment [LR $\chi^2(15) = 123.5$; $p < 0.001$]. After applying stepwise regression, predictors for referrals following the clinical interview were: a very low body mass index (BMI), suicidal behaviour, depression, use of tobacco and the use of illegal drugs. The mean number of exceeded cut-offs at

Table 3 Frequencies of exceeded cut-offs at Stage 1 and results of the regression model for prediction of interview attendance as dependent variable and age, gender and screening parameters as explanatory variables

	Interview attendees (IA) ($n = 707$)[a]	Interview non-attendees (NA) ($n = 1{,}139$)	Odds ratio[b]	95 % CI
Age			0.72**	0.64–0.81
Male gender			0.86	0.70–1.06
Screening parameters [*n* (%)][c]				
Self-injury	208 (29.4)	246 (21.6)	1.32*	1.04–1.67
Tobacco	145 (20.6)	304 (26.6)	0.68**	0.53–0.87
Alcohol	360 (50.9)	590 (51.8)	1.06	0.86–1.32
Illegal drugs	60 (8.5)	83 (7.3)	1.33	0.91–1.95
Sensation seeking and delinquency	109 (15.5)	138 (12.1)	1.21	0.90–1.63
Excessive media exposure	102 (14.4)	206 (18.1)	0.76*	0.58–1.00
Truancy	34 (4.8)	78 (6.8)	0.72	0.47–1.12
Suicidal behaviour	201 (28.4)	252 (22.1)	1.12	0.87–1.44
Depression	254 (35.9)	305 (26.8)	1.32*	1.02–1.71
Anxiety	105 (14.9)	128 (11.2)	0.96	0.68–1.34
Loneliness/ social relationship problems	87 (12.3)	98 (8.6)	1.23	0.87–1.75
Peer victimization	139 (19.7)	108 (9.5)	1.96**	1.48–2.62
BMI	37 (5.2)	68 (6.0)	0.81	0.53–1.25

* Significance with $p \leq 0.05$

** Significance with $p \leq 0.01$

[a] 19 subjects were excluded from the analyses due to missing values in age and gender

[b] Odds ratio = odds of interview attendance in presence of screening parameter divided by the odds of interview attendance in absence of screening parameter

[c] Percentage of all participating/non-participating adolescents

Table 4 Frequencies of adolescents who exceeded cut-offs in Stage 1 and results of the regression model for the prediction of clinical referral to mental health care as dependent variable and age, gender and screening parameters as explanatory variables

	Clinical referral to mental health care ($n = 380$)[a]	No clinical referral to mental health care ($n = 327$)	Odds ratios[b]	95 % CI
Age			1.06	0.87–1.30
Male gender			1.22	0.86–1.74
Screening parameters [*n* (%)][c]				
Self-injury	132 (34.7)	76 (23.2)	1.19	0.81–1.75
Tobacco	108 (28.4)	37 (11.3)	2.81**	1.79–4.43
Alcohol	210 (55.3)	150 (45.9)	1.31	0.92–1.87
Illegal drugs	46 (12.1)	14 (4.3)	2.42*	1.20–4.87
Sensation seeking and delinquency	72 (18.9)	37 (11.3)	1.56	0.94–2.59
Excessive use of media	64 (16.8)	38 (11.6)	1.68*	1.04–2.73
Truancy	27 (7.1)	7 (2.1)	2.35	0.91–6.08
Suicidal behaviour	143 (37.6)	58 (17.7)	2.34**	1.56–3.52
Depression	172 (45.3)	82 (25.1)	1.78**	1.18–2.67
Anxiety	77 (20.3)	28 (8.6)	1.36	0.78–2.38
Loneliness/ social relationship problems	61 (16.1)	26 (8.0)	1.31	0.75–2.30
Peer victimization	73 (19.2)	66 (20.2)	0.91	0.60–1.40
BMI	24 (6.3)	13 (4.0)	3.52**	1.67–7.43

* Significance with $p \leq 0.05$

** Significance with $p \leq 0.01$

[a] 5 subjects were excluded from the analyses due to missing values in age and gender

[b] Odds ratio = odds of clinical referral in presence of screening parameter divided by the odds of clinical referral in absence of screening parameter

[c] Percentage of all participating/non-participating adolescents

Stage 1 was 3.2 (SD = 1.9) for referrals and 1.9 (SD = 1.4) for non-referrals. The groups showed significant differences ($t = 10.3$, $df = 723$, $p < 0.001$), which suggests that a higher number of screening criteria met was associated with a referral to mental healthcare.

Risk-behaviour as an indicator of adolescent psychopathology

To investigate the additive impact of risk-behaviours assessed by the ProfScreen, we tested the hypothesis that the odds ratios of all risk-behaviours in the regression are 1 [Wald test $\chi^2(7) = 49.25$; $p < 0.001$]. Results show that screening of risk-behaviours contributed to the detection of additional pupils presenting severe psychological problems and requiring mental healthcare.

Of the adolescents who were referred to mental healthcare, 271 pupils (70.6 %; CI 66.0–75.1 %) could have been detected by the screening of psychopathology only. Similarly, screening of risk-behaviours alone could have detected 313 pupils (81.5 %; CI 77.6–85.4 %). Screening of risk-behaviours alone identified a significantly higher amount of total referred pupils ($p < 0.001$).

Screening of psychopathology versus screening of risk-behaviours differed slightly in terms of the number of false positives yielded in both groups. A greater number of false positives were identified when screening parameters were

based only on risk-behaviours ($n = 238$; 43.2 %; CI 39.1–47.3 %) in comparison to psychopathology ($n = 167$; 38.1 %; CI 33.6–42.7 %). However, this difference did not reach statistical significance ($p = 0.108$).

Discussion

To our knowledge, this is the first study that performed a school-based professional mental health screening among a large and representative sample of adolescents in Europe. The novelty of this European screening programme (ProfScreen) was the inclusion of distinctive risk-behaviours. Previous studies have primarily focused on emotional problems, substance abuse and suicidal behaviours [31, 32]; whereas the present study has expanded the range of risk-behaviours and psychopathology to also include: tobacco use, sensation seeking, truancy, excessive media exposure, and a broader spectrum of psychopathological variables.

Sample and screening procedure

During Stage 1, approximately two-thirds of adolescents in this sample were screened as being at-risk for the leading causes of morbidity and mortality in this age group. These results corroborate previous reports of a high prevalence of risk-behaviour and psychological problems among adolescents [7]. As many as 381 pupils (12.5 %), out of the 3,070 screened, were identified by the clinical interview because they presented mental health problems that required subsequent mental healthcare. Similar numbers have been previously confirmed in the US [15]. However, this number must be considered as the minimum, due to the drop-out rate from the clinical interview at Stage 2, which limits representativeness of the interview sample. Our results strongly support a high burden of mental health disease in adolescent populations, and call for further public health attention.

In contrast to other screening programmes, Stage 1 of the ProfScreen identified a substantially higher number of adolescents at-risk. For example, "TeenScreen" identified an at-risk rate for adolescents ranging from 23 to 45 %, during the first stage of screening [3, 14, 31]. This higher rate of at-risk adolescents identified in this study (61 %) may be due to the additional screening of risk-behaviours, which are generally quite prevalent among adolescents [7]. Moreover, the SEYLE study comprised an extended range of psychopathological variables (e.g. loneliness/social relationship problems, peer victimization and low BMI); and the larger number of constructs evaluated may be associated with the number of positive screens. However, the results from this study could also potentially reflect the current situation of mental health among European youth: our representative, multi-cultural sample might differ from the more selected and local samples in the US with regard to the prevalence of risk-behaviours and psychopathology.

The purpose of the European ProfScreen was to identify and refer pupils requiring mental healthcare. Some low thresholds may have potentially increased the sensitivity of the screening programme; if thresholds were higher, many at-risk pupils would have gone undetected. Exploratory and descriptive analyses for each screening item indicated that every increase of cut-offs, resulting in a decrease of false positives, would have also resulted in a loss of referrals (false negatives); this underlines the importance of sensitive screening.

In Stage 2, during the clinical interview, more than half of the at-risk sample (53.6 %) was diagnosed with serious psychological problems requiring mental healthcare; rates were higher [9, 31] or similar to previous screening procedures [28].

Participation to clinical interview

The participation rate for the clinical interview at Stage 2 was generally low (38 %), which may reflect general lack of help-seeking among European adolescents including fear of stigma and little trust in the mental healthcare systems. In this context, it should be mentioned that the SEYLE study ensured a professional follow-up of all students reporting serious suicidal thoughts or even suicide attempts during the past weeks at Stage 1 (so-called emergency cases), including those who did not attend the clinical interview (e.g. via clinical exploration of adolescents or caregivers on the phone).

In some study sites, the clinical interview was administered at the study research centre, while other sites performed the clinical interview at the respective schools. The predictive value concerning the average travel time from pupils' school to the study centre was examined; results indicated a significant negative correlation between travel time and attendance to the clinical interview ($p < 0.01$). In previous screening programmes, clinical interviews that were performed onsite at the respective school or conducted via telephone suggested an increase in participation rates [3, 32]. This finding could also support public health systems that have made efforts to establish social and psychological support directly available at schools (e.g. school counselling), which is not the case in many European countries.

Age differences regarding interview participation may be due to the fact that younger adolescents were more likely to adhere to rules, procedures and recommendations. While higher attendance rates in girls have been reported previously [3], significant gender differences in the clinical interview attendance were not found in the present study.

Victimization by peers demonstrated the highest predictive value for participating in the clinical interview. Victimization by fellow peers may potentially cause a substantial psychological strain for adolescents. The high participation rate of this adolescent group may also reflect a lower fear of stigmatization and denial of their problems, because these problems are externalized, as opposed to being internalized [11].

Self-injury was also a significant predictor of help-seeking behaviour in our study. These results potentially mirror the psychological strain that arises from repetitive self-injury as well as actual desire for professional help among these adolescents. It has been reported that adolescents with nonsuicidal self-injury often lack motivation to seek help, especially on their own [6, 37]; however, our results differ from these findings, and show that self-injury may even have a signalling effect for adolescents that they might be in need of mental health care. This function of self-injury has previously been described among the interpersonal functions of self-injury [22]. Additionally, our results may indicate that this group could potentially benefit from particularly proactive support (e.g. by participating in a screening procedure) since educational prevention programmes (e.g. the "signs of self-injury" programme) were not able to increase help-seeking actions in adolescents engaging in self-injury [25].

Suicidal adolescents are frequently resistant to seek professional help [7]. This suggests that acute suicidality may be associated with a decrease in help-seeking behaviour [14]. Our results indicate that suicidal behaviour among adolescents was neither a positive nor negative predictor of participation in the clinical interview, which paints a less pessimistic picture on suicidal adolescents' help-seeking behaviour compared to previous findings, and may refer to cultural differences.

Interestingly, excessive media exposure significantly predicted non-attendance in the clinical interview, which suggests that this specific group of adolescents is particularly difficult to engage to seek professional help. This finding may be important with regard to newly appearing disorders, such as Internet addiction (ICD-11) or Internet Gaming Disorder (DSM-5), which mainly occur among adolescents and currently are on the rise; they also match the clinical experience that those subjects are hard to motivate or engage for treatment.

Smoking predicted non-attendance to the clinical interview, which implies that this behaviour seems to be associated with a reluctance to seek help. Other research has shown that certain risk-behaviours may serve as an important coping function, wherein adolescents utilize these behaviours in order to be accepted by peers and/or adapt to their environment [17]. This might result in decreased motivation to change some of these behaviours.

Referral to mental health care

In general, pupils who met more screening criteria were also more likely to receive a referral to mental healthcare. This result points to the fact that multiple rather than isolated problems and risk-behaviours may indicate the development of mental health problems during adolescence.

Suicidal behaviour and depression were significant predictors of referral to mental healthcare, similar to previous research [21, 32]. Anxiety and self-injury were not independently predictive of severe psychological problems requiring mental healthcare in the regression model. This might occur due to high inter-correlation between depression, anxiety, self-injurious and suicidal behaviour, as shown in a previous study [16]. Due to this overlap, future screening development could consider one shorter questionnaire including those variables.

Use of tobacco and illicit drugs was also predictive of referral to mental healthcare, which is in agreement with previous studies [13, 21]. Although a correlation between alcohol use, depression and suicidal behaviour was found, excessive alcohol use did not appear to be independently predictive of subsequent referral to. This could eventually be explained by the overall high percentage (55 %) of European adolescents who drink alcohol.

Another significant predictor for the referral to mental healthcare, in this study, was a low BMI. During the early stages of adolescent eating disorders, symptoms often go unnoticed. Screening for BMI may be an effective strategy in identifying at-risk pupils not recognized as at-risk during previous screening [34].

Due to the attrition rate, the sample at Stage 2 may not be representative for the normal adolescent population anymore. However, the final sample is representative for a help-seeking adolescent population which will be found in other prevention or early intervention settings when performed in clinical practice, and therefore has high external validity.

Added value of risk-behaviours in a school-based screening

Our results demonstrate that a broader screening of risk-behaviours has an added value in identifying adolescents requiring mental healthcare. Moreover, screening of risk-behaviours may have certain advantages, as behaviours are potentially more observable compared to thoughts and feelings.

These data show that screening of risk-behaviours alone detects a higher percentage of referred pupils requiring mental healthcare compared to the screening of psychopathology alone. Therefore, assessing risk-behaviours provides a higher sensitivity than screening only for psychopathology and is a potential strategy for detecting

pupils requiring mental healthcare. Of course, the highest sensitivity may be achieved by assessing both risk-behaviours and psychopathology. However, it causes slightly higher rates of false-positive cases. Further research is needed to examine the sensitivity and specificity of screening procedures when using risk-behaviours alone.

Strengths, limitations and future research

The strength of the study includes the standardized methodology and the large sample size. The screening questionnaire comprised a substantial number of variables allowing for extensive scrutiny of specific psychological and risk-behaviours, which could be analysed in various models.

The relatively low compliance rate regarding the attendance in the clinical interview is a limitation. Future studies and clinical approaches should try to increase interview participation rates by providing clinical interviews onsite in the respective schools. In addition, studies including interviews with a random group of students who did not screen in Stage 1 should be performed to further assess the validity (particularly sensitivity) of the screening procedure. However, due to the implementation of the ProfScreen as a practical intervention within 11, culturally diverse, non-artificial settings and samples, our results may reflect high ecological validity, allowing us to provide new knowledge about factors contributing to help-seeking or help-avoiding behaviour among adolescents at-risk. Furthermore, the clinical interview was a semi-structured, professional-based interview specifically developed for prevention purposes in the SEYLE study. A potential limitation, however, is that cut-offs for clinical referral were arbitrarily defined by the SEYLE group and their validity, however, has not been assessed in comparison to ICD-10 or DSM-IV psychiatric diagnoses.

With regard to the ProfScreen as a tool of prevention or early intervention, future research will be necessary to evaluate both effectiveness and cost-effectiveness of such screening procedures. The large number of screening variables requires time which may be related to costs and burden of participants. The sensitive self-report screening, indeed, leads to the need of a two-stage screening which is accompanied by the problem of high attrition rates. Therefore, longitudinal assessment of long-term benefits (e.g. increased help-seeking, improved mental health or quality of life), which will need to be compared to the high costs of school-based screening procedures, is urgently needed.

Conclusion

The SEYLE results call for public mental health actions, as 12.5 % of the adolescents were identified as being in need of mental health care. Accessibility of interviews and younger age were predictors for help-seeking behaviour, which may be interpreted as a signpost to easy accessible and early interventions. Attention to adolescent risk-behaviours in addition to psychopathology is critical in facilitating prevention and early intervention since risk behaviours may influence adolescent help-seeking and may also serve as indicators of adolescent psychopathology. Screening in schools for both risk-behaviour and psychopathology could be a valuable approach in detecting students with psychological problems that require subsequent mental health care, but further research on both effectiveness and cost-effectiveness is critical. Strategies to increase compliance to clinical interviews are needed to improve the value of screening procedures.

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

Ethical standards The study has been approved by the appropriate ethics committee of each study centre and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

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