Research paper

Handedness and depression: A meta-analysis across 87 studies

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ABSTRACT

Alterations in functional brain lateralization, often indicated by an increased prevalence of left- and/or mixed-handedness, have been demonstrated in several psychiatric and neurodevelopmental disorders like schizophrenia or autism spectrum disorder. For depression, however, this relationship is largely unclear. While a few studies found evidence that handedness and depression are associated, both the effect size and the direction of this association remain elusive. Here, we collected data from 87 studies totaling 35,501 individuals to provide a precise estimate of differences in left-, mixed- and non-right-handedness between depressed and healthy samples and computed odds ratios (ORs) between these groups. Here, an OR > 1 signifies higher rates of atypical handedness in depressed compared to healthy samples. We found no differences in left- (OR = 1.04, 95% CI = [0.95, 1.15], p = .384), mixed- (OR = 1.64, 95% CI = [0.98, 2.74], p = .060) or non-right-handedness (OR = 1.05, 95% CI = [0.96, 1.15], p = .309) between the two groups. We could thus find no link between handedness and depression on the meta-analytical level.

1. Introduction

Many forms of human behavior are characterized by side biases, for example a preference for using one limb or sensory organ over the other (Pearson and Hodgetts, 2004; Ocklenburg and Güntürkün, 2017). Side biases can be found in several motor actions, such as hand (Papadatou-Pastou et al., 2020), foot (Packheiser et al., 2020), or eye use (Brown and Taylor, 1988), but also many other actions, such as social touch or turning behavior (Mohr et al., 2003; Ocklenburg et al., 2018). Of these, the most researched side bias is handedness (Güntürkün et al., 2020). Approximately 10.6% of the population favor using the left hand and 9.3% favor no hand for everyday tasks indicating a strong right-sided population bias in hand preference (Papadatou-Pastou et al., 2020). Individuals who are either left- or mixed-handed are therefore considered atypical in their hand preference.

Since behavior is generated in the brain, lateral behavioral biases are inevitably linked to functional hemispheric asymmetries. In motor or premotor cortices, movements with the preferred/dominant hand are usually accompanied by strong activations of the contralateral hemisphere whereas movements of the non-dominant hand demonstrate more bilateral activation patterns (Grabowska et al., 2012; Packheiser et al., 2020; Schmitz et al., 2019; van den Berg et al., 2011). Atypical cerebral motor lateralization would therefore be constituted if individuals demonstrate stronger right-hemispheric activation if the left hand is used and a rather bilateral activation pattern if the right hand is used. Apart from motor lateralization, language processing is also strongly lateralized in humans on the population level (Hirnstein et al., 2014). Here, the left hemisphere is dominant in language processing and speech production in the large majority of individuals (Friederici, 2011). Thus, individuals with bilateral or right-hemispheric language lateralization demonstrate atypical language lateralization.

Both atypical handedness and atypical language lateralization have been associated with increased rates of mental and neurodevelopmental disorders (Hugdahl and Davidson, 2004). Patients with schizophrenia

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for example demonstrate less left-hemispheric language lateralization compared to controls (Bleich-Cohen et al., 2009; Sommer et al., 2001; Weiss et al., 2006). Differences between patients with schizophrenia and healthy controls are not limited to functional hemispheric asymmetries but can also be seen structurally in decreased lateralization of the planum temporale (PT) which plays a major role in language processing (Somer et al., 2001). Individuals with schizophrenia also display elevated rates of atypical hand preference (Dragovic and Hammond, 2005; Sommer et al., 2001). In individuals with dyslexia, reduced structural PT asymmetries and hypoactivation in the left-hemispheric language network (Altarelli et al., 2014; Norton et al., 2015) as well as increased rates of non-right-handedness have been detected (Eglin-ton and Annett, 1994). A similar picture also emerges in individuals with autism spectrum disorders (ASD) as they demonstrate an average rightward asymmetry of the PT (Gage et al., 2009), altered white matter asymmetries that are associated with deficits in language processing (Lo et al., 2011), and higher prevalence of atypical handedness (Markou et al., 2017).

Compared to other disorders, less is known about the association of depression with atypical lateralization despite depression being one of the most prevalent mental disorders worldwide with more than 264 million individuals affected (World Health Organization, WHO). Depression is a multifaceted disorder with several different subdiagnoses that differ for example in symptoms, severity or duration (Benazzi, 2006). It has also been described as the leading cause for disability in the world (WHO, 2020). Regarding lateralization, the strongest evidence of changes in patients suffering from depression comes from studies investigating EEG alpha asymmetries (for review, see Bruder et al., 2017). A meta-analysis investigating alpha asymmetries in depression found a moderate effect of frontal alpha power asymmetries between patient and control groups (Thibodeau et al., 2006). Since frontal alpha asymmetries are strongly linked to deficits in emotional regulation (Reznik and Allen, 2018), this finding could indicate a deficiency in emotional regulation in depressed patients. Given these changes in EEG alpha asymmetries, there seems to be some evidence in favor of the hypothesis that depression and atypical lateralization are associated.

Only a few studies have investigated an association with language lateralization, and their results are inconclusive. Wale and Carr (1990), for example, studied language lateralization in individuals suffering from Major Depressive Disorder (MDD) and controls in a dichotic listening task. They found decreased left-hemispheric lateralization in depressed individuals compared to controls indicating more symmetrical language processing in MDD. In contrast, Bruder et al. (1989) and Hugdahl et al. (2003) found that individuals suffering from melancholic depression and MDD, respectively, do not display any difference from healthy controls in dichotic listening tasks.

With regard to handedness, several studies have found a significant association between hand preference and depression. Bruder et al. (1989) found an increased prevalence of left-handedness in 65 individuals with melancholic depression compared to 30 controls. A systematic investigation of left-handedness and attention deficit hyperactivity disorder (ADHD) revealed no direct association in 140 ADHD and 120 control children, but found that non-right-handedness increased the risk for MDD and reduced psychosocial functioning in children with ADHD (Beideman et al., 1994). In 137 non-diagnosed college students with high scores in the Beck Depression Inventory (BDI), Overby III (1994) found elevated rates of left-handedness compared to a control sample consisting of 963 students with low BDI scores. This increase was, however, only detected in females. Interestingly, Elias et al. (2001) designed a similar study in a total sample of 541 undergraduate students, finding an increased rate of left-handedness specifically in depressed males compared to male controls. In contrast, Moscovitch et al. (1981) found decreased rates of left-handedness in individuals suffering from MDD compared to healthy controls. Most recently, Logue et al. (2015) studied 692 children and found a 53% increased risk of suffering from depression in left-handed children.

Overall, most small to medium scale studies indicate that depression and handedness are associated, with the majority of studies showcasing an increased rate of left-handedness in depressed individuals. To provide more substantial and well-powered insight into this matter, Denny (2009) evaluated a large population survey on the association between depression and atypical handedness in a sample of 27,482 individuals from twelve European countries. He found that in males who experienced depressive symptoms for at least two weeks according to the Euro-D questionnaire (Castro-Costa et al., 2008; Prince et al., 1999), the risk of depression was significantly increased in left-handed (25%) compared to right-handed individuals (19%). For females, a non-significant increase from 33% (left-handers) to 36% (right-handers) was observed.

As evident from the literature, most of the studies that specifically investigated the relation between handedness and depression support the notion that these variables are associated with one another. However, the results are inconclusive as the aforementioned studies strongly differ in their reported effect sizes, their effect direction and possible sex differences. Due to the low power of each study (with the exception of the study by Denny (2009)) and to the heterogeneity of sampling and experimental procedures as well as in the measurements for handedness and depression that were used, individual studies can hardly be representative for the relationship between these variables. Recently, it was argued that the skewedness of individual studies is especially true for laterality research because lateralized phenotypes are heavily skewed in the population (Tran et al., 2014). Therefore, very large sample sizes are required to represent each phenotype sufficiently (Ockenburg et al., 2020). Importantly, these issues can be resolved via the application of meta-analyses as they are (1) more resistant to sampling errors, (2) allow for the identification of publication/small study biases and (3) enable the investigation of moderating factors that could potentially influence the association between handedness and depression.

The aim of the present study was to conduct a large-scale meta-analysis on the relationship between handedness and depression in order to identify possible differences in atypical handedness between patient and control samples. To this end, we investigated clinical samples and their respective control groups (if available) with regard to their handedness. We included not only studies that specifically investigated handedness in depressed individuals and healthy controls (as they were rather rare), but also studies that merely reported handedness as a demographic variable. Patient-to-control odds ratios (ORs) of atypical handedness were classified using multiple classification schemes from a conservative left-mixed-right-handedness criterion to a more liberal non-right-handedness criterion. Moderator analyses were conducted investigating (1) sex ratio, (2) age, (3) handedness classification, and (4) publication year to assess possible interaction effects with sample type.

2. Materials and methods

For consistency purposes, we will label all groups that were determined as the depression group in the respective study as patient groups, regardless of whether or not a clinical diagnosis was made.

2.1. Study selection

The electronic databases PubMed (https://www.ncbi.nlm.nih.gov/pubmed/), Web of Science (https://www.webofknowledge.com), and Google Scholar (https://scholar.google.de/) were searched for the terms “depression”, “major depression”, “unipolar depression”, “bipolar depression” and “mood disorder” combined with the terms “handedness” or “hand preference”. Next, reference lists of eligible studies were inspected for relevant publications. E-mail requests were sent to corresponding authors if the study clearly stated that data on handedness and depression had been collected but did not report them in a way that
allowed for data extraction (e.g., data only presented in graphs). Study selection was conducted by CCS and JS and concluded in August 2020. Details about the study selection are shown in Fig. 1. Data extraction was conducted by CCS, LP, and evaluated by JP. Interrater reliability was at 91.8%. Disagreements were resolved by discussion. Study selection was in agreement with the PRISMA guidelines on reporting items for systematic reviews (Moher et al., 2009).

### 2.2. Inclusion and exclusion criteria

This study used the following criteria to determine in- or exclusion of datasets:

1. **Participants**: participants of all ages were included into the meta-analysis. Datasets were classified as child cohorts if the participants’ age ranged between 0 and 17 years and classified as adult cohorts if the participants’ ages were 18 years or above. If the cohort consisted both of children and adults ($k = 8$ studies), they

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**Fig. 1.** Flow diagram of the search and inclusion criteria. The procedures were followed in accordance with the PRISMA guidelines for systematic reviews and meta-analyses (Moher et al., 2009). A complete list of all included studies and additional study information can be found in Supplementary Table 1.
were excluded from the moderator analysis comparing child and adult cohorts (see below).

(2) Studies had to report at least one patient group and a corresponding control group.

(3) Publication language: articles included in the present meta-analysis had to be written either in English, German, Greek or French (all articles finally included in the study were written in English however).

(4) Handedness report: studies were included if handedness prevalence was clearly stated or could be recovered by contacting the authors. Studies reporting only lateralization quotients or p-values were excluded.

(5) Pre-selection based on handedness: studies were excluded if the sample was pre-selected to solely contain left- or right-handed individuals or if the sample purposefully balanced the number of left- and right-handed participants.

A total of \( k = 87 \) studies were eligible for statistical analysis after applying the inclusion and exclusion criteria. All included articles could be found on Google Scholar, 17 duplicates were found on PubMed and no included studies were found on Web of Science.

2.3. Statistical analysis

Meta-analysis was performed using the R package metafor (Viechtbauer, 2010). Random effect models were used as they acknowledge differences in research designs and data collection approaches. The following protocol was followed in the analyses:

(1) For each study, we derived patient-control odds ratios (ORs) for left-, mixed- and non-right-handedness. ORs indicate whether or not there is a difference between two groups, with a value of 1 representing no difference. In this case, ORs > 1 indicated a higher prevalence of atypical handedness in patient groups compared to controls. Meta-analysis was performed on the ORs using random effect models.

(2) Each grouping (left-, mixed- and non-right-handedness) was tested for homogeneity using the homogeneity statistic Q, and the I2 index reflecting the variance explained by heterogeneity across studies. The I2 index can be described as low, moderate, and high, when close to 25%, 50%, and 75%, respectively (Higgins et al., 2003). Additionally, the Tau2 index was computed to specify if there was variance between studies.

(3) The funnel plot (funnel() function) was visually inspected to identify small study bias. Furthermore, we used Egger’s regression test (regtest() function) to provide a quantitative estimate of the asymmetry of the funnel plot. Finally, the trim and fill method (trimfill() function) (Duval and Tweedie, 2000) was used to make the funnel plot symmetrical by omitting and/or adding hypothetical data points due to an asymmetrical distribution.

(4) Moderator analyses were conducted for all moderator variables using the Non-Right/Right classification from all included studies. The Non-Right/Right classification was chosen to maximize the sample size as it was the most inclusive classification system.

2.4. Moderator analyses

(1) Sex ratio: Sex effects are well established in handedness research with males showing increased rates of left-handedness compared to females (Papadatou-Pastou et al., 2008). These effects were investigated through the ratio of males to females in the study as a proxy. Almost no study reported handedness broken down by sex precluding a direct comparison of males and females.

(2) Age: We included the moderators “mean age”, “age group” (< 18, 18 – 30, 31 – 50, 51 – 70, > 70; based on mean age) and “children vs. adults” (< 18 vs. > 18; based on mean age) since handedness has been associated with age (Papadatou-Pastou et al., 2020).

(3) Handedness classification: We included three classification systems (Left-Mixed-Right (L-M-R), Left-Right (L-R), and Non-Right/Right (NR-R)) to identify the effect of a conservative or liberal classification of handedness.

(4) Year of publication: Higher prevalences of left-handedness have been shown in more recent studies compared to very early studies (Papadatou-Pastou et al., 2020). We therefore included year of publication as a moderator.

(5) Patient studies vs. cohort studies: We additionally tested whether ORs differ between studies conducted in clinically diagnosed patients and cohort studies, performed in student or general population samples (e.g., Denny (2009)).

We did not include known moderators of handedness such as ancestry or cultural background as the majority of studies were conducted in Western societies with European ancestry. Moreover, we did not include specific diagnoses as moderator, as the majority of studies included patients diagnosed with Major Depression.

2.5. Data availability

All data and analysis codes are made available in the OSF project “Meta-analysis on handedness and depression” under the link: https://osf.io/xx2ew/.

3. Results

We first tested whether there was a difference in left-, mixed-, or non-right-handedness between patient and control samples, i.e., whether ORs were different from 1. The overall sample included \( k = 87 \) studies totaling \( n = 35,501 \) individuals (\( n_{\text{depression}} = 9,801; n_{\text{control}} = 25,700 \)). Study details are presented in Supplementary Table 1.

Meta-analysis 1: Left-handedness. Among the 87 studies, \( k = 59 \) reported data on left-handedness, totaling \( n = 33,092 \) individuals (\( n_{\text{depression}} = 8,814; n_{\text{control}} = 24,278 \)). The left-handedness OR was estimated to be 1.04 (95% CI = [0.95, 1.15], \( z = 0.87, p = .383 \), Figure S1). There was no evidence for heterogeneity among the studies (\( Q = 35.85, p = .990, I^2 = 0.00\), Tau2 = 0.00). Neither Egger’s regression test for funnel plot asymmetry (\( z = -1.30, p = .195 \)) nor visual inspection of the funnel plot (Fig. 2A) revealed any evidence for small study bias. However, according to the trim and fill test, eight studies (SE = 5.02) would need to be imputed to the right of the mean for the funnel plot to be symmetrical. The resulting adjusted OR was 1.06 (95% CI = [0.96, 1.17], \( z = 1.22, p = .221 \)), also suggesting absence of small study bias.

Meta-analysis 2: Mixed-handedness. Only \( k = 12 \) studies reported data on mixed-handedness, totaling \( n = 1,838 \) individuals (\( n_{\text{depression}} = 428; n_{\text{control}} = 1,410 \)). The mixed-handedness OR was estimated to be 1.64 (95% CI = [0.98, 2.74], \( z = 1.88, p = .060 \), Figure S2). There was no evidence for heterogeneity among the studies (\( Q = 6.71, p = .822, I^2 = 0.00\), Tau2 = 0.00). Neither Egger’s regression test for funnel plot asymmetry (\( z = -0.93, p = .350 \)) nor visual inspection of the funnel plot (Fig. 2B) revealed any evidence for small study bias. However, according to the trim and fill test, three studies (SE = 2.36) would need to be imputed to the right of the mean for the funnel plot to be symmetrical. The resulting adjusted OR was 1.90 (95% CI = [1.16, 3.12], \( z = 2.54, p = .011 \)).

Meta-analysis 3: Non-right-handed. In total, \( k = 82 \) studies reported data on non-right-handedness, totaling \( n = 35,095 \) individuals (\( n_{\text{depression}} = 9,581; n_{\text{control}} = 25,514 \)). The non-right-handedness OR was estimated to be 1.05 (95% CI = [0.96, 1.15], \( z = -1.02, p = .309 \), Figure S3). There was no evidence for heterogeneity among the studies (\( Q = 54.12, p = .991, I^2 = 0.00\), Tau2 = 0.00). Neither Egger’s regression test for funnel plot asymmetry (\( z = -1.43, p = .152 \)) nor visual inspection of the funnel plot (Fig. 2C) revealed any evidence for small
study bias. However, according to the trim and fill test, 11 studies (SE = 5.90) would need to be imputed to the right of the mean for the funnel plot to be symmetrical. The resulting adjusted OR was 1.07 (95% CI = [0.98, 1.17], \( z = 1.53, p = .125 \)), again suggesting absence of small study bias. With an overall sample size of \( n = 27,482 \) participants (\( n_{\text{depressed}} = 6,549, n_{\text{control}} = 20,933 \)), the study by Denny (2009) contributed the most participants to the overall sample. In accordance with Richards et al. (2021), we reran meta-analyses 1 and 3 (as Denny (2009) did not provide data on mixed-handedness) excluding this study. The left-handedness OR was estimated to be 0.98 (95% CI = [0.79, 1.21], \( z = -0.18, p = .857 \)) and the non-right-handedness OR was estimated to be

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**Fig. 2.** Funnel plots of standard errors on logit OR. No asymmetries in the funnel plots could be detected for (A) left-handedness, (B) mixed-handedness and (C) non-right-handedness, indicating that there was no small study bias.
1.05 (95% CI = [0.96, 1.15], z = 1.02, p = .991), suggesting that the study results obtained by Denny (2009) did not substantially affect the overall result pattern.

3.1. Moderator variable analysis

We performed moderator analyses in the Non-Right/Right classification as this was the most inclusive (k = 82 studies overall).

3.2. Sex ratio

Sex ratio was extracted from k = 81 studies. There was no evidence for a moderating effect of sex ratio on non-right-handedness OR (Q(1) = 0.92, p = .337).

3.3. Mean age

Mean age was extracted from k = 66 studies. There was no evidence for a moderating effect of mean age on non-right-handedness OR (Q(1) = 0.902, p = .964).

3.4. Age group

Age group was extracted from k = 77 studies (< 18: 7 studies, 18 – 30: 10 studies, 31 – 50: 45 studies, 51 – 70: 11 studies, > 70: 4 studies). There was no evidence for a moderating effect of age group on non-right-handedness OR (Q(4) = 3.82, p = .431).

3.5. Children vs. adults

Children vs. adults was extracted from k = 79 studies (children: 7 studies, adults: 72 studies). There was no evidence for a moderating effect on non-right-handedness OR (Q(1) = 0.92, p = .339).

3.6. Handedness classification

Handedness classification was extracted from k = 78 studies (L-M-R: 10 studies, L-R: 42 studies, R-NR: 26 studies). There was a trend towards a moderating effect on non-right-handedness OR (Q(2) = 5.07, p = .079). Compared to the L-M-R classification (OR = 1.51, 95% CI = [1.08, 2.12], z = 2.39, p < .05), the non-right-handed OR was reduced in the L-R classification (OR = 1.02, 95% CI = [0.92, 1.13], z_{diff} = -2.18, p_{diff} < .05). In the R-NR classification, the OR did not significantly differ from the L-M-R classification (OR = 0.96, 95% CI = [0.69, 1.31], z_{diff} = -1.93, p_{diff} = .053).

3.7. Year of publication

Year of publication was extracted from k = 82 studies. There was no evidence for a moderating effect of publication year on non-right-handedness OR (Q(1) = 2.53, p = .112).

3.8. Patient studies vs. cohort studies

This moderator was extracted from k = 74 studies (k = 6 cohort studies and k = 68 patient studies). There was no evidence for a moderating effect of patient studies vs cohort studies on non-right-handedness OR (Q(1) = 1.60, p = .206).

4. Discussion

In the present study, we investigated the relationship between depression and handedness on a meta-analytical level as these variables have been associated in previous research, but only within the scope of individual studies. To assess possible differences in the prevalence of atypical handedness between depression and healthy samples, we determined ORs between groups diagnosed with depression and their respective control groups. We found no evidence of increased left-, mixed-, or non-right-handedness in individuals with depression compared to healthy controls. Furthermore, there was no evidence for a moderating effect of any variable on patient-to-control ORs.

In contrast to previous studies on the association between depression and handedness (e.g., Elias et al., 2001; Overby III, 1994), we did not find increased rates of left- or mixed-handedness in depressed compared to control samples. This finding is especially striking given its contrast to the study conducted by Denny (2009) who investigated a large sample of 27,482 individuals and found a small effect of increased risk for depression in left-handed individuals. The discrepancy in the results highlights the importance of conducting meta-analyses in addition to large-scale data collections. A potential reason explaining the difference between our and Denny’s findings could relate to sampling biases. Denny (2009) solely studied non-clinically diagnosed individuals, similar to most other studies reporting effects on the distribution of altered handedness in depression (Elias et al., 2001; Overby III, 1994). In these studies, questionnaires were used to determine whether an individual was classified as depressed or non-depressed, but no proper clinical assessment was conducted. Since other individual studies found decreased rates of left-handedness in patients compared to controls (Moscovich et al., 1981), the heterogeneity of results in the literature can be potentially explained by underpowered studies and/or sampling errors. We should note that there was a trend in the mixed-handedness analysis that even reached significance when hypothetical studies were imputed. This result could indicate that future research might discover a significant link between increased rates of mixed-handedness and depression. However, even if this association becomes robust in future research, it is likely of a very small effect size.

Our null finding about the association between handedness and depression fits well into recent large-scale investigations on the link between functional and structural brain asymmetries and depression. A meta-analysis in 1883 patients and 2161 controls investigated frontal alpha power asymmetries as a diagnostic marker and found that this functional asymmetry was of no diagnostic value (van der Vinne et al., 2017). For structural asymmetries, de Kovel et al. (2019) investigated both subcortical volume and cortical thickness as well as surface area in a sample of 2540 individuals with MDD and 4230 healthy controls. Not a single effect for any evaluated parameter exceeded a threshold of Cohen’s d > 0.1 which would be equal to at least a small effect (Cohen, 2013). Thus, any possible association of depression with brain asymmetries seems to be exceedingly small, if existent at all.

Since we could not demonstrate a relationship between depression and atypical handedness, the question remains why there is evidence that other disorders such as dyslexia (Vlachos et al., 2013), autism spectrum disorders (Markou et al., 2017) and schizophrenia (Sommer et al., 2001) show altered levels of left- and/or mixed-handedness. While most findings on depression point towards no association with language lateralization (Bruder et al., 1989; Hugdahl et al., 2003), changes in language lateralization seem to be present in all of these disorders (Heim et al., 2004; Ocklenburg et al., 2013; Pearson and Hodgetts, 2004) even though the literature has also pointed otherwise in the case of schizophrenia (Sommer et al., 2001). Interestingly, Papadatou-Pastou and Safar (2016) found that increased rates of atypical handedness in deaf individuals were present when handedness was measured using manipulative actions but not when it was measured using sign actions. Moreover, the authors suggested that deaf individuals who acquired language (either sign or spoken) at a later age are those who present with increased rates of atypical handedness. A possible reason could be that increased rates of left- and/or mixed-handedness seem to be specifically associated with conditions related to impaired language-related abilities (Papadatou-Pastou et al., 2019). This is in line with the finding that higher genetic risk for ADHD and genetic liability towards lower intelligence and educational years have been associated with reduced language-related skills (Verhof et al., 2019) and left-handedness, while...
there is no association between handedness and genetic factors involved in bipolar disorder (Schmitz et al., 2021). The null result in depression disorders for altered distributions of atypical handedness could thus be related to depression not affecting language acquisition and/or language lateralization. It should be noted however that handedness and language lateralization have recently been demonstrated to be less associated than previously thought (Packheiser et al., 2020) calling into question whether there is a strong association between language lateralization and handedness.

The present study is subject to limitations that should be addressed. First, our study specifically measured only hand preference and not hand skill because hand preference was the only reported variable in almost all studies. These two concepts have however been suggested to be lateralized independently (Triggs et al., 2000) despite them being moderately to strongly correlated (Todor and Doane, 1977). Future studies will need to investigate differences in lateralization of hand skill in patients compared to healthy controls. Second, a major factor that is indicated in the literature is the role of sex in handedness (Papadatou-Pastou et al., 2009). In this study, we used sex ratios as moderators as almost no study broke down handedness in depressed and healthy individuals by sex. Thus, a direct comparison between males and females could only be approximated. We urge researchers for that reason to upload raw data sets in Open Science formats to allow for a more fine-grained evaluation of their data. Finally, the large majority of our studies comprised patients diagnosed with Major Depression with only a small subset of patients suffering from for example bipolar disorders preventing a meaningful analysis of diagnosis as moderator. The possibility therefore remains that our null findings are specific for Major Depression. Similarly, while we recorded comorbidities, they were too diverse for meaningful moderator analysis. Since many psychiatric and neurodevelopmental disorders are associated with atypical brain asymmetries, it cannot be excluded that some of these comorbidities slightly influenced the results.

In conclusion, we found no effect that atypical handedness is increased in individuals who suffer from depression compared to healthy controls. Considering that large-scale meta-analyses found no structural and functional alterations in hemispheric asymmetries in depressed individuals, this result is well in line with recent discoveries about the impact of depression on brain lateralization or vice versa. In the future, it would be interesting to specifically investigate the association between language lateralization and depression in larger samples to further determine if there is no link between depression and atypical lateralization patterns.

Declaration of Competing Interest

The authors declare no conflict of interest.

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Supplementary materials


References


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