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Long-term effects of parental divorce on mental health – A meta-analysis

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A B S T R A C T

The aim of this study was to estimate the long-term effects of parental divorce on their offspring's mental health as well as substance-based addiction. We performed a systematic literature search on PubMed, Medline, PsyINFO, PsyARTICLES and PsycNET for the time period from 1990 until March 2018 in English language. In total 54 studies were included in the meta-analysis resulting in 117 effect sizes as well as a total sample of 506,299 participants. A significant association between parental divorce and every aspect of mental health was found with the following pooled ORs (95% CIs): Depression 1.29 (1.23–1.35), anxiety 1.12 (1.04–1.12), suicide attempt 1.35 (1.26–1.44), suicidal ideation 1.48 (1.43–1.54), distress 1.48 (1.37–1.6), alcohol 1.43 (1.34–1.53), smoking 1.64 (1.57–1.72) and drugs 1.45 (1.44–1.46) could be estimated. There was significant association between the effect sizes and the publication date specifically for distress ($r = -0.995$, $p = .005$). The results of the meta-analysis show a consistent direction of influence regarding the long-term effect of parental divorce on their children. Individuals affected by parental divorce have a higher risk of developing a variety of mental health conditions, although the effect sizes decreased from 1990 to 2017. Further research should focus on developing programmes to promote the resilience of children affected by divorce.

1. Introduction

There is no doubt that parental divorce is one of the most important adverse events in a child's life. Parental divorce has been restricted by religion and politics for a long time because marriage has been considered as the mainstay for building a family. As a consequence, divorce has long been accompanied by social stigmatisation. It was only in the last decades of the 20th century that divorce began to be accepted as a social normality. According to Eurostat (2017), the divorce rate in Europe increased from 0.8 per 1000 persons in 1965 to 1.9 in 2013. According to the most recent available date for all EU Member States from Eurostat (2017), 2.1 million marriages and 943,000 divorces took place in 2013 in the EU. Regarding these facts, it is not surprising that increasing divorce rates have raised public concerns about potential negative long-term effects. A more profound knowledge of this issue would be useful for parents and teachers as well as for public health institutions and politicians in order to prevent or at least to extenuate possible negative effects.

During the past few decades, several studies have been published on our topic. Most of them have focused on very particular aspects of mental health such as behavioural problems (Amato and Cheadle, 2008), depression (Choi et al., 2017), addiction (Aro and Palosaari, 1992) and chronic pain (Voerman et al., 2015). However, the results remain very heterogeneous and ambiguous. This can be an indication that the time period in which divorces occur has an influence on its association to long-term effects. As divorce has become more common in society during the past decades, it seems possible that its potential negative effects on mental health have decreased.

To our knowledge, three meta-analyses have been conducted so far that focus solely on the long-term influence associated with parental divorce in the context of mental health. Two of them were published nearly three decades ago: Amato and Keith (1991) found a potential negative impact on well-being, whereas Reid and Crisafulli (1990) demonstrated associations to higher levels of emotional and behavioural problems after parental divorce. Finally, a recent meta-analysis addressed two special aspects of mental health. Based on 18 studies, Sands et al. (2017) found a significant association between parental divorce and adult offspring depression, but not for anxiety. However, they failed to prove that there was any influence of the time period in which divorces occur.

Summing up, we can state that despite the existence of several studies on this topic, the results remain unclear. The meta-analytic research is either not up to date (e.g. Amato and Keith (1991); Reid and Crisafulli (1990)), or it focuses only on a small aspect of mental health (Sands et al. (2017)). Therefore, we have carried out a meta-analysis including a great variety of mental health aspects. Depression, anxiety,

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suicide attempt and ideation, alcohol, smoking, drugs and distress were chosen as outcomes due to its appropriate number of literature and standardized characterisation in the ICD 10 (for a more detailed explanation see section 2). Firstly, we tried to determine whether parental divorce has a connection to negative long-term impact on adult offspring at all. Secondly, we aimed to clarify which aspects of mental health are affected. Finally, the potential influence of the time period in which divorces occur was explored.

2. Methods

2.1. Source and search of data

We performed a systematic literature search in PubMed, Medline, PsyINFO, PsyARTICLES and PsycNET, which were chosen for their great variety of clinical studies. We used the combinations "parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("mental health"[MeSH Terms] OR ("mental"[All Fields] AND "health"[All Fields]) OR "mental health"[All Fields]). The combinations ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("mental disorders"[MeSH Terms] OR ("mental"[All Fields] AND "disorders"[All Fields]) OR "mental disorders"[All Fields] OR ("mental"[All Fields] AND "illness"[All Fields]) OR "mental illness"[All Fields]) were also used. Furthermore we used the combinations ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("psychopathology"[MeSH Terms] OR "psychopathology"[All Fields]). The terms ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("mental disorders"[MeSH Terms] OR ("mental"[All Fields] AND "disorders"[All Fields]) OR "mental disorders"[All Fields] OR ("mental"[All Fields] AND "illness"[All Fields]) OR "mental illness"[All Fields]) were used additionally. We also used the combinations ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("depressive disorder"[MeSH Terms] OR ("depressive"[All Fields] AND "disorder"[All Fields]) OR "depressive disorder"[All Fields] OR "depression"[All Fields] OR "depression"[MeSH Terms])Also ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("anxiety disorders"[MeSH Terms] OR ("anxiety"[All Fields] AND "disorders"[All Fields]) OR "anxiety disorders"[All Fields] OR ("anxiety"[All Fields] AND "disorder"[All Fields]) OR "anxiety disorder"[All Fields]) was used. In addition ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("suicide"[MeSH Terms] OR "suicide"[All Fields]) was used. Also ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("suicide"[MeSH Terms] OR "suicide"[All Fields]).Moreover we used ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("smoking"[MeSH Terms] OR "smoking"[All Fields]). Furthermore the combinations ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("pharmaceutical preparations"[MeSH Terms] OR ("pharmaceutical"[All Fields] AND "preparations"[All Fields]) OR "pharmaceutical preparations"[All Fields] OR "drugs"[All Fields]) were used. Finally we used ("parents"[MeSH Terms] OR "parents"[All Fields] OR "parental"[All Fields]) AND ("divorce"[MeSH Terms] OR "divorce"[All Fields]) AND ("stress disorders, traumatic"[MeSH Terms] OR ("stress"[All Fields] AND "disorders"[All Fields] AND "traumatic"[All Fields]) OR "traumatic stress disorders"[All Fields] OR ("stress"[All Fields] AND "disorder"[All Fields]) OR "stress disorder"[All Fields]).

The results were restricted to the period of 1990–2018. We chose this time span with regard to Amato and Keith's large meta-analysis on this subject which was published in 1991. Amato and Keith found that for some outcomes more recent studies yielded weaker effect sizes than studies carried out during earlier decades. We would like to discuss how this effect developed over time until today, since statistical calculations by EuroStat show that the crude divorce rate increased steadily from 1990 (1.6) to 2000 (1.8) to 2010 (2) in European countries.

2.2. Study selection

In total, the first step of our literature search included 3378 studies. After this, we excluded every work that was not written in English or did not correspond to our interest. In total we included 54 studies that met the following criteria for our meta-analysis:

(1) Subjects who had reached the age of 18 years were asked.
(2) Parental divorce took place before the children involved turned 18 years of age.
(3) The study reported the sample size and appropriate statistics to calculate an effect size.
(4) The study population was not systematically restricted due to sociodemographic or clinical variables (such as being inhabitant of certain institutes, showing specific symptoms or history, or similar).
(5) Empirical peer-reviewed study published in English.
(6) No preselections were carried out regarding health symptoms.

(For more detailed information on the study selection process see our flow chart in Fig. 1).

2.3. Data extraction and quality assessment

The screening process for data extraction was initially carried out by second through last author using a developed coding scheme. Results

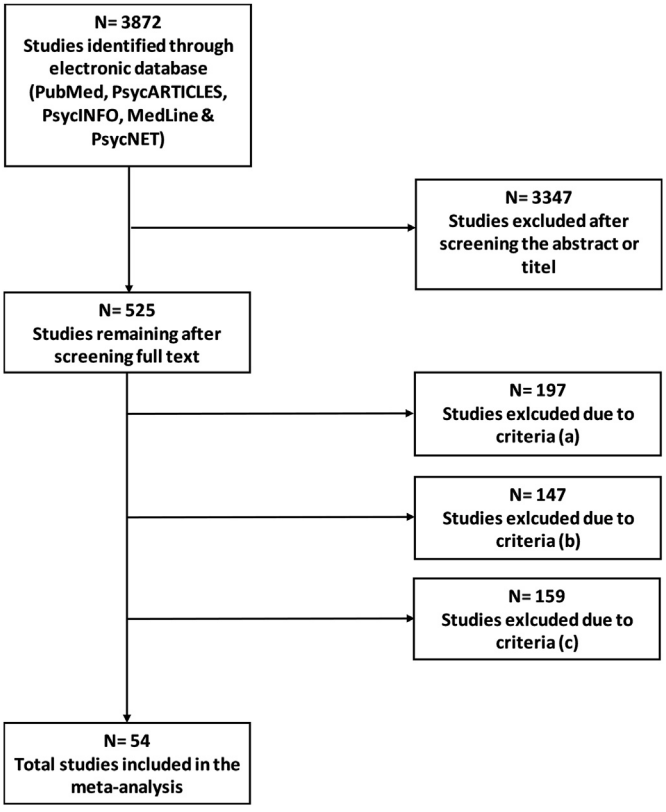

Fig. 1. Flow chart for study selection process.

Table 1

Variable	Studies
Depression	Frost and Pakiz (1990); McLeod (1991); Aro and Palosaari (1992); Oakley Browne et al., 1995; Palosaari and Aro (1995); Aseltine (1996); O'Conner et al. (1999); Maier and Lachman, 2000; Richardson McCabe (2001); Anda et al. (2002); Gilman et al. (2003); Mack, 2001; Otowa et al., 2014; D'Onofrio et al., 2007; Huure et al. (2006); Pilowsky et al. (2006); Bloch et al. (2007); Pelkone et al. (2008); Tyrka et al. (2008); Afifi et al. (2009); Angarne-Lindberg and Wadsby (2009); Donahue et al. (2010); Hovens et al. (2010); Benjett et al. (2011); Rønning et al. (2011); Uphold-Carrier and Utz, 2012; Kim et al. (2013); Sareen et al. (2013); Zeratsion et al. (2013); Tebeka et al. (2016); Choi et al. (2017); Hadzikapetanovich et al. (2017)
Anxiety	Mäkikyrö et al. (1998); Richardson and McCabe, 2001; Otowa et al., 2014; Pilowsky et al. (2006); Bloch et al. (2007); Angarne-Lindberg and Wadsby (2009); Afifi et al. (2009); Hovens et al. (2010); Benjet et al. (2011); Kim et al. (2013); Sareen et al. (2013); Tebeka et al. (2016); Choi et al. (2017)
Suicide - Attempt	Rubenstein et al. (1998); Afifi et al. (2009); Lizardi et al. (2009); Kim et al. (2013); Alonzo et al. (2014); You et al. (2014); Coêlho et al. (2016); Lindström and Rosvall (2016)
Suicide - Ideation	D'Onofrio et al., 2007; Afifi et al. (2009); Fuller-Thompson and Dalton (2011); Kim et al. (2013); You et al. (2014); Coêlho et al. (2016); Lindström and Rosvall (2016); Hadzikapetanovich et al. (2017)
Alcohol	Aro and Palosaari (1992); Mäkikyro et al. (1998); Hope et al. (1998); Anda et al. (2002); Thompson et al. (2008); Huurre et al. (2010); Strine et al. (2012); Thompson et al. (2014); Otowa et al. (2014); Zeratsion et al. (2014)
Smoking	Frost and Pakiz (1990); Aro and Palosaari, 1992; Anda et al., 1999; Chapman et al. (2013); Fuller-Thompson et al. (2013); Zeratsion et al. (2014)
Drugs	Frost and Pakiz (1990); Nurco et al., 1994; Pilowsky et al. (2006); Sakyi et al. (2012); Otowa et al. (2014); Haug et al. (2014); Ding et al. (2014); Tebeka et al. (2016)
Distress	Davidson et al., 1991; Richardson and McCabe (2001); Chapman et al. (2013); Sareen et al. (2013), Choi et al. (2017)

were collaterally reviewed by the first author, discrepancies in coding were resolved by consensus. Regarding the inter-coder reliability, ICC of .98 based on a two-way mixed effects model, mean rating (k = 3; absolute agreement) was estimated for the coded effect size. As described above, the meta-analysis started based on search strings similar to the words “parental” and “divorce” on the side of the cause, and “mental health”, “illness” or “disorder” on the dependent side. The selected studies were assigned to one or more topics which followed the WHO's ICD 10 Classification of Mental and Behavioural Disorders on the 2-digit level (e.g. F10 “Mental and behavioural disorders due to use of alcohol”). For those sub-dimensions of mental health for which a promising number of studies (more than five) was available in the first round (F32 Depressive episodes, F41 Other anxiety disorders, F43 Reaction to severe stress, and adjustment disorders, F10 Mental and behavioural disorders due to use of alcohol, and F17 Mental and behavioural disorders due to use of tobacco), an additional keyword search was carried out yielding the first five out of seven items of the following final list of topics:

2.3.1. Depression

The studies included in relation to the outcome variable "depression" either assessed the severity of depressive symptoms by means of self-reported questionnaires (e.g. Beck's Depression Inventory (see for example Aro and Palosaari, 1992; Palosaari and Aro, 1995; Huurre et al., 2006; etc.)) or used structured diagnostic interviews (e.g. Composite International Diagnostic Interview (see for example Sareen et al., 2013; Hovens et al., 2010).

2.3.2. Anxiety

Concerning anxiety, assessments of severity consisted of either self-reported questionnaires (e.g. Depression Anxiety Stress Scale; see for example Richardson and McCabe, 2004 or Hamilton Anxiety Scale, see for example Kim et al., 2013) or structured diagnostic interviews (e.g. Composite Internationale Diagnostic Interview (see for example Afifi et al., 2009; Hovens et al., 2010; Tebeka et al., 2016; and Choi et al., 2017).

2.3.3. Distress

Distress was assessed by structured diagnostic interviews on post traumatic stress disorders (such as the Composite International Diagnostic Interview [e.g. Sareen et al., 2013]) and self-reported questionnaires regarding frequent mental stress (e.g. Depression Anxiety Stress Scale; see for example Richardson and McCabe, 2001).

2.3.4. Alcohol

The measurement for alcohol consisted of self-reported questionnaires (e.g. Alcohol Use Disorders Identification Test (e.g. Huurre et al., 2010), the CAGE questionnaire (e.g. Hope et al., 1998) as well as a screening question (e.g. Anda et al., 2002; Zeratsion et al., 2014) and of structured diagnostic interviews (e.g. Thompson et al., 2008; Otowa et al., 2014; Thompson et al., 2014).

2.3.5. Smoking

For smoking the studies included used a set of variables assessing the smoking status of the subjects (for a detailed explanation see for example Chapman et al., 2013; Fuller-Thompson et al., 2013; Zeratsion et al., 2014).

2.3.6. Drugs

Drugs were included as an umbrella category for drug-related topics which did not reach the target number (in particular category F12, “cannabinoids”, 3 studies) or with a more general scope (such as “substance use disorder” in general). According to the heterogeneous character of this category, aggregation to an average effect is not intended, but reporting seems valuable. Drug addiction was either assessed by structured diagnostic interviews (e.g. the Structured Clinical Interview for DSM-IV; see for example Nurco et al., 1994; Mack, 2001; Otowa et al., 2014) or by a set of variables (for a detailed explanation see for example Sakyi et al., 2012; Haug et al., 2014; Ding et al., 2014).

2.3.7. Suicide

The suicidal aspect of depressive episodes has been dealt with so extensively by various studies that it could be added as an area of its own, even allowing for the differentiation between suicide attempts and suicide ideation in the evaluation. For suicide measurements the majority of the studies reported either a set of added self-report variables (for a detailed explanation, see for example Rubenstein et al., 1998; Afifi et al., 2009; You et al., 2014) or questions used in structured diagnostic interviews (see for example Kim et al., 2013; Alonzo et al., 2014; Coêhlo et al., 2016); while only a few studies used self-report measurement scales such as Beck's Depression Inventory II (Hadzikapetanovich et al., 2017) or the Symptom Checklist 90 (D'Onofrio et al., 2007).

For a more detailed explanation of which studies were included for the specific variables, see Table 1.

Specific information was extracted from the collected studies that were gathered by the search strategy deployed which we discussed earlier on. Year of publication, the author(s), the characteristics of the sample as well as the relevant results were the fundamental data which we focused on. When adjusted, odd ratios were given in addition to unadjusted odd ratios and the former were included in the meta-analysis. Effect sizes that were not given in odd ratios of any form were converted by methodical transformation standards (see Figs. 1 and 2 in supplementary material). In studies where not the total sample results

were given but those of subgroups (e.g. regarding gender), these groups entered the meta-analysis as independent samples.

Regarding the methodological quality of the studies we employed the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (QATOCCSS) of the National Heart, Lung, and Blood Institute of the National Institutes of Health (NIH). Within this tool, studies are judged by a total of 14 questions in consideration of a broad variety of aspects (e.g. research question, sample size justification, statistical analyses, etc.). Additionally in regards to these perspectives, studies are considered of good, fair or bad quality. Two researchers independently participated in this process, while disagreements were addressed by consensus through discussion. An interrater reliability of .89 for the coding of the study quality was estimated.

2.4. Data synthesis and analysis

Since the majority of studies provided odds ratios or adjusted odd ratios, or at least frequency data which allowed for the computation, odds ratios were selected as the effect size for the meta-analysis. However, we did not aggregate adjusted and unadjusted odds ratios but provided separate results. In studies where not the total sample results were given but those of subgroups (e.g. regarding gender), these groups entered the meta-analysis as independent samples. For studies that did not report the appropriate effect sizes, we applied the transformation formulas provided to convert them into comparable measures. Effect sizes were calculated in such a way that larger than 1 values display a higher probability of the various outcome variables manifested in the subjects concerned.

The pooling of effect sizes used Hedges' inverse variance weighting (Borenstein et al., 2009). We tested for heterogeneity and the significance of the aggregated information by means of a random effects model using the Rpackage “metafor” (Viechtbauer, 2010) (REML estimator). To be included in such an evaluation for a single symptom, the results of this variable had to be supported by sufficient information to convert the study's effect size into an odds ratio equivalent. In general, effect sizes were analysed repeatedly for “depression”, “anxiety”, “smoking”, “drugs”, “suicide attempt“, „suicide ideation” and “distress”. Converted odd ratios were calculated with the appropriate 95% confidence intervals. Effect sizes were synthesised using the log odd ratios and were weighted using the inverse of their variance. Log odd ratios were then exponentiated for ease of interpretation. In general, odd ratios displaying a value above 1 represent an increased possibility for depression, anxiety, smoking, taking drugs, suicide ideation or a suicide attempt. Possible publication bias was not only visually addressed by generating funnel plots (see Figs. 3–16 in supplementary material), except for adjusted effect sizes of smoking and distress, because the number of effect sizes too small, but also by Eggers'-tests (Egger et al., 1997) and p-curve analyses (Simonsohn et al., 2014) (see Figs. 17–24 in supplementary material).

3. Results

3.1. Study characteristics

Overall, we included 54 studies accompanied by a total of 117 effect sizes consisting of 70 adjusted odds ratios (59,83%) and 47 unadjusted odds ratios (40,17%). Taking all studies in consideration from 1990 to 2017, we achieved a total sample of 506,299 participants. The quality of the included studies was considered as fair, while the majority of the studies showed deficits in respect of the perspectives study population as well as sample size justification. In addition only few studies explicitly estimated the specific time since parental divorce in years, while the majority referred to heterogenic time windows since this event (e.g. before age 7; before age 16; etc.). A detailed description of the characteristics for the separate variables is given in Table 2 as well as for all studies in Table 1 in the supplementary material.)

In spite of the lack of age information on an individual level, many studies report the average age of the sample, which – together with the condition that the parental divorce took place at a child's age of 18 at most – allows for computing a lower bound for the average time span between divorce and assessment which will be reported per variable. In general, no linear or nonlinear relations between this time span and the observed odds ratio were found in bivariate consideration or in moderator analyses. In particular, there was no tendency in any variable that studies with longest time spans resulted in smaller odds ratios.

3.2. Meta-analytic results

Since the adjusted and non-adjusted values as published do differ slightly, Fig. 2 and the following figures are disaggregated for this property. As a general but not strict tendency, adjusted odds ratios are smaller, which is not surprising assuming that unfavourable factors act as confounders, predicting divorce history and mental health problems at the same time. However, when comparing both adjusted and not adjusted OR where both are reported, this does not hold for depression, and makes hardly any difference for drugs. Only unadjusted effect sizes were pooled, since the adjusted ones were not comparable due to different choices of variables which were adjusted for. Separate results for unadjusted and adjusted effect sizes for outcome measures are listed in detail in Table 3.

3.3. Depression

The homogeneity test indicated that the unadjusted effect sizes ($Q(25) = 95.762$. $p < .001$) included were heterogeneous. However, a direction of association could be found considering that only 5.4% ($n = 2$) of the ORs are lower than 1, with only one study being significant (O'Connor et al., 1999). Therefore, a random-effect model meta-analysis across the unadjusted effect sizes ($n = 45615$) with a total of 26 effect sizes was used demonstrating that parental divorce is significantly associated with offspring's depression, OR = 1.61 (95% confidence interval 1.46 to 1.76, $p < .001$). Adjusted odds ratios ranged between 1.00 and 8.50. Moderator analyses (again using the metafor package) considering publication year ($X^2(1) = 1.81$, $p = .18$; $r^2 = 0.00$, $b = 0.01$), study quality ($X^2(1) = 2.59$, $p = .11$; $r^2 = 0.12$, $b = 0.09$), estimated average minimum time since divorce ($X^2(1) = 0.24$, $p = .63$; $r^2 = 0.00$, $b = 0.01$), or all three variables ($X^2(3) = 3.60$, $p = .31$; $r^2 = 0.00$, $b_{publicationyear} = 0.02$, $b_{studyquality} = 0.02$, $b_{meanage} = 0.00$) did not reveal any significant moderator influences. Local regression plots suggested slightly convex odds ratio developments with increasing moderators, but taking quadratic shapes did not lead to noteworthy changes (see Figs. 25, Figs. 30 and 37 in supplementary material).

3.3.1. Anxiety

Regarding anxiety, heterogeneous unadjusted effect sizes ($Q(6) = 29.218$, $p < .001$) were shown by the test, the 8 adjusted odds ratios ranged between 0.85 and 2.10 (with only one more odds ratio of 0.98 slightly below 1). One unadjusted OR (0.73) could be found below 1. The results of the random-effect model meta-analysis show a significant association between the anxiety of offspring and parental divorce (unadjusted OR estimate = 1.51 (95% confidence interval 0.98 to 2.03, $p < .001$)). Moderator analyses did not indicate any effects of publication year ($X^2(1) = 0.02$, $p = .90$; $r^2 = 0.00$, $b = 0.00$), study quality ($X^2(1) = 0.04$, $p = .88$; $r^2 = 0.00$, $b = -0.05$), estimated average minimum time since divorce ($X^2(1) = 0.24$, $p = .62$; $r^2 = 0.00$, $b = 0.00$) or a combination of all three ($X^2(3) = 4.18$, $p = .12$; $r^2 = 0.73$, $b_{publicationyear} = -0.84$, $b_{studyquality} = -2.17$, $b_{meanage}$ could not be computed). The small number of studies did not allow for a reasonable investigation of nonlinearities (see Figs. 26, Figs. 31 and 38 in supplementary material).

Table 2
Study characteristics.

Outcome	studies included	Unadjusted effect sizes	Adjusted effect sizes	n total sample	Range sample	Median sample	Mean years since divorce	Range publication date
Depression	32	18	19	127470	44–33377	1708.5	14	1990–2017
Anxiety	13	8	7	80254	44–33377	2268	12	1998–2017
Suicide-Attempt	8	2	13	27997	254–28935	3797	10	1998–2016
Suicide-Ideation	8	3	13	30853	168–6006	3755	12	2006–2017
Alcohol	10	4	9	88097	1387–43039	4942	17	1992–2014
Smoking	6	6	2	58714	361–25810	5815.5	9	1990–2014
Drugs	6	3	5	40876	125–33377	722.5	10	1990–2016
Distress	5	4	2	52038	165–25810	8340	24	1991–2017

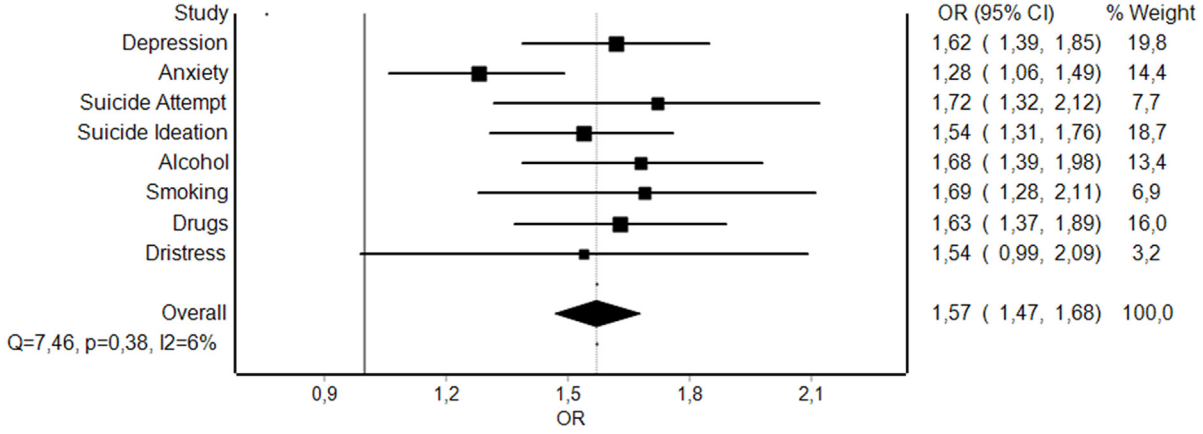

Fig. 2. Odds ratios for outcomes.

Table 3
Meta-analytic results.

Outcome	Pooled Log-Odds (unadjusted)	SE	τ^2
Depression	0.41	0.03	0.09
Anxiety	0.18	0.09	0.32
Suicide-Attempt	0.66	0.03	0.36
Suicide-Ideation	0.65	0.03	0.19
Alcohol	0.54	0.04	0.10
Smoking	0.63	0.03	0.35
Drugs	0.37	0.00	0.08
Distress	0.41	0.04	0.68

3.3.2. Suicide

The studies about suicide attempts provide a heterogeneous picture regarding the unadjusted effect sizes ($Q(13) = 157.596$, $p < .001$) included despite a marked tendency towards negative effects of divorce with only one OR (0.95) below 1 (Afifi et al., 2008), adjusted odds ratios scored between 0.68 (again Afifi et al., but the adjusted value; this was the only odds ratio smaller 1 here) and 2.43. A random-effect meta-analysis of seven studies and a total of 14 unadjusted effect sizes demonstrated a significant association between parental divorce and suicide attempts of their offspring (OR = 1.94, 95% confidence interval 1.60 to 2.27, $p < .001$). Again, no moderation effects were observed regarding publication year ($X^2(1) = 0.09$, $p = .77$; $r^2 = 0.00$, $b = 0.01$) and study quality ($X^2(1) = 1.18$, $p = .28$; $r^2 = 0.01$, $b = -0.37$), the time span could not be evaluated since only two studies allowed for computing, neither was the data basis sufficient to detect non-linear relationships (see Figs. 32 and 39 in supplementary material).

Similarly, heterogeneity is observed for suicide ideation regarding unadjusted effect sizes ($Q(10) = 257.724$, $p < .001$; smallest value 1.3), adjusted values were between 0.92 (only value < 1.0, again from Afifi et al., 2008) and 2.36. Across four studies and 11 effect sizes a random-effect meta-analysis was carried out indicating a significant association between suicide ideation of offspring and parental divorce (unadjusted OR = 1.81, 95% confidence interval 1.49 to 2.14, $p < .001$). Neither moderator analyses nor local regressions were carried out due to a lack of variation in the moderator variables.

3.3.3. Alcohol

Heterogeneity of unadjusted effect sizes ($Q(6) = 42.528$, $p < .001$) was also observed for alcohol although there is not a single OR below 1 which shows a straight direction of influence (adjusted odds ratios between 1.00 and 3.70) In a random-effect model meta-analysis of 7 studies including 9 effect sizes, a significant association was shown between parental divorce and alcohol (unadjusted OR = 1.66, 95% confidence interval 1.40 to 1.92, $p < .001$). Neither did moderator analyses regarding year of publication ($X^2(1) = 0.18$, $p = .67$; $r^2 = 0.00$, $b = -0.01$), study quality ($X^2(1) = 0.02$, $p = .88$; $r^2 = 0.00$, $b = 0.02$), estimated average minimum time since divorce ($X^2(1) = 1.42$, $p = .23$; $r^2 = 0.09$, $b = 0.01$), or all three variables ($X^2(3) = 4.67$, $p = .11$; $r^2 = 0.30$, $b_{publicationyear} = 0.34$, $b_{studyquality} = -3.86$, $b_{meanage} = 0.14$) result in significant p-values, nor the local regression plots indicate consistent patterns (see Figs. 27, Figs. 33 and 40 in supplementary material).

3.3.4. Smoking

While the homogeneity test indicated heterogeneous unadjusted effect sizes ($Q(4) = 111.959$, $p < .001$), the tendency towards unambiguous results is also seen for smoking, where none of the ORs is below 1 (only two adjusted odds ratios were available: 1.14 and 1.53). The results of a random-effect model meta-analysis across five studies and effect sizes demonstrated a significant association between parental divorce and smoking of offspring (unadjusted OR = 1.85, 95% confidence interval 1.31 to 2.38, $p < .001$).

Study quality did not show enough variation to be analysed as moderator. Neither publication year ($X^2(1) = 0.54$, $p = .46$; $r^2 = 0.00$, $b = -0.02$) nor the time span variable ($X^2(1) = 0.37$, $p = .54$; $r^2 = 0.00$, $b = -0.01$) showed moderating effects, nor did the sample

size allow for non-linearity investigations (see Figs. 28 and 34 in supplementary material).

3.3.5. Drugs

Analogously, heterogeneity was found for the unadjusted effect sizes (Q(5) = 19.321, p = .001) regarding drugs, while there was no OR with a value below 1 (adjusted odds ratios between 1.2 and 2.03). Across six publications and effect sizes the random-effect model meta-analysis resulted in a significant association between parental divorce and drugs (unadjusted OR = 1.65, 95% confidence interval 1.34 to 1.97, p < .001).

Regarding drugs, the mean age of the sample ($X^2(1) = 16.75$, p < .001; $r^2 = 1.00$, b = 0.00) is clearly a moderating variable, in contrast to publication year ($X^2(1) = 0.72$, p = .39; $r^2 = 0.00$, b = 0.00) and study quality ($X^2(1) = 2.12$, p = .14; $r^2 = 0.00$, b = −0.02). With all three variables as multiple moderators ($X^2(3) = 18.10$, p < .001; $r^2 = 1.00$, $b_{publicationyear} = 0.94$, $b_{studyquality} = 0.84$, $b_{meanage} = 0.02$), mean age of the sample is still significant (p = .02) in contrast to publication year (p = .94) and study quality (p = .84). Due to local regression plots, quadratic effects have been assumed for all variables however, the result is robust regarding linear or quadratic assumptions (see supplementary material). The odds ratios drop with increasing mean age of the study sample, indicating – as can be expected – larger effects for younger samples (see Figs. 29, Figs. 35 and 41 in supplementary material).

3.3.6. Distress

There was again heterogeneity of the unadjusted effect sizes (Q(3) = 31.855, p < .001; only 2 adjusted effect sizes were given, 1.10 and 1.15, men and women from Sareen et al., 2013), with one OR (0.98) slightly below 1 (Choi et al., 2007). The results of the random-effect model meta-analysis showed a significant association between the distress of offspring and parental divorce (unadjusted OR = 1.78, 95% confidence interval given as 0.94 to 2.63, but p < .001).

Distress is the only variable where publication year acts as significant moderator ($X^2(1) = 9.74$, p = .002; $r^2 = 0.87$, b = −0.07) for study quality, which was implemented as quadratic effect after inspection of a local regression plot (see supplementary material), no significant results were found ($X^2(1) = 1.80$, p = .18; $r^2 = 0.18$, b = 0.03). Time span could not be analysed for lack of data. With both variables as multiple moderators ($X^2(2) = 14.73$, p < .001; $r^2 = 0.93$, $b_{publicationyear} = -0.06$, $b_{studyquality} = 0.02$), publication year is still significant (p = .001) in contrast to study quality (p = .12) (see Figs. 36 and 42 in supplementary material).

3.4. Trends

In order to investigate trends regarding the effect sizes, at first an overall evaluation is performed considering all the included studies, in order to circumvent Type I error inflation by multiple testing for several dimensions. Thereby, a significant negative correlation could be found between the effect sizes, using the same precision-weights as in the meta-analysis, and the publication date of the study (r = −0.223, p = .01). Investigating the single dimensions separately now, a significant Spearman correlation could only be obtained between the specific outcome variable “distress” and publication date (r = −0.995, p = .005). The odds ratio drops from about 3 in a 1991 study down to about 1 in 2017. As described in 3.2.7, the result holds when considering the study quality in an appropriate moderator analysis. No other variable outcome correlated significantly with the publication date.

Summing up, comparing the odds ratios it can be seen that the results vary between the studies in size, failing to reach homogeneity in general, but hardly in their direction of influence. Divorce seems to be associated with more unfavourable measurement values regarding a broad range of different affective or behavioural dimensions. In general, aggregated effects, ignoring their heterogeneity for a moment, vary by around 1.5, smoking scoring slightly higher, with the exception of the variable “anxiety”, where the values tend to be below 1.3. It can therefore be stated that parental divorce may be consistently connected to detrimental long-term effects, whereby their sizes vary across samples and measures, but with a clear and marked but unspecific disadvantage for those who had experienced it. It is important to note that even though the negative impact of divorce on offspring is consistent throughout the considered variables, there seems to be a relevant connection between the sizes of effects and the year of publication.

3.5. Sensitivity analysis and publication bias

All results were screened for outliers on the basis of normal distribution assumptions (using the function rstandard from the metafor package). Few studies markedly deviated from a common normal distribution assumption, in particular Rønning et al. (2011) for depression (unadjusted and adjusted odds ratios), Angarne-Lindberg and Wadsby (2009) for anxiety (unadjusted odds rations), and maybe Mäkikyrö et al. (1998) for mental health (unadjusted odds ratios). In none of the cases, taking out the outlier would remove the significant outcome of the heterogeneity test. In only one case, the Rønning study within the adjusted odds ratios regarding depression, a striking impact on the outcome was observed (1.45 instead of 1.95).

The funnel plots visually suggest, in general, patterns of asymmetry which would indicate some publication bias (see Figs. 3–16 in supplementary material). In addition significant Egger's-tests were found for adjusted effect sizes regarding depression (p < .001), unadjusted (p = .008) and adjusted effect sizes (p < .001) for anxiety, unadjusted effect sizes regarding suicide ideation (p = .027) as well as for adjusted effect sizes in the outcome alcohol (p < .001) and for unadjusted effect sizes for the outcome distress (p = .037). Both effect sizes of suicide attempt, smoking and drugs were not significant (p > .05). However, since there is ubiquitous heterogeneity in the resulting effect sizes, reporting a particular average value cannot be recommended.

Tests against p-hacking have been conducted using p-curve analyses (Simonsohn et al., 2014; the charts were generated via the online tool http://www.p-curve.com/app4/; see Figs. 17–24 in supplementary material). For anxiety, the number of significant studies in the sample was too small to run a meaningful analysis, the other variables performed well: All tests for right-skewness (presence of non-zero effect) were significant (depression, suicide attempts, suicide ideation, alcohol, smoking and drugs: p < .001, distress: p = .004), and all against flatness (testing for p-hacking) non-significant (depression p = .98, distress p = .88, all others p > .999).

Summing up, there were indications for file-drawer bias, but none for p-hacking. In spite of some possible file-drawer bias, considering the vast majority of odds ratios larger than 1, there cannot be any reasonable doubt about an overarching negative relation between parental divorce and later mental well-being problems. Considering the heterogeneity between the studies included in our meta-analysis, a systematic comparison with grey literature was not considered promising.

4. Discussion

Our analysis clearly shows a consistent negative association between parental divorce on all observed dimensions, which are: depression, anxiety, distress, suicide (attempts and ideation), alcohol and drug consumption, as well as smoking. Although we found evidence that the impact of the connection to mental health decreases over time, based on the year of publication, the effect only remained significant for distress. The impact on the outcomes in general may be driven by distress itself or the higher quality of later studies.

4.1. Strengths and weakness of the study

This meta-analysis is the first for many years to consider a great variety of mental health aspects. It provides an overview of nearly three decades of research and incorporates the most recent findings. The method of meta-analysis is a very useful technique for aggregating the results of a number of separate studies. It gives a conclusive overview about a certain field of research and overcomes the problem of reduced power due to small sample sizes by using an enhanced pooled sample size, and therefore leads to more accurate estimates of the effect size. However, several methodological limitations have to be mentioned.

Firstly, the heterogeneity of the effect sizes has to be taken into account when interpreting the results. Reflecting on the possible components for heterogeneous outcomes, as Kriston (2013) suggests when dealing with the role of heterogeneity in clinical meta-analysis, specific important factors can be found. Due to the diversity in study designs, sample sizes as well as the assessment methods of the interested variables heterogeneity is to be expected. Even though homogeneity could not be demonstrated in single factors, the direction of influence of parental divorce shows a homogenous picture. The findings of this meta-analysis were therefore interpreted in such a way as to take the role of heterogeneity into account. Additionally, only a marginal proportion of included studies reported the exact time duration since parental divorce had happened. Due to this heterogeneity of measured time windows, specific time effects of parental divorce regarding offspring's mental health were restricted to be identified in this meta-analysis. However it is to mention that our results are consistent with studies in which possible negative long-term effects were outlined (e.g. Huurre et al., 2006). Nevertheless this analysis should be replicated when a more homogenous body of duration measurement is given.

Moreover, publication bias also has to be considered (e.g. Coburn and Vevea, 2015). Our results show strong indicators of publication bias regarding the outcomes anxiety, depression, alcohol and distress. Our findings related to these mental health outcomes can thus be affected in that we might inevitably be overestimating the effects of parental divorce. Finally, the complex nature of mental health has to be mentioned. This complexity interferes with the comparability of studies and increases the variety of variables of the meta-analysis. Most of the studies used relied on self-reported measures of mental health rather than on diagnosis confirmed by clinical experts, although self-reported data has often been criticised for its lack of validity.

4.2. Plausible mechanisms

To explain the potential long-term impact of divorce, several mechanisms have to be considered. According to already Bowlby's early attachment theory (1969), separation from a person to whom one is attached, like a parent, could lead to insecure attachment in offspring, which seems to be strongly linked to depression (e.g. Fuhr et al., 2017). Fischer-Kern et al., (2013)found a high proportion of insecure and disorganised attachment in their sample of severely depressed female patients. Lee and Hankin (2009) associated insecure attachment with vulnerability for juvenile and adult depression. Miniati et al. (2017) showed that an insecure attachment style, mostly anxious, and unresolved trauma are associated with an increased suicide risk. Özer et al. (2015) showed higher rates of suicide attempts in patients with a fearful attachment style. The topic of addiction may be also linked to attachment styles. Both substance-based and non-substance based addictions could be associated with insecure attachment.

Eichenberg et al. (2017) found a link between an insecure attachment style and a higher tendency towards pathological internet usage. Gidhagen et al. (2018) succeeded in showing an association between attachment style and substance use. They found that an insecure attachment style was more common among patients with substance use disorders compared to non-clinical groups. Furthermore, several studies (e.g. Schimmenti and Bifulco, 2013) discuss the link between anxiety disorders and attachment styles. Patients with a fearful attachment style score higher on psychological distress than patients with a secure attachment style (Gidhagen et al., 2018). Notzon et al. (2016) found a significant association between a less secure attachment style and greater social anxiety. According to Andrews and Hicks (2017), the literature shows that one of the strongest predictors for trait anxiety is an interpersonal attachment style. Gidhagen et al. (2018) found a significant relationship between patients' attachment style and their initial psychological distress. Furthermore, the association between parental divorce and mental health can be explained via social and economic pathways. As a consequence of divorce, economic disadvantages can lead to a lower socio-economic status in childhood (Eggebeen and Lichter, 1993). In turn this may affect psychological and educational development negatively, which increases the risk for mental health problems in adulthood. In addition, the stigmatisation which – depending on the respective religious and worldview predominant in a society – is connected with divorce should not be forgotten. Stigmatisation of this kind can create a high level of mental-emotional stress for children and thus increase vulnerability for mental health problems (Konstam et al., 2016). Our result – that the negative association between divorce and mental health is reduced in newer research – might be explained by the fact that in the meantime divorce has become very common and is therefore much less stigmatised than in the past.

Additionally, the neuropsychological pathway of stress and its endocrinological impact on the brain might give further explanation regarding the psychopathological symptoms. When parental divorce is assessed as a negative event, the hypothalamic-pituitary-adrenal (HPA) axis is activated by the hippocampus. By releasing arginine vasopressin (AVP) and corticotropin-releasing factor (CRF), the amygdala, the sympathetic nervous system as well as pituitary-adrenal axis are activated. The anterior pituitary is then caused by CRF to secrete adrenocorticotropic hormone (ACTH) which then activates the production of cortisol in the suprarenal gland (Stephens and Wand, 2012).

As a potential pathomechanism, when exposed to chronic stress, for example in the case of parental divorce, a dendritic reduction and loss of spines in the hippocampal and in the medial amygdala is suggested, whereas proposing an expansion of dendrites in the basolateral amygdala, resulting in an imbalance of the hypothalamo-pituitary-adrenal axis as well as in structural and functional alterations in both regions (Vyas et al., 2002; Bennur et al., 2007; McEwen, 2016; Lau et al., 2017).

Disruptions in the frontoamygdal connectivity have been linked to a variety of mental health problems such as depression (Kaiser et al., 2015) and anxiety (Hamm et al., 2014). Moreover, Roberto at al. (2012) found out that the amygdala may play an important key role in alcohol dependence, whereas Koob (2009) linked it to drug addiction. Our findings are consistent with these results, showing a clear association between mental disorders and addictive behavior and experience of parental divorce.

4.3. Implications

Our results show that adults who have experienced divorce as children exhibit an increased risk for mental disorders. It would thus seem to be prudent to develop selective intervention programmes for these high-risk individuals. Such programmes could include psychological support for children and both parents during and after the divorce. Following Sands et al. (2017), such interventions should aim to improve resilience and coping strategies to decrease the risk of mental disease. The programmes could be carried out in facilities such as schools or public health centres by doctors, psychologists or specially-trained volunteers. Furthermore, it would be useful to mitigate the negative financial disadvantages of parental divorce for affected families. Such measures could include tax benefits for single parents or financial support for health and education. Since high-conflict divorces seem to be especially demanding for children, action should be taken to handle the dissolution of a marriage as harmoniously as possible. That could

mean mandatory mediation, conversations with the children of divorcing parents and closer monitoring of the psychological pressure those families experience. Additionally, care should be taken that parental divorce loses its stigma to minimize the related social burden. Finally, whenever a mental-health history is taken, further studies including questions about the exact duration since parental divorce are desirable regarding specific time effects.

5. Conclusions

Taken as a whole, this meta-analysis provides evidence that parental divorce has a negative impact on the mental health of adults. Although the design of the studies does not allow for strict causal inference, it is clearly shown that children of divorcees have a higher risk of mental health disease. As a consequence, children of divorcees as well as their parents should be treated in special prevention programmes as early as possible. Further research should concentrate its main focus on the development of such prevention programmes in order to strengthen sustainable resilience in both children and parents.

Declaration of competing interest

No competing interests: All authors declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2019.09.011.

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