Improvise, adapt, overcome?

The mental health and compliance of youth during the COVID-19 pandemic

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Chapter 4

Has the COVID-19 Pandemic Affected the Mental Health of Late Adolescents and Young Adults? A Meta-analysis of the Evidence

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Abstract

The worst of the COVID-19 pandemic seems to be past us, but did the COVID-19 pandemic affect the mental health of late adolescents and young adults? The aim of this meta-analysis was to examine the effects of the first year of the COVID-19 pandemic on the mental health of late adolescents and young adults (16 – 30 years). We extracted 105 effect sizes from 22 studies. These were classified into 13 mental health domains and later merged into two overarching mental health domains, namely, internalizing and externalizing symptoms. The effect sizes ranged from d = -0.069 to d = 0.082, and were very small and non-significant. These results indicate that the COVID-19 pandemic did not have a significant effect on the mental health of late adolescents and young adults during the first year of the pandemic. Future research should focus on the possible long-term effects of the COVID-19 pandemic on mental health of late adolescents and young adults.

Keywords: COVID-19, Mental Health, Late Adolescents, Young Adults

Introduction

According to the WHO (World Health Organization), the COVID-19 pandemic had a severe impact on the mental health of people around the world (2022a), which is for instance evidenced by a substantial increase of 25% in the worldwide prevalence of anxiety and depression (WHO, 2022b). It is plausible to assume that the preventive measures that were put in place to reduce the spread of the COVID-19 virus, and in particular social distancing and quarantine measures, played a significant role in the deterioration of mental health of people. Indeed, the meta-analysis by Brooks et al. (2020) showed that the psychological impact of quarantine was substantial, wide ranging, and potentially long lasting. In addition, a systematic review by Pedrosa et al. (2020) provided evidence for the negative psychological impact of both the preventive measures and the COVID-19 pandemic itself. The current meta-analytic review focused on the mental health of particularly late adolescents and young adults, as they may have been affected most given their developmental stage.

Preventive measures such as quarantine, online education, and social distancing can be particularly challenging for young people, such as college students (Khan et al., 2022). Naturally, the COVID-19 pandemic came with multiple difficulties, such as high infection and death rates, and restrictive preventive measures. Although everyone faced these difficulties, late adolescents and young adults seem to have suffered the most. The infection rates were the lowest in young people, but multiple studies revealed that the increase in mental health problems were substantially higher in young people compared to adults (e.g., Courtney et al., 2020; Loades et al., 2020; Samji et al., 2021). In spring 2021, about 66% of young people in the age of 18 to 29 years were at risk for depression according to their self-reported score on the five item World Health Organization - Well-being Index (WHO-5) (Eurofound, 2021a). Given these alarming results, it is of particular interest to get a clear picture of the actual impact of the COVID-19 pandemic on young people.

Self Determination Theory (SDT; Ryan & Deci, 2000) offers an explanation as to why late adolescents and young adults were susceptible to the negative impact of the COVID-19 pandemic on their mental health. SDT is regarded as a broad theoretical framework that comprises six smaller sub-theories, of which one theory is the Basic Psychological Needs Model (BPNT, Deci & Ryan, 2017; Vansteenkiste et al., 2020). This model assumes that three basic psychological needs should be met in order to maintain personal psychological wellbeing and intrinsic motivation for healthy development (Baard et al., 2004; Luyckx et al., 2009; Ryan et al., 2008). These three needs concern competence, relatedness, and autonomy. The failure to meet these needs is as assumed to result in *need frustration*, which can lead to mental health problems or a decline in wellbeing (Niemiec et al., 2006; Ryan et al., 2016; Vandenkerckhove et al., 2020; Vansteenkiste & Ryan, 2013). The fulfillment of all three needs was at risk during the COVID-19 pandemic.

The autonomy of young people was clearly at risk during the COVID-19 pandemic. Some preventive measures directly restricted the autonomy of people. Specifically, during the course of the COVID-19 pandemic many governments repeatedly reduced the freedom of citizens to go outside or to attend social gatherings by imposing social distancing measures. Many governmental measures like these were obligatory and led to a restriction of the opportunity for individual decision-making, such as not being able to go to work or engage in sports or social/group activities. This could lead to *autonomy need frustration* (see Vermote et al., 2021).

The COVID-19 pandemic and the preventive measures may have frustrated the need for relatedness as well. Because preventive measures greatly reduced the opportunity to socially connect with others (e.g., people were obliged to stay at home and to keep distance from others), it became difficult for young people to meet with friends and family, and to engage in physical contact. Although other means of social contact such as video calling were used more frequently to keep in touch with others, these technologically driven forms of communication are generally experienced to be less intense and fulfilling than face-to-face or physical contact (e.g., hugging) (Lee et al., 2011). Consequently, this may lead to *relatedness need frustration*, and result in solitude and feelings of loneliness (Vermote et al., 2021). Late adolescents and young adults are already at higher risk for loneliness because of developmental changes, so *relatedness need frustration* may further increase that risk (Laursen & Hartl, 2013).

Last, the need for competence was at risk during the COVID-19 pandemic. The closing of schools and other educational institutions hindered training in social, cognitive, and academic skills in the optimal context, hampering the acquisition of competencies and skills. Furthermore, some people might have doubted their capacity to balance their different roles (e.g., studying, working, and socializing both remotely and simultaneously), which could lead to feelings of ineffectiveness and less confidence (Spinelli et al., 2020). *Competence need frustration* can lead to feelings of inadequacy or failure (Bartholomew, Bosch et al., 2011; Bartholomew et al., 2011).

As soon as the COVID-19 pandemic was a fact, the impact of governmental measures and the pandemic itself on well-being and mental health gained attention among scholars all over the world. Consequently, an increasing number of primary studies examining the impact of the pandemic appeared, including studies focusing on the well-being and mental health of young adults and late adolescents in specific. These studies provide an inconclusive picture. Many studies found evidence for an increase in mental health problems, such as depression symptoms, anxiety symptoms, and stress symptoms, but some studies found only small effects (Gopalan et al., 2022; Rimfeld et al., 2021), whereas others reported medium effects (Savage et al., 2022).

Some studies did not find an increase in mental health symptoms at all (Knowles et al., 2022) or even reported a decrease in these symptoms, albeit small in magnitude (Marmet et al., 2021). Furthermore, some studies showed an increase in one mental health symptom (e.g., depression), but a decrease in a different mental health symptom (e.g., anxiety) in the same sample (Hawes et al., 2021; Lee et al., 2020; McLafferty et al., 2021; Wieman et al., 2022). These results show that the primary evidence is inconclusive and that a clear understanding of how the pandemic has impacted the well-being, and mental health of young people could not be derived from the available primary research. Therefore, conducting a meta-analysis that summarizes all available empirical evidence is a valuable addition to the literature.

Current study

Until now, such a quantitative overview was not yet available. Therefore, this study aimed to provide such an overview by conducting a three-level meta-analysis that examined the impact of the COVID-19 pandemic on the well-being and mental health of late adolescents and young adults in the general population. In meeting this aim, mental health symptoms in the broadest possible sense were examined in a series of separate meta-analyses, as well as positive psychological attributes that define well-being (e.g., life satisfaction). As such, this meta-analytic review contributes to a further understanding of the short-term impact of the COVID-19 pandemic on the well-being and mental health of late adolescents and young adults in the general population.

Methods

Inclusion and Exclusion Criteria

Multiple criteria were formulated for the selection of primary studies.

Outcome

The aim was to shed light on how governmental measures taken during the COVID-19 pandemic affected the mental health of adolescents and young adults in the broadest possible sense. Therefore, studies examining any mental health problem or problem symptom(s) – either internalizing or externalizing – were included, such as studies examining substance abuse, depression symptoms, and/or anxiety symptoms.

Studies not specifically examining mental health problems, but other dimensions of mental health (e.g., life satisfaction or positive affect) were also included.

Study design

Studies had to examine the association between governmental measures that were taken during the COVID-19 pandemic (e.g., social distancing) and one or more aspects of mental health. This implied that the design of a primary study had to involve at least two measurement waves: One of the waves had to occur prior to the introduction of governmental measures so that it could serve as a baseline assessment, and at least one wave had to occur after these measures were introduced.

Study sample

This review focused on the mental health of late adolescents and young adults in the general population. Therefore, studies were included if the mean sample age was between 16 and 30 years. The standard deviation of this mean sample age was not restricted implying that adolescents younger than 16 and young adults older than 30 could have been sampled as well. Studies examining samples of late adolescents and young adults with a (pre-existing) mental health disorder or with a medical condition were not included.

Statistical information

Each study had to report at least one Cohen's *d* value, at least one effect size that could be transformed into Cohen's *d*, or sufficient statistical information to calculate at least one Cohen's *d* value. Examples of this information are means and standard deviations before and during/after governmental measures, proportions, and/or test statistic and *p* values.

Published and unpublished studies

To reduce the risk of publication bias, primary studies were eligible for inclusion when they were published either as a peer-reviewed journal article or as a (non-peer reviewed) research report that was digitally accessible to the authors of this review. Furthermore, (peer- or nonpeer-reviewed) pre-prints of scientific articles were eligible for inclusion. This latter criterion further reduced the risk for publication bias, but also assured that the most up-to-date primary study results could be part of the synthesis.

Language

Only English written studies of which the full text could be retrieved were included.

Exclusion

This review focused on the mental health of Western populations of adolescents and young adults, and primary studies conducted in non-Western countries were therefore excluded. Cross-sectional studies were excluded as well, because contrary to longitudinal studies, a cross-sectional design does not allow for drawing inferences on how governmental measures to reduce and avoid the spread of COVID-19 affected the mental health of late adolescents and young adults.

Search Strategy

In identifying relevant studies, we first searched the electronic databases MEDLINE, ERIC, and PsycINFO. The search string consisted of five components and was constructed with the help of an academic librarian with extensive knowledge about searching databases. The first component defined the COVID-19 measures and included permutations of keywords such as: “social distancing”, “lock down”, “isolation”, and “stay-at-home”. The second component defined mental health and comprised an extensive list of permutations of keywords such as: “depression”, “anxiety”, “mental health”, and “loneliness”. The third component consisted of permutations of keywords related to specifically the COVID-19 pandemic and not other pandemics and consisted of keywords such as “corona”, “COVID”, and “sarscov”. The fourth component defined the late adolescents and young adults with keywords such as: “youth”, “student”, and “adolescent”. The fifth and final component comprised keywords for reducing the number of hits by disregarding studies that are not eligible for inclusion. This last component consisted of an extensive list of permutations of keywords such as: “clinical”, “patient”, “elderly”, and “pregnant”. In the electronic search, we applied a filter so that only studies published between 2020 and 2022 were searched. Appendix A shows the full search string. We ended our search strategy in March 2022 after which we started coding the studies. The flowchart of the search procedure, the references of the included studies, and an overview of included studies and some of their characteristics can be found in Appendix B, Appendix C Appendix D, Appendix E, respectively.

Coding of Studies

A coding form was developed by the first and second author to code each of the included studies. This coding form was first tested and refined based on the first and second authors' independent codings of five studies that were randomly selected from all studies that were eligible for inclusion. These authors compared their codings, resolved any discrepancy through discussion, and adapted the coding form accordingly. After all authors agreed on the finalized coding form, the first author coded all retrieved primary studies including the five studies that were used for refining the coding form. In case the first author had doubts about any coding, the second author was consulted, after which a decision was made through discussion. Some variables were coded for descriptive purposes only. These variables were publication year, country in which a study was performed, percentage of Whites, and the number of days between the pre-COVID measure and each measure during the COVID pandemic a primary study reported on. Several other variables were coded as they may moderate the association between the enforcement of governmental COVID-19 measures and the mental health of adolescents and young adults (see below).

Type of mental health

As the number of mental health aspects examined in the primary studies was too large for performing an individual meta-analysis for each mental health aspect, we classified each examined mental health aspect into one of several more broadly defined "mental health domains". We defined a mental health domain as a broad category of mental health aspects or symptoms that are more or less similar in nature. These domains were created after all mental health aspects as examined in each of the included primary studies were coded. In total, 13 mental health domains were created, which are presented in Appendix F. A separate meta-analysis was performed for each of these domains. The 13 mental health domains were in itself also classified into two overarching domains: internalizing symptoms and externalizing symptoms. A separate meta-analysis was also performed for these two overarching domains of mental health.

Time passed since start COVID-19 pandemic

For each measurement wave within each study, the number of days between the start of the COVID-19 pandemic (March 11th, 2020, World Health Organization, 2020) and a particular wave was coded. This code provides information on the duration of a sample's exposure to governmental measures that were imposed to combat the pandemic. As an increase in this duration may increase levels of mental health problems, it was deemed relevant to code this variable.

Age, gender distribution, and drop-out in sampled participants

For each study, the mean age of the sample (in years), the percentage of males, and the percentage of drop-out were coded.

Status of publication

As we included both peer-reviewed published articles and article pre-prints, the publication status of each article was coded (published vs. pre-print).

The coding of all studies was performed in SPSS by the first author.

Calculating Effect Sizes

Cohen's *d* was used as common effect size measure to quantify the effect of the COVID-19 measures on the mental health of late adolescents and young adults. Most primary studies only reported means and standard deviations, so most *d* values were first calculated with an effect size calculator (Lipsey & Wilson, 2001). The formulas of Ferguson (1966), Rosenthal (1994), and Lipsey and Wilson (2000) were used to transform statistical information into Cohen's *d*.

In the primary studies that were eligible for inclusion, the same group of participants were assessed prior to governmental measures and during and/or after those measures. This type of design introduces dependency in data that should be taken into account when calculating effect sizes to obtain unbiased effects (Morris & DeShon, 2002). Therefore, the correlation between assessments (prior and during/after governmental measures) were taken into account in each effect size by transforming the calculated *d* values into new *d* values using formula 12 of Morris and DeShon (2002, pg.111). As primary studies seldomly report on the correlation between assessments, we estimated this correlation based on previous research (e.g., Lee, 2012; Lewinsohn et al., 2003; Ramo et al., 2020; Doran et al., 2022), which we estimated to be .40 for internalizing problems and .60 for externalizing problems. The latter correlation is estimated to be a bit higher than the former, because externalizing problems generally tend to require more effort to change than internalizing problems (Lee, 2012; Lewinsohn et al., 2003; Ramo et al., 2020; Doran et al., 2022).

As these correlation estimates represent best guesses but rather crude approximations of the data dependency in the primary studies examining internalizing and/or externalizing problems, we also calculated a set of Cohen's *d* values based on substantial higher correlations of .70 and .80 for internalizing and externalizing problems respectively, and a set of *d* values based on correlations of 0 for both internalizing and externalizing problems (assuming data independency). In this way, two sensitivity analyses could be performed to determine how different estimates of data (in)dependency in the primary studies would affect the results. One of these analyses was conducted using the *d* values that were based on strong data dependency and the other was conducted using the *d* values that were based on data independency.

For each Cohen's *d* value, the formula of Morris and DeShon (2002) (fourth formula in Table 2, pg. 117) was used to calculate the standard error and variance. In these calculations of effect size accuracy, the dependency in data was taken into account using the same correlations as mentioned above.

Statistical Analysis

A main assumption in traditional meta-analysis is that effect sizes that are to be synthesized are independent (Lipsey & Wilson, 2000). However, the primary studies that were eligible for inclusion often reported on multiple relevant outcomes. If only one effect size had been extracted from each primary study, a lot of relevant information would be lost and statistical power in the analyses would decrease. Therefore, we applied a multilevel approach to meta-analysis in which the dependency in effect sizes is modeled so that all relevant effect sizes from each primary study could be extracted and synthesized (see, for instance, Assink & Wibbelink, 2016; Cheung, 2014; Van den Noortgate et al., 2013; Van den Noortgate, 2014). Specifically, we conducted three-level meta-analysis in which the effect size dependency is modeled by taking three sources of variance into account: sampling variance of the observed effect sizes (modeled at level 1), variance in effect sizes extracted from the same study (modeled at level 2 and also referred to as within-study variance), and variance in effect sizes extracted from different studies between studies (modeled at level 3 and also referred to as between-study variance). In short, two forms of dependency were taken into account in our analyses: dependency resulting from the association between baseline and follow-up assessments (see previous section on effect size calculation) and dependency resulting from extracting multiple relevant effect sizes from individual primary studies.

As we were interested in examining the effect of governmental measures on different mental health aspects, we conducted a separate three-level meta-analysis for each of the mental health domains that we created (described in the section on study coding). We were also interested in the effect of governmental measures on internalizing and externalizing problems in a broad sense, and we therefore also conducted a separate meta-analysis for internalizing and externalizing problems after we merged all internalizing and externalizing mental health domains respectively. All three-level meta-analyses were conducted following the steps of Assink and Wibbelink (2016).

To examine effect size heterogeneity and whether moderator analyses were warranted, two one-sided log-likelihood-ratio tests were conducted to test the significance of the within-study variance (at level 2 of the model) and the significance of the between-study variance (at level 3 of the model). A significant result of any of these tests indicates heterogeneity in effect sizes, implying that the overall mean effect size is not sufficiently representative of the true effect size, and that study, sample, and/or mental health characteristics may influence this effect. If heterogeneity in effect sizes would be detected, moderator analyses were performed in an attempt to explain this heterogeneity.

All meta-analytic models were built in the R environment (Version 4.2.1; R Core Team, 2022) by using the “rma.mv” function of the “metafor” package (Viechtbauer, 2010).

Assessment of Bias

Although we tried to be exhaustive in our search for relevant primary studies, we may have missed relevant studies because of limitations in our search strategy or because of different forms of bias, such as publication bias. To examine the extent to which our results were affected by (a form of) bias, two bias assessment analyses were conducted. First, we performed the funnel-plot-based trim and fill method (Duval & Tweedie, 2000a, 2000b) in each of the meta-analyses that were performed for each mental health domain. A funnel plot depicts effect sizes against a measure of precision (standard error in the current review). If the plot is asymmetrical because the distribution of effect sizes is asymmetric, the trim-and-fill method estimates effect sizes from ‘missing studies’ based on the observed effect sizes and adds these “missing” effect sizes to the plot to restore its symmetry. The imputed effect sizes can be higher or lower than the estimated mean effect and indicate whether meta-analytic results are underestimated or overestimated, respectively. In case of publication bias, low and/or insignificant effect sizes are missing implying that meta-analytic results overestimate true effects.

Second, we conducted an Egger’s test in each of the meta-analyses to determine whether effect sizes are associated with their standard errors. A significant association indicates that meta-analytic results may have been affected by (a form of) bias. Here, we conducted an “adapted” Egger’s test in which we tested the standard error as moderator of the overall effect size (see Sterne et al., 2000), by adding the standard error as a covariate to a three-level intercept-only model. A significant slope is an indication for publication bias.

Results

At the end of the search procedure, a total of *k* = 22 studies were included from which *u* =105 effect sizes were extracted. These studies were published between 2020 and 2022 (median publication year is 2021) and were conducted in Europe (*k* = 12) and North America (*k* = 10). Sample sizes ranged from 10 to 7686 (*M* = 740.82, *SD* = 1217.99). The mean sample age was on average 22.73 years (*SD* = 3.93), the mean percentage of males in the studied samples was 59.05 (*SD* = 34.52), and the mean percentage of Non-White participants in the samples was 35.78 (*SD* = 18.14), The number of extracted effect sizes ranged from 1 to 9, with a mean of 3.18 (*SD* = 2.07). The references of all included studies are presented in Appendix C, Appendix D presents an overview of included studies and some of their characteristics, and Appendix E provides information about the average effect size of the included studies.

Overall Mean Effects of the Mental Health Domains and Heterogeneity in Effect Sizes

The overall mean effects of the COVID-19 pandemic on each of the mental health domains can be found in Table 1. None of the conducted meta-analyses produced a significant overall effect. The non-significant mean effects ranged from *d* = -0.069 to *d* = 0.082 and can be regarded as extremely small according to Cohen's (1988) criteria for interpreting effect sizes. The two log-likelihood ratio tests that were performed in each meta-analysis to determine the significance of the variation in effect sizes did not reveal significant within-study variance nor between-study variance. This implied there was no significant heterogeneity in effect sizes. Therefore, no variables were tested as moderator. The mental health domain "anger" consisted of only two effect sizes (namely, *d* = .330, *N* = 378 and *d* = .242, *N* = 408) extracted from one study (Shanahan et al., 2022). Therefore, a meta-analysis was not conducted for this domain.

In calculating the effect sizes, we estimated the dependency between measures to be *r* = .40 for internalizing problems and *r* = .60 for externalizing problems. To examine whether the obtained mean effect sizes as presented in Table 1 were robust against different estimates of these correlations, two sensitivity analyses were conducted that comprised of reperforming the meta-analyses with Cohen's *d* values that were based on different correlations (*r* = .00 and *r* = .70 for internalizing problems, and *r* = .00 and *r* = .80 for externalizing problems). These analyses once again produced only non-significant mean effects that are all small or extremely small in magnitude according to Cohen's (1988) criteria. Also, no significant within- nor between-study variance was found in any of the sensitivity analyses implying the absence of effect size heterogeneity. These results show that our initially obtained results seem robust against misspecifications of the correlations between assessments that were used in calculating the *d* values. Appendix G presents the results of these meta-analyses.

To increase statistical power, we also synthesized effect sizes in two additional meta-analyses. The first synthesized all effect sizes related to one of the internalizing mental health domains, whereas the second synthesized all effect sizes related to one of the externalizing mental health domains. We once again performed two sensitivity analyses for each of these meta-analyses. All results can be found in Table 2. In line with the results of the meta-analyses of each separate mental health domain, the table shows very small and non-significant mean effects of the COVID-19 pandemic on both internalizing and externalizing symptoms. The sensitivity analyses produced non-significant and very small effects for both internalizing and externalizing symptoms indicating that the results of the two meta-analyses seem robust against misspecifications of the estimated correlations between measures (i.e., $r = .40$ and $r = .60$ for internalizing symptoms and externalizing symptoms, respectively). In neither of the two meta-analyses significant within- and between-study variance was found, implying there is no heterogeneity in effect sizes. Heterogeneity was also not identified in the sensitivity analyses, as no significant within- nor between study variance was found. Therefore, no moderator analyses were conducted in the two meta-analyses on internalizing and externalizing problems in general.

Table 1

Mean Effect Sizes of the Mental Health Domains with Corresponding Level 2 and Level 3 Variance Estimates

Mental health domain	**# Studies**	**# ES**	**Mean *d* (SE)**	**95% CI**	**Sig. Mean *d(p)***	**% Var. at level 1**	**Level 2 variance**	**% Var. at level 2**	**Level 3 variance**	**% Var. at level 3**
Anxiety symptoms (Int.)	9	13	0.008 (0.024)	[-0.043;0.060]	.727	100	0.000	0.00	0.000	0.00
Depression symptoms (Int.)	10	15	0.008 (0.026)	[-0.048;0.064]	.758	100	0.000	0.00	0.000	0.00
Stress symptoms (Int.)	8	14	0.050 (0.045)	[-0.047;0.146]	.289	82.79	0.000	0.00	0.004	17.21
Cannabis use (Ext.)	5	7	-0.055 (0.056)	[-0.192;0.082]	.362	100	0.000	0.00	0.000	0.00
Alcohol use (Ext.)	5	10	-0.015 (0.019)	[-0.059;0.029]	.465	100	0.000	0.00	0.000	0.00
Cigarette (nicotine) use (Ext.)	2	4	-0.040 (0.029)	[-0.134;0.054]	.268	100	0.000	0.00	0.000	0.00
Other substance use or addictive behavior (Ext.)	1	6	0.049 (0.033)	[-0.035;0.134]	.194	100	0.000	0.00	0.000	0.00
Sleeping problems (Int.)	3	8	-0.007 (0.030)	[-0.079;0.065]	.824	100	0.000	0.00	0.000	0.00
Loneliness (Int.)	2	3	0.082 (0.067)	[-0.206;0.371]	.344	100	0.000	0.00	0.000	0.00
General mental wellbeing (Int.)	2	3	-0.062 (0.184)	[-0.851;0.728]	.769	63.97	0.000	0.00	0.036	36.03
Other internalizing symptoms (Int.)	7	13	-0.069 (0.041)	[-0.158;0.019]	.112	100	0.000	0.00	0.000	0.00
Positive psychological attributes (Int.)	3	7	0.004 (0.033)	[-0.077;0.085]	.909	100	0.000	0.00	0.000	0.00

Note. #Studies = Number of studies; # ES = Number of effect sizes; Mean d = Mean Cohen's d; SE = Standard error; CI = Confidence interval; Var = Variance; Int. = Internalizing mental health domain; Ext. = Externalizing mental health domain.
For all internalizing mental health domains, a correlation of $r = .4$ was used in accounting for dependency in a pre- and during-COVID assessment. For all externalizing mental health domains, a correlation of $r = .6$ was used (see also the Methods section).
"Anger" is not presented as a mental health domain with an overall mean effect size, since effect sizes were extracted from only one study (see Results section for details).

Table 2

Mean Effect Sizes of the Overarching Mental Health Domains for the Initial and Sensitivity Analyses

Mental health domain	**# Studies**	**# ES**	**Mean *d* (SE)**	**95% CI**	**Sig. Mean *d(p)***	**% Var. at level 1**	**Level 2 variance**	**% Var. at level 2**	**Level 3 variance**	**% Var. at level 3**
Initial analyses										
Internalizing symptoms (*r* =.4)	16	69	0.003 (0.013)	[-0.023;0.030]	.806	99.12	0.000	0.00	0.000	0.88
Externalizing symptoms (*r* = .6)	7	29	-0.010 (0.014)	[-0.039;0.019]	.486	100	0.000	0.00	0.000	0.00
Sensitivity analyses										
Internalizing symptoms (*r* = 0)	16	69	0.069 (0.039)	[-0.009;0.146]	.080	8.22	0.032	66.76	0.012	25.02
Internalizing symptoms (*r* = .7)	16	69	0.009 (0.015)	[-0.020;0.038]	.541	97.67	0.000	0.00	0.000	2.33
Externalizing symptoms (*r* = 0)	7	29	0.036 (0.033)	[-0.032;0.104]	.289	8.64	0.026	91.36	0.000	0.00
Externalizing symptoms (*r* = .8)	7	29	-0.013 (0.014)	[-0.042;0.015]	.349	100	0.000	0.00	0.000	0.00

Note. #Studies = Number of studies; # ES = Number of effect sizes; Mean *d* = Mean Cohen's *d*; SE = Standard error; CI = Confidence interval; Var = Variance. The correlation (*r*) represents the value that was used in the effect size calculations and represents the strength of the association between a pre-COVID and during-COVID measure that was taken into account (see Methods section for details).
Effect sizes for "anger" are part of "externalizing symptoms".

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Assessment of Bias

Bias was assessed using two methods: the funnel plot based trim-and-fill method and the Egger's test. Appendix H presents a funnel plot of each mental health domain for which a meta-analysis was performed. The results of the trim-and-fill analysis indicated there was no bias in eight mental health domains. However, the results revealed a potential underrepresentation of below average effect sizes in the domains depression, stress, other substance use and addiction, and sleeping problems. In each of these domains, the "missing" effect sizes were imputed to the dataset after which the overall effects of these four domains were calculated again. The "adjusted" mean Cohen's *d* values were $d = 0.002$ for depression, $d = 0.010$ for stress, $d = 0.001$ for other substance use and addiction, and $d = -0.014$ for sleeping problems. None of these adjusted mean effects were significant.

The adapted Egger's test indicated publication bias for only one mental health domain which was the stress domain ($\beta_1 = 1.139$, $p = .033$, 95%CI [0.109, 2.169]). The slope was positive indicating a positive association between standard error and effect size, which is in line with the funnel plot that revealed that below average effect sizes were potentially missing.

Discussion

During the COVID-19 pandemic, an increasing number of scholars directed their attention to the impact of the pandemic, as governments all over the world implemented stay-at-home and social distancing measures. Because of their developmental stage, particularly late adolescents and young adults were challenged and vulnerable to the negative consequences of these imposed measures, as they faced periods of remote learning, closed schools, limited social interaction with peers, and restricted mobility, which affected their lives in an unprecedented way. This review aimed to examine the impact of the COVID-19 pandemic on multiple aspects of the mental health of late adolescents and young adults in the general population by performing a series of meta-analyses of internalizing symptoms (e.g., anxiety, depression), externalizing symptoms (e.g., anger, substance use), and positive psychological attributes (life satisfaction, self-efficacy). The results of these meta-analyses consistently show that the COVID-19 pandemic did not have a significant effect on any of the outcomes that were examined in this review. This implies that in general, the COVID-19 pandemic did not affect the mental health of late adolescents and young adults in the general population in terms of the outcomes that were examined in this review. How can we understand these results, and to what extent can they be generalized to other populations than the general population (e.g., those receiving mental health care)?

First, this review specifically focused on late adolescents and young adults from the general population, who may be less vulnerable to negative environmental influences than youth with pre-existing mental health problems. Indeed, studies found that people with pre-existing mental health problems showed an increase in the levels of their problems due to the COVID-19 pandemic and its accompanying preventive measures (Carvalho et al., 2022; Chatterjee et al., 2020; Fisher et al., 2022). Therefore, the results of the present meta-analysis cannot be generalized to clinical populations of young people who already faced stressors and/or risk factors prior to the pandemic.

Second, this review focused on mental health symptoms in late adolescents and young adults between 16 and 30 years, as they were thought to be most at risk for mental health problems due to the COVID-19 restrictions (e.g., Eurofound, 2021a; Samji et al., 2021). Indeed, there is some empirical evidence showing that younger age (18 to 35 years old) was associated with a decrease in mental health during the COVID-19 pandemic (O'Connor et al., 2020; Pieh et al., 2020; Pieh et al., 2021). Moreover, it seems that children as well as early and middle adolescents experienced different challenges during the COVID-19 pandemic than late adolescents and (young) adults. Their schools and universities were closed, they were forced to switch to online education, they could not go out or have close contact with their friends due to social distancing measures, and they often experienced a lack of future perspective (OECD, 2021; Power et al., 2020). It is plausible that late adolescents and young adults did not experience the same difficulties as children and early adolescents, and therefore the results of the current meta-analysis should not be generalized to younger populations.

Third, generalizability of the results is restricted, because this review synthesized results from only Western countries. We decided not to include studies performed in non-Western countries, as the COVID-19 preventive measures and the way in which populations have the means to cope with the measures may not have been comparable to the situation in Western countries. Late adolescents and young adults from non-Western (low-income) countries may not have had similar opportunities to follow education at home. They may not have received education at all or may not have had access to (mental) health services, which could have resulted in a greater risk for (mental) health problems. In contrast, late adolescents and young adults in Western countries may have had more opportunities and resources (e.g., funds for laptops or access to (mental) health services) to cope with the restrictive COVID-19 measures. On top of that, they may have been more resilient because resiliency-enhancing conditions in the pre-COVID period were more present in Western than in non-Western countries.

Psychological resilience is a factor that plays a key role in mental health and wellbeing, and is best conceived of as the dynamic process of positive adaption during and after stressful life circumstances (Kalisch et al., 2017). Positively adapting to stressful and extraordinary conditions, such as the COVID-19 pandemic, can be seen as the ability to support or retrieve psychological wellbeing (Demetriou, 2021). Being unable to positively adapt to the reduced opportunities for social contact that was a direct consequence of social distancing measures may increase the risk of mental health problems. On the other hand, the perception that social support is available is associated with less mental health problems (e.g., Cicchetti et al., 1993).

It has been theorized that psychological resilience is not only based on an individual's personality and skills to cope with stressful situations, but also on the quality of relations with significant others (Masten et al., 2021; Raghavan & Sandanapitcha, 2020). A natural mentor is an example of someone who provides social support, which can increase resilience (Masten & Garmezy, 1985) and may act as a buffer against developing mental health problems in stressful situations. A natural mentor is a non-parental adult who provides support, may teach skills and moral values, increases motivation, and fosters self-esteem (Southwick et al., 2010). Following from this, it may be that those who have insufficient resources are unable to successfully adapt to a stressful live event, and may start showing mental health problems. This may have been the case for people who already showed mental health illness prior to the pandemic (Masten et al., 2021). However, even those people showed resilience in the first period of the COVID-19 pandemic (Pinkman et al., 2020).

Fourth, the increase in mental health problems in late adolescents and young adults, as found in multiple studies (e.g., Khan et al., 2022), may not have been caused by the COVID-19 pandemic and/or the restrictive measures. In the years before the pandemic, mental health problems in late adolescents and young adults have been steadily increasing for quite some years (Ford et al., 2021; Plana-Ripoll et al., 2022). It is reasonable to assume that this increase did not stop during the pandemic, and it may just be a continuation of the ongoing trend (Rømer et al., 2023). A study by Ten Have et al. (2023) could already confirm this line of reasoning for the Netherlands, which showed that the increase in mental health disorders was not caused by the COVID-19 pandemic. Future research should investigate whether these results hold for other countries as well.

Finally, how one copes with the COVID-19 pandemic can also be a factor that influences the development of mental health problems. Positive or active coping strategies are negatively associated with perceived stress, depression, anxiety, and insomnia (Budimir et al., 2020). Another study found that the use of positive (active) coping strategies were associated with higher wellbeing (McFadden et al., 2021). Therefore, it could mean that if one uses adequate coping strategies during a pandemic, mental health problems will not start to develop or increase.

Strengths and Limitations

The main strength of this study is that, to our knowledge, it is the first meta-analytic review in which three-level meta-analyses were conducted to examine the impact of the COVID-19 pandemic on a broad spectrum of various mental health outcomes in late adolescents and young adults in the general population, accounting for differences within and between studies.

Additionally, a second strength of this study is the sensitivity with which the analyses were done. We accounted for the dependency in data (since it concerns pre-pandemic and during pandemic measures within the same sample) and checked whether this led to substantial differences. We also created two overarching categories, namely internalizing and externalizing symptoms, to check if this would lead to a different result. Therefore, we depleted every option to account for differences in data to our knowledge. All efforts were in line with the primary results, thus the results of this study seem robust and not influenced by the dependency in the data.

However, this study also has its limitations. The first limitation of this meta-analysis is that relevant studies eligible for inclusion may have been missed. We only included studies that were published between 2020 and 2022. An alternative inclusion strategy would have been to include studies up to 2023, but this could have polluted the search results (for instance with primary studies reporting findings that were obtained in the second year of the pandemic). To check for potential publication bias, we applied two different methods. These methods showed some indication of publication bias in four mental health domains representing an underrepresentation of below average effect sizes, but it did not seem to influence the results.

The second limitation is that some mental health domains consisted of a small number of effect sizes. For instance, both the mental health domain 'loneliness' and 'general mental well-being' only consisted of 3 effect sizes from 2 studies. In an attempt to meet this problem, we increased the statistical power in the analyses by aggregating individual mental health domains in two broader domains: one for internalizing mental health (sub-) domains and one for externalizing mental health (sub-) domains

The final limitation is that the current results only apply to the first year of the pandemic. This period was intense and comprised many uncertainties (e.g., limited knowledge about the virus, no vaccines). Because of this time restriction, the results cannot be generalized to any potential long-term effects of the COVID-19 pandemic on the mental health of late adolescents and young adults. It may be well possible that their mental health in the second year of the pandemic deteriorated. Resilience is a dynamic construct, which could imply that an adolescent is resilient in the first year of the pandemic, but less resilient in the second year due to a decreasing resilience capacity (Masten &

Motti-Stefanidi, 2020). An additional meta-analysis synthesizing longitudinal data about the second year of the pandemic should be conducted in due time to gain more insight into the long-term effects of the pandemic and the measures that were imposed.

Conclusion and implications

To our knowledge, this is the first meta-analysis examining the effects of the COVID-19 pandemic on the well-being and mental health of late adolescents and young adults during the first year of the pandemic. Although the results of this study do not indicate that the first year of the COVID-19 pandemic had any effect on the mental health of adolescents and young adults, long-term effects should not be ruled out. Notably, the current results only apply to the general population. Late adolescents and young adults at risk and/or those with pre-existing mental health disorders or problems who were affected by the COVID-19 pandemic should receive proper care and support. Governments should also pay attention to the strengths of late adolescents and young adults and enable them to be resilient. They could monitor the mental health of late adolescents and young adults better and stimulate the use of natural mentors for support to improve resilience and wellbeing (Koper et al., 2022). Since this might not be the final pandemic humans have to endure, governments should make a careful consideration of which preventive measures are essential, and which preventive measures should be used as limited and as short-term as possible. Regardless, this study shows that the well-being and mental health of late adolescents and young adults from the general population was not affected by the COVID-19 pandemic, and therefore the restrictive measures imposed by the governments can be considered again for a future pandemic to curb infections, albeit as sparingly and short-term as possible.

Appendices

Appendix A

Search string

1 ("social distanc*" or "physical distanc*" or "interpersonal distanc*" or quarantin* or isolation or confinement or lockdown or "stay* at home" or separation or seclusion or "non-pharmaceutical intervention").mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

2 (affect* or anger or anx* or depress* or distress* or fear* or frustrat* or happiness or happy or hopefulness* or irritabl* or loneliness or lonely or "mental health" or resilien* or sad* or "social deprivation" or "social effect" or "social impact" or "social relation*" or stress* or unhappy or wellbeing or well-being or internalizing or internalising or externalising or externalizing or aggress*).mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

3 (corona or covid* or ncov* or sars* or sarscov* or "severe acute respiratory syndrom*" or "sudden acute respiratory syndrom*").mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

4 (child* or prepub* or puber* or pubescen* or teen* or young* or youth* or minor* or underag* or juvenile* or preadolesc* or adolesc* or student*).mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

5 1 and 2 and 3 and 4

6 limit 5 to yr="2020 - 2022"

7 limit 6 to all journals [Limit not valid in Ovid MEDLINE(R),Ovid MEDLINE(R) Daily Update,Ovid MEDLINE(R) PubMed not MEDLINE,Ovid MEDLINE(R) In-Process,Ovid MEDLINE(R) Publisher,ERIC; records were retained]

8 qualitativ*.mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

9 (clinic* or hospit* or patient* or client* or outpatient* or medical or diseas* or illness* or diag* or disorder*).mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

10 "physical health".mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

11 (toddler* or infant* or baby or "middle childhood" or "early childhood" or preschool*).mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

12 elderly.mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

13 (pregnan* and prenatal).mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

14 (labor or labour).mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

15 syndrom*.mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

16 pregnan*.mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

17 (mother* or maternal).mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

18 parenting.mp. [mp=ti, ab, ot, nm, hw, fx, kf, ox, px, rx, ui, an, sy, id, tc, tm, mf]

19 7 not 8

20 19 not 9

21 20 not 10

22 21 not 11

23 22 not 12

24 23 not 13

25 24 not 14

26 25 not 15

27 26 not 16

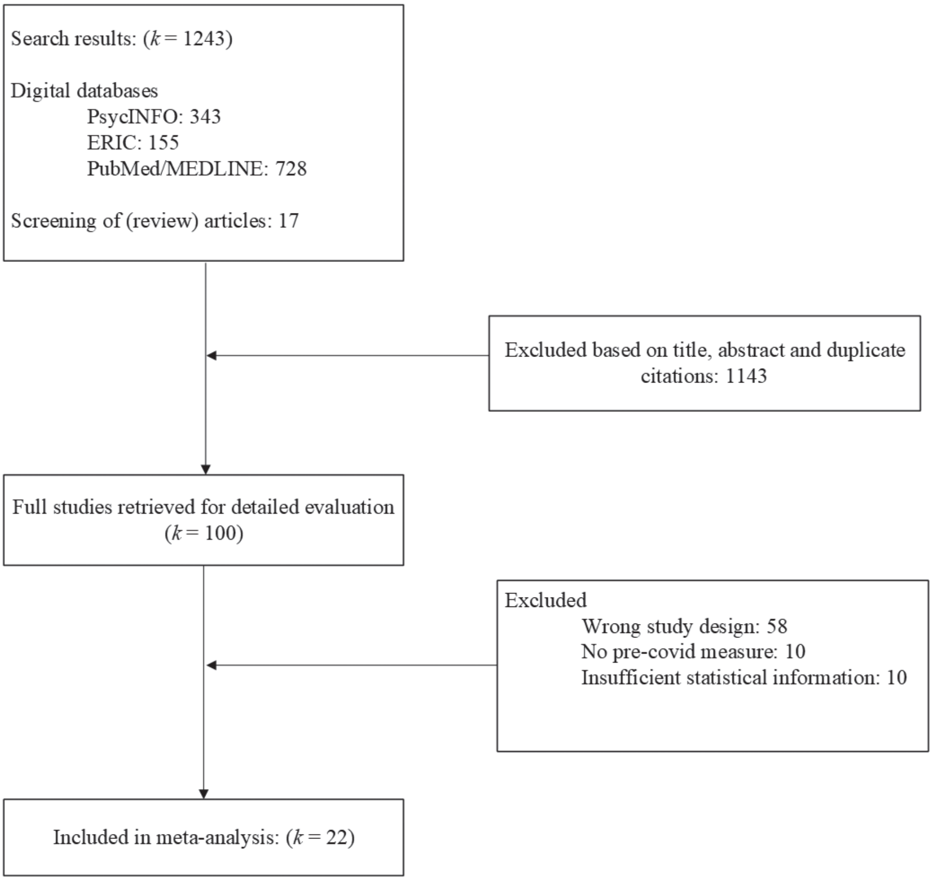
28 27 not 17

29 28 not 18

30 remove duplicates from 29

Appendix B

Flowchart of the study selection process



Appendix C

References of the included studies

Aresi, G., Sorgente, A., Cleveland, M. J., & Marta, E. (2022). Patterns of Alcohol Use Among Italian Young Adults Before and During a COVID-19 Lockdown: A Latent Class Analysis Study. *Journal of Prevention, 43*(2), 191-208. https://doi.org/10.1007/s10935-022-00675-2

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Bartel, S. J., Sherry, S. B., & Stewart, S. H. (2020). Self-isolation: A significant contributor to cannabis use during the COVID-19 pandemic. *Substance Abuse, 41*(4), 409-412. https://doi.org/10.1080/08897077.2020.1823550

Elmer, T., Mepham, K., & Stadtfeld, C. (2020). Students under lockdown: Comparisons of students' social networks and mental health before and during the COVID-19 crisis in Switzerland. *Plos one, 15*(7), e0236337. https://doi.org/10.1371/journal.pone.0236337

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Gopalan, M., Linden-Carmichael, A., & Lanza, S. (2022). College students' sense of belonging and mental health amidst the COVID-19 pandemic. *Journal of Adolescent Health, 70*(2), 228-233. https://doi.org/10.1016/j.jadohealth.2021.10.010

Graupensperger, S., Fleming, C. B., Jaffe, A. E., Rhew, I. C., Patrick, M. E., & Lee, C. M. (2021). Changes in young adults' alcohol and marijuana use, norms, and motives from before to during the COVID-19 pandemic. *Journal of Adolescent Health, 68*(4), 658-665. https://doi.org/10.1016/j.jadohealth.2021.01.008

Hawes, M., Szenczy, A., Klein, D., Hajcak, G., & Nelson, B. (2022). Increases in depression and anxiety symptoms in adolescents and young adults during the COVID-19 pandemic. *Psychological Medicine, 52*(14), 3222-3230. https://doi.org/10.1017/S0033291720005358

Knowles, G., Gayer-Anderson, C., Turner, A., Dorn, L., Lam, J., Davis, S., Blakey, R., Lowis, K., Schools Working Group, Young Persons Advisory Group, Pinfold, V., Creary, N., Dyer, J., Hatch, S. L., Ploubidis, G., Bhui, K., Harding, S., & Morgan, C. (2022). Covid-19, social restrictions, and mental distress among young people: a UK longitudinal, population-based study. *Journal of Child Psychology and Psychiatry, 63*(11), 1392-1404. https://doi.org/10.1111/jcpp.13586

Krautter, K., Friese, M., Hart, A., & Reis, D. (2022). No party no joy?—Changes in university students' extraversion, neuroticism, and subjective well-being during two COVID-19 lockdowns. *Applied Psychology: Health and Well-Being, 14*(4), 1314-1332. https://doi.org/10.1111/aphw.12336

LaCaille, L. J., Hooker, S. A., Marshall, E., LaCaille, R. A., & Owens, R. (2021). Change in Perceived Stress and Health Behaviors of Emerging Adults in the Midst of the COVID-19 Pandemic. *Annals of Behavioral Medicine, 55*(11), 1080-1088. https://doi.org/10.1093/abm/kaab074

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Marmet, S., Wicki, M., Gmel, G., Gachoud, C., Bertholet, N., & Studer, J. (2021). Sexual minority orientation is associated with greater psychological impact due to the COVID-19 crisis—evidence from a longitudinal cohort study of young Swiss men. *Frontiers in Public Health,* 9:692884. https://doi.org/10.3389/fpubh.2021.692884

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Meine, L. E., Strömer, E., Schönfelder, S., Eckhardt, E. I., Bergmann, A. K., & Wessa, M. (2021). Look After Yourself: Students Consistently Showing High Resilience Engaged in More Self-Care and Proved More Resilient During the COVID-19 Pandemic. *Frontiers in Psychiatry, 12*:784831. https://doi.org/10.3389/fpsyt.2021.784381

Rimfeld, K., Malanchini, M., Arathimos, R., Gidziela, A., Pain, O., McMillan, A., Ogden, R., Webster, L., Packer, A. E., Shakeshaft, N. G., Schofield, K. L., Pingault, J., Allegrini, A. G., Stringaris, A., von Stumm, S., Lewis, C. M., & Plomin, R. (2022). The consequences of a year of the COVID-19 pandemic for the mental health of young adult twins in England and Wales. *BJPsych Open, 8*(4), e129. https://doi.org/10.1192/bjo.2022.506

Savage, M. J., James, R., Magistro, D., Donaldson, J., Healy, L. C., Nevill, M., & Hennis, P. J. (2020). Mental health and movement behaviour during the COVID-19 pandemic in UK university students: Prospective cohort study. *Mental Health and Physical Activity, 19*(2020), 100357. https://doi.org/10.1016/j.mhpa.2020.100357

Shanahan, L., Steinhoff, A., Bechtiger, L., Murray, A. L., Nivette, A., Hepp, U., Ribeaud, D., & Eisner, M. (2022). Emotional distress in young adults during the COVID-19 pandemic: evidence of risk and resilience from a longitudinal cohort study. *Psychological medicine, 52*(5), 824-833. https://doi.org/10.1017/S003329172000241X

Skumlien, M., Langley, C., Lawn, W., Voon, V., & Sahakian, B. J. (2021). Apathy and anhedonia in adult and adolescent cannabis users and controls before and during the COVID-19 pandemic lockdown. Int*ernational Journal of Neuropsychopharmacology, 24*(11), 859-866. https://doi.org/10.1093/ijnp/pyab033

Stubbe, J. H., Tiemens, A., Keizer-Hulsebosch, S. C., Steemers, S., van Winden, D., Buiten, M., Richardson, A., & van Rijn, R. M. (2021). Prevalence of mental health complaints among performing arts students is associated with COVID-19 preventive measures. *Frontiers in Psychology, 12*:676587. https://doi.org/10.3389/fpsyg.2021.676587

Wieman, S. T., Fields, J. S., Arditte Hall, K. A., MacDonald, H. Z., & Liverant, G. I. (2022). Effects of the COVID-19 pandemic on anhedonia, reward exposure and responsiveness, and sleep in college students. *Journal of American College Health, 2022*, 1-5. https://doi.org/10.1080/07448481.2022.2047705

Zimmermann, M., Bledsoe, C., & Papa, A. (2020). *The impact of the COVID-19 pandemic on college student mental health: A longitudinal examination of risk and protective factors.* PsyArXiv. https://doi.org/10.31234/osf.io/2y7hu

4

Appendix D

Characteristics of Included Studies

Reference	Year	Sample size	% Males	% Whites	Mean age of sample	Country[a]	# Extracted effect sizes	Mental health domain[b]
Aresi et al.	2022	7686	50.90	-	25.97	Italy	2	5
Baiano et al. (1)	2020	10	0	-	23.84	Italy	1	11
Baiano et al. (2)	2020	15	100		23.84	Italy	1	11
Bartel et al.	2020	70	34.30	-	22.03	Canada	2	4
Elmer et al. (1)	2020	212	64.00	-	19.82	Switzerland	4	1, 2, 3, 9
Elmer et al. (2)	2020	137	64.00	-	-	Switzerland	4	1, 2, 3, 9
Fruehwirth et al.	2021	439	28.00	60.10	18.90	USA	1	5
Gopalan et al.	2022	1004	38.20	62.80	19.34	USA	3	1, 2, 12
Graupensperger et al. (1)	2021	572	39.20	50.60	25.14	USA	3	4, 5
Graupensperger et al. (2)	2021	461	-	-	-	USA	1	5
Hawes et al. (1)	2022	451	34.60	82.90	17.49	USA	2	3
Hawes et al. (2)	2022	295	0	-	-	USA	2	1, 2
Hawes et al. (3)	2022	156	100	-	-	USA	2	1, 2
Knowles et al. (1)	2022	725	0	31.30	-	United Kingdom	3	1, 2, 11
Knowles et al. (2)	2022	349	100	31.30	-	United Kingdom	3	1, 2, 11
Krautter et al.	2022	162	21.40	-	21.90	Germany	3	11, 12
LaCaille et al.	2021	234	41.40	89.70	18.10	USA	2	3
Lee et al.	2020	564	39.30	54.50	25.10	USA	3	1, 2, 9
Marmet et al. (1)	2021	2035	100	-	29.10	Switzerland	9	2, 3, 4, 5, 6, 7, 8
Marmet et al.[c] (2)	2021	310	100	-	29.00	Switzerland	9	2, 3, 4, 5, 6, 7, 8

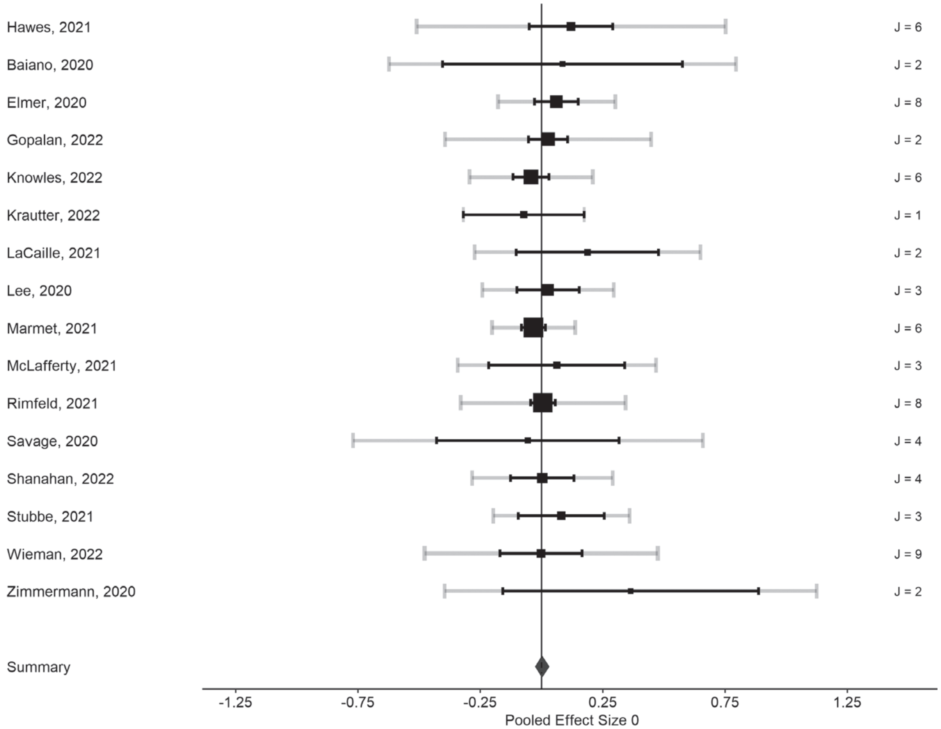
Reference	Year	Sample size	% Males	% Whites	Mean age of sample	Country[a]	# Extracted effect sizes	Mental health domain[b]
McLafferty et al.	2021	884	39.40	-	21.00	Ireland	3	1, 2, 11
Meine et al.[d]	2021	12 - 62	8.3 – 34.2	-	20.35 - 21.29	Germany	4	12
Rimfeld et al. (1)	2022	2691 - 2970	0	-	22.27	Multiple European countries	4	1, 2, 11
Rimfeld et al. (2)	2022	1538 - 1801	100	-	22.27	Multiple European countries	4	1, 2, 11
Savage et al. (1)	2020	154	0	77.40	20.00	United Kingdom	2	3, 10
Savage et al. (2)	2020	60	100	77.40	20.00	United Kingdom	2	3, 10
Shanahan et al. (1)	2022	378	0	-	22.00	Switzerland	3	3, 11, 13
Shanahan et al. (2)	2022	408	100	-	22.00	Switzerland	3	3, 11, 13
Skumlien et al. (1)	2021	170	45.80	-	22.51	Multiple European countries	3	4, 5, 6
Skumlien et al. (2)	2021	172	46.51	-	16.65	Multiple European countries	3	4, 5, 6
Stubbe et al.	2021	213	24.50	-	19.89	Netherlands	3	3, 8, 10
Wieman et al.	2022	87	12.60	74.70	-	USA	9	1, 2, 3, 8, 11
Zimmermann et al.	2020	205	23.80	83.90	18.40	USA	2	1, 2

Note. Year = publication year, % Males = percentage of males in a sample, % Whites = percentage of Whites/Caucasians in a sample, Continent = the continent the data collection took place, #Extracted effect sizes = the number of extracted effect sizes per study. [a] If study collected data from multiple countries, this was specified as multiple European/North-American countries. [b] Each number corresponds with a mental health domain. 1= Anxiety, 2 = Depression, 3 = Stress, 4 = Cannabis use, 5 = Alcohol use, 6= Cigarette use, 7 = Other substance use or addictive behavior, 8 = Sleeping problems, 9 = Loneliness, 10 = General mental wellbeing, 11 = Other internalizing symptoms, 12 = Positive psychological attributes, 13 = Anger. [c] Sexual minority sample. [d] study reports four different resilience trajectories. Dashes indicate that a statistic could not be retrieved from a study.

Appendix H

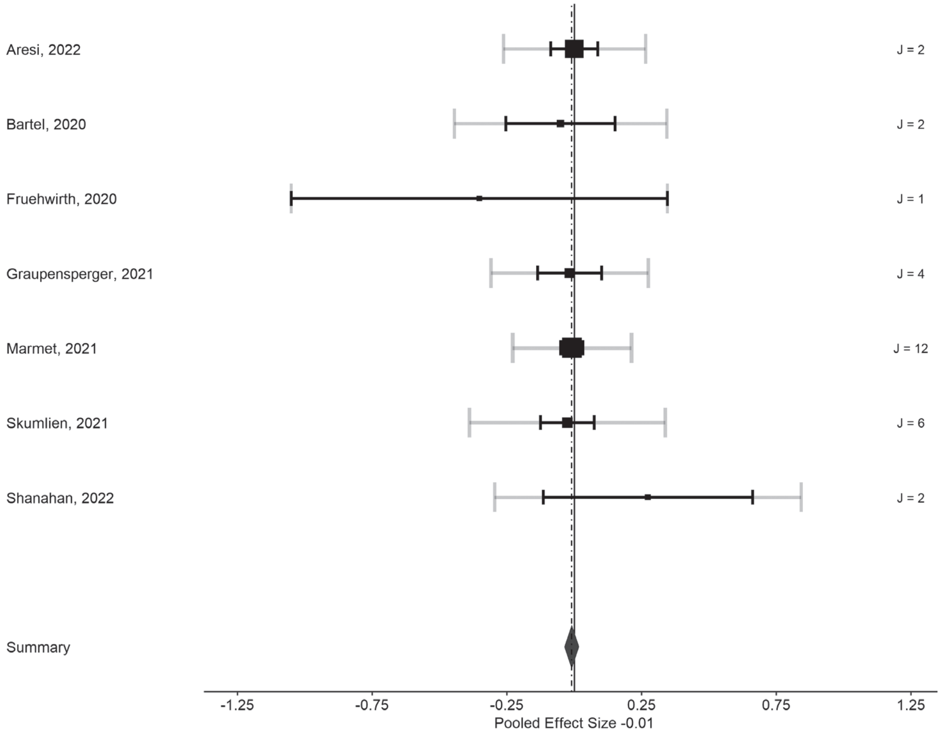
Forest plots

Figure 1. Forest plot internalizing symptoms



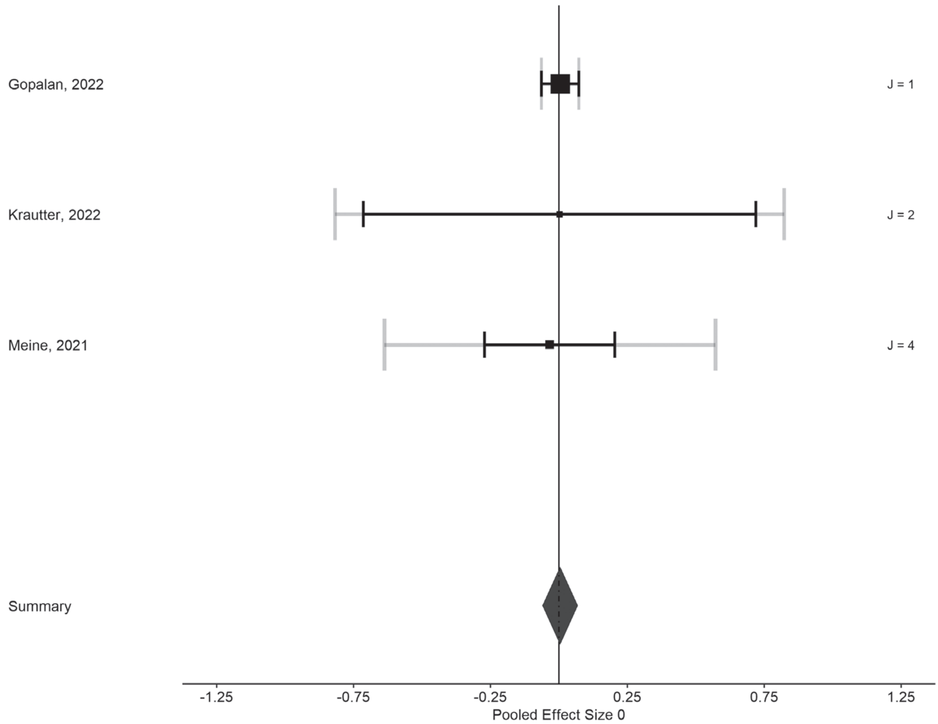
Note. A dot representing the meta-analytic study mean has been depicted in each line along with its 95% CI in bold black; the grey CI is based on the sampling variance of individual observed ES's of the study. The thickness of the grey confidence intervals is proportional to the number of effect sizes reported within studies.

Figure 2. Forest plot externalizing symptoms



Note. A dot representing the meta-analytic study mean has been depicted in each line along with its 95% CI in bold black; the grey CI is based on the sampling variance of individual observed ES's of the study. The thickness of the grey confidence intervals is proportional to the number of effect sizes reported within studies.

Figure 3. Forest plot positive psychological attributes



Note. A dot representing the meta-analytic study mean has been depicted in each line along with its 95% CI in bold black; the grey CI is based on the sampling variance of individual observed ES's of the study. The thickness of the grey confidence intervals is proportional to the number of effect sizes reported within studies.

Appendix F

List of Mental Health Domains

Mental health domain	Explanation
Anxiety	Anxiety symptoms as measured by per example the Generalized Anxiety Disorder -7 Assessment (GAD-7).
Depression	Depression symptoms as measured by per example the Short Mood and Feelings Questionnaire (SMFQ) or Patient Health Questionnaire (PHQ).
Stress	Stress symptoms as measured by per example the Perceived Stress Scale (PSS).
Cannabis use	Cannabis use measured as quantity (e.g., grams/joints per day/week).
Alcohol use	Alcohol use measured as quantity (e.g., glasses per day/week)
Cigarette (nicotine) use	Cigarette use measured as quantity (e.g., cigarettes per day/week)
Other substance use or addictive behavior	Residual category for other substance use (e.g., hard drugs) or other addictive behavior (e.g., pornography or social media)
Sleeping problems	Sleeping problems measured various ways such as quality of sleep or quantity of sleep.
Loneliness	Loneliness as measured by per example UCLA Loneliness Scale (University of California, Los Angeles).
General mental wellbeing	Residual category for general mental wellbeing, for instance measured by The Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS).
Other internalizing symptoms	Residual category for other internalizing mental health symptoms (e.g., anhedonia).
Positive psychological attributes	Category for all positive psychological attributes (e.g., self-efficacy or life satisfaction).
Anger[1]	Anger symptoms as measured by per example the PROMIS® Emotional Distress – Anger – Short Form.

Note. [1] = Anger was extracted from just one study, so no meta-analysis was done for this domain seperately. However, “anger” was included in the externalizing domain.

4

Appendix G

Sensitivity Analyses

Table G1

Mean Effect Sizes of the Mental Health Domains with Corresponding Level 2 and Level 3 Variance Estimates without accounting for dependency

Mental health domain	**# Studies**	**# ES**	**Mean Cohen's *d* (SE)**	**95% CI**	**Sig. Mean *D (p)***	**% Var. at level 1**	**Level 2 variance**	**% Var. at level 2**	**Level 3 variance**	**% Var. at level 3**
Anxiety symptoms	9	13	-.008 (0.05)	[-0.117;0.101]	.878	12.43	0.026	87.57	0.000	0.000
Depression symptoms	10	15	.173 (0.083)	[-0.004;0.351]	.055	3.456	0.004	96.544	0.059	0.000
Stress symptoms	8	14	.163 (0.065)	[0.022;0.304]	.027*	6.460	0.007	93.540	0.023	0.000
Cannabis use	4	7	-.022 (0.083)	[-0.225;0.180]	.797	13.89	0.037	86.11	0.000	0.000
Alcohol use	5	10	-.029 (0.061)	[-0.166;0.108]	.641	2.375	0.029	97.625	0.000	0.000
Cigarette (nicotine) use	2	4	-.038 (0.027)	[-0.125;0.049]	.256	5.841	0.000	94.159	0.000	0.000
Other substance use or addictive behavior	1	6	.173 (0.055)	[0.031;0.314]	.026*	2.116	0.015	97.884	0.000	0.000
Sleeping problems	3	8	.147 (0.117)	[-0.129;0.423]	.249	12.096	0.000	87.904	0.034	0.000
Loneliness	2	3	.118 (0.047)	[-0.084;0.319]	.129	8.340	0.000	91.661	0.000	0.000
General mental wellbeing	2	3	-.117 (0.205)	[-1.000;0.767]	.627	17.212	0.000	82.788	0.072	0.000
Other internalizing symptoms	7	13	-.109 (0.073)	[-0.268;0.049]	.158	3.334	0.003	96.661	0.025	0.000
Positive psychological attributes	3	7	-.041 (0.135)	[-0.371;0.290]	.774	17.142	0.089	82.858	0.000	1.598

Note. Anger has not been included as a mental health domain, since the effect sizes were extracted from just one study. * $p < .05$

Table G2

Mean Effect Sizes of the Mental Health Domains with Corresponding Level 2 and Level 3 Variance Estimates accounting for extreme high dependency

Mental health domain	# Studies	# ES	Mean Cohen's *d* (SE)	95% CI	Sig. Mean *D (p)*	% Var. at level 1	Level 2 variance	% Var. at level 2	Level 3 variance	% Var. at level 3
Anxiety symptoms	9	13	0.010 (0.023)	[-0.039,0.060]	.663	100	0.000	0.00	0.000	0.00
Depression symptoms	10	15	0.017 (0.027)	[-0.041;0.075]	.540	100	0.000	0.00	0.000	0.00
Stress symptoms	8	14	0.058 (0.052	[-0.054;0.170]	.286	80.57	0.000	0.00	0.006	19.43
Cannabis use	4	7	-0.065 (0.063)	[-0.219;0.089]	.342	100	0.000	0.00	0.000	0.00
Alcohol use	5	10	-0.016 (0.017)	[-0.055;0.022]	.362	100	0.000	0.00	0.000	0.00
Cigarette (nicotine) use	2	4	-0.056 (0.036)	[-0.170;0.058]	.214	100	0.000	0.00	0.000	0.00
Other substance use or addictive behavior	1	6	0.062 (0.038)	[-0.036;0.159]	.165	100	0.000	0.00	0.000	0.00
Sleeping problems	3	8	-0.005 (0.031)	[-0.080;0.069]	.871	100	0.000	0.00	0.000	0.00
Loneliness	2	3	0.110 (0.074)	[-0.208;0.427]	.276	100	0.000	0.00	0.000	0.00
General mental wellbeing	2	3	-0.079 (0.258)	[-1.188;1.030]	.788	54.79	0.000	0.00	0.086	45.21
Other internalizing symptoms	7	13	-0.070 (0.041)	[-0.160;0.021]	.118	100	0.000	0.00	0.000	0.00
Positive psychological attributes	3	7	0.004 (0.025)	[-0.057;0.064]	.886	100	0.000	0.00	0.000	0.00

Note. The correlations for the dependency are $r = .7$ for internalizing mental health domains and $r = .8$ for externalizing mental health domains. "Anger" has not been included as a mental health domain, since effect sizes were extracted from just one study.

4

Appendix H

Funnel plots