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Anxiety disorders, depression and incontinence in preschool children—A population-based study

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Abstract

Objective: The aim was to examine associations of specific anxiety disorders, depressive symptoms, and incontinence in a representative, population-based sample of preschool children.

Methods: All preschool children of a defined geographical area examined before school-entry were included. Parents completed a questionnaire including the Preschool Feelings Checklist (PFC), eight questions referring to nocturnal enuresis (NE), daytime urinary incontinence (DUI), fecal incontinence (FI) and constipation, and 30 items regarding Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition (DSM-5) diagnostic criteria of separation anxiety disorder (SAD), social phobia (SOC), specific phobia (PHOB), and generalized anxiety disorder (GAD). Data of 1206 children (mean age = 5.7 years; 53.5% boys) are presented.

Results: 34.6% of incontinent children had an anxiety disorder based on DSM-5 criteria and 13.3% had clinically relevant depressive symptoms (measured by the PFC). Rates of incontinence overall were 14.1% (11.9% NE, 3.1% DUI, and 1.8% FI) and 6.3% for constipation. Rates of SOC and PHOB were increased in NE (20.8% and 25.4%), DUI (39.3% and 34.5%) and FI (35.3% and 50.0%) compared to continent children (13.5% and 17.2%). Children with constipation had higher rates of SOC, PHOB, and GAD than those without. Compared to continent children (9.7%), depressive symptoms were more frequent in children with NE (26.8%), DUI (50.0%), and FI (61.9%).

Conclusion: Anxiety disorders and depressive symptoms are common in children with incontinence. The most specific DSM-5 disorders associated with incontinence are SOC and PHOB, which can be incapacitating and may require treatment. Due

Abbreviations: DSM-5, Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition; DUI, daytime urinary incontinence; FI, fecal incontinence; GAD, generalized anxiety disorder; ICCS, International Children's Continence Society; NE, nocturnal enuresis; PFC, Preschool Feelings Checklist; PHOB, specific phobia; SAD, separation anxiety disorder; SOC, social phobia.

to the high rates of anxiety disorders, it is important to screen all children with incontinence, for example, with specific questionnaires.

KEYWORDS

anxiety disorders, depression, enuresis, incontinence, preschool children

1 | INTRODUCTION

Anxiety disorders belong to the most common psychiatric disorders in children and adolescents. In a representative, nationwide German cohort study (BELLA), 14% of 7- to 10-year-old children and 9.9% of 11- to 17-year-old adolescents were affected by clinically relevant anxiety symptoms.[1] In preschool age, population-based studies show prevalences of 1.5%–22.2% for any anxiety disorder.[2–5] The most common anxiety disorders in preschool age are separation anxiety disorder (SAD), social phobia (SOC), specific phobia (PHOB), and generalized anxiety disorder (GAD). Reported prevalences are 0.3%–7.0% for SAD, 0.5%–10.7% for SOC, 0.7%–9.8% for PHOB, and 0.6%–6.5% for GAD.[2–6]

According to the Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition (DSM-5), anxiety disorders are defined by an inappropriate and excessive fear or distress about a specific object (e.g., dogs and spiders in PHOB) or situation (e.g., separation from parent in SAD and social interactions in SOC), which can lead to physiological reactions (e.g., sweating, crying, and stomachaches) and avoidance behavior. In GAD, anxiety about a variety of events is accompanied by exaggerated worry and somatic reactions (restlessness, irritability, and sleep disturbances).[7] The Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood (DC: 0–5) specifies diagnostic criteria for young children in detail.[8] The minimum age for a diagnosis is 24 months for SAD and SOC and 36 months for GAD.[8] Despite their high prevalence, anxiety disorders are often overlooked in young children. Also, young children with behavioral and emotional disorders are less likely to be referred to mental health services than school-aged children.[9]

Anxiety disorders are not only highly comorbid with each other, but also with further internalizing symptoms such as depression. Depression in preschool age is difficult to diagnose as the symptoms differ from depression in older children or adults.[10] In population-based samples, prevalence of depression in preschool children is 0.3%–2.1%.[2,3,5,6] When measuring clinically relevant depressive symptoms with age-appropriate questionnaires, for example, the Preschool Feelings Checklist (PFC), rates of 5.7% are reported.[11,12]

Functional, nonorganic incontinence includes nighttime wetting (nocturnal enuresis [NE]), daytime wetting (daytime urinary incontinence [DUI]), and soiling (fecal incontinence [FI]) and is diagnosed according to ROME-IV and ICCS (International Children's Continence Society) criteria. NE and DUI are diagnosed in children from 5 years of age onwards, FI in children from 4 years onwards; in all cases, symptoms must occur at least 1×/month and organic causes have to be excluded.[13,14] Prevalence of incontinence in 5- to 6-year-old children is about 9%–10% for NE, 2%–3% for DUI, and 1%–1.5% for FI.[15,16] Constipation can be already diagnosed in infants that show typical symptoms, for example, two or fewer defecations/week, stool retention, and painful/hard bowel movements.[13,17] Prevalence of constipation in children 4 years or older is 9.6%.[18]

There is limited evidence that incontinence and internalizing disorders co-occur, but only a few studies have addressed anxiety disorders specifically. Symptoms of anxiety disorders in 7- to 9-year-old children with incontinence were significantly higher than in those without, showing rates of 8%–14% for NE, 7%–11% for DU, and 15%–22% for FI.[19–21] The same studies report a depression rate of 14%–21% in children with incontinence. In preschool children, 14%–20% of the children with incontinence show clinically relevant anxious-depressed symptoms versus 12% of the continent children.[16]

The aim of this study was to assess specific associations between anxiety disorders (SAD, SOC, PHOB, and GAD), depressive symptoms and incontinence (NE, DUI, and FI), and constipation in a representative population-based sample of preschool children.

2 | MATERIALS AND METHODS

All children of a defined geographical area (Regionalverband Saarbrücken, Germany) who presented for the mandatory examination before school-entry between January 2018 and May 2019 were included ($N = 2730$) (inclusion criteria). There were no exclusion criteria. A parental questionnaire was sent with the invitation letter

before the examination. Following informed consent, parents were asked to complete the questionnaire and hand it out in a sealed envelope to the community pediatricians who performed the school-entry examination. The study was approved by the local ethics committee. Complete questionnaires of 1206 children were returned.

The parental questionnaire contained 59 items, including five general questions (who filled out the questionnaire, age, gender, weight, and height of the child). Further, eight questions referred to the presence and rate of NE, DUI, FI, and constipation according to the ICCS and DSM-5 criteria.[7,14] Incontinence was diagnosed in children aged 5 years (4 years regarding FI, respectively) or older if it occurred at least once per month. Constipation was diagnosed when parents answered with "yes" or when the child had two or fewer bowel movements/week.

Anxiety disorders were assessed by 30 items from the parental DISYPS-III questionnaire on anxiety (FBB-ANG).[22] The FBB-ANG includes the DSM-5 diagnostic criteria of SAD (10 items), SOC (7 items), PHOB (6 items), and GAD (7 items). Parents rate on a 4-point Likert scale how often each symptom affects their child (0 = *never*, 1 = *somewhat*, 2 = *widely*, 3 = *highly*). Sum scores were calculated for each scale (SAD, SOC, PHOB, and GAD). According to norms for 4-, 0- to 6-, and 11-year-old children, scores were converted to percentile ranks, which were regarded as clinically significant when ≥90th percentile.[22]

The 16 items of PFC assess depressive symptoms in preschool children.[11,12] Parents answer in a "yes"/"no" format. "Yes" is rated with 1 and "no" with 0. A sum score ≥3 indicates clinically relevant depressive symptoms. The psychometric properties, that is, internal consistency (Cronbach's $\alpha = 0.77$) and validity, are good.

Statistical analyses were performed with IBM SPSS Statistics 23. Group differences for categorical variables were calculated by χ^2 tests and Fisher's Exact tests. Analyses of variances (ANOVAs) and regression analysis were for parametric data. Results were regarded as significant with $p < 0.05$.

3 | RESULTS

The final sample included 1206 children aged 4.4–7.8 years (mean age = 5.7 years, SD = 0.44). Four hundred ninety-seven (46.5%) were girls, 571 (53.5%) were boys, and in 138 cases, sex was not reported. Age was missing in 48 cases.

Table 1 shows the total rates and differences between boys and girls of incontinence, anxiety disorders, and clinically relevant depressive symptoms. 14.1% of the total sample had incontinence overall. NE was reported in 11.9%, DUI in 3.1% and FI in 1.8%, and constipation in 6.3%, respectively. Boys were more often affected by incontinence overall, NE, and constipation (Table 1). 34.6% of all children met the criteria for any DSM-5 anxiety disorder, with PHOBs being the most common

TABLE 1 Descriptive data on age, incontinence, anxiety disorders, and depressive symptoms in total sample, girls and boys

	Total ($N = 1206$)[a]	Girls ($N = 497$)	Boys ($N = 571$)	p Value[b]	OR (95% CI) (boys/girls)
Mean age in years (SD)	5.7 (0.44)	5.7 (0.43)	5.7 (0.44)	0.90	
Any incontinence, % (n)	14.1 (161/1140)	10.7 (51/476)	16.7 (90/538)	0.006**	1.68 (1.16–2.42)
Nocturnal enuresis, % (n)	11.9 (138/1156)	8.1 (39/482)	15.4 (84/546)	<0.001***	2.07 (1.38–3.09)
Daytime urinary incontinence, % (n)	3.1 (36/1177)	2.1 (10/485)	3.4 (19/559)	0.20	
Fecal incontinence, % (n)	1.8 (21/1177)	1.4 (7/488)	2.0 (11/558)	0.51	
Constipation, % (n)	6.3 (74/1180)	3.9 (19/488)	6.8 (38/560)	0.04*	1.80 (1.02–3.16)
Any anxiety disorder, % (n)	34.6 (364/1052)	26.8 (131/489)	41.4 (233/563)	<0.001***	1.93 (1.49–2.51)
Separation anxiety, % (n)	10.2 (108/1062)	13.4 (66/494)	7.4 (42/568)	0.001**	0.52 (0.34–0.78)
Social phobia, % (n)	15.1 (159/1052)	7.7 (38/492)	21.6 (121/560)	<0.001***	3.29 (2.24–4.85)
Specific phobia, % (n)	18.8 (98/1056)	11.0 (54/492)	25.5 (144/564)	<0.001***	2.78 (1.98–3.91)
Generalized anxiety, % (n)	10.4 (110/1056)	10.2 (50/491)	10.6 (60/565)	0.82	
Clinical depressive symptoms, % (n)[c]	13.2 (158/1198)	11.9 (59/495)	12.9 (73/566)	0.63	

Abbreviations: CI, confidence interval; OR, odds ratio.

[a]Due to missing data, rates could not be calculated in all cases. The denominator reports the number of cases available for calculation.

[b]χ^2 tests; significant results are outlined with asterisks (*p<0.05; **p< 0.01; ***p < 0.001).

[c]Sum score ≥3 in Preschool Feelings Checklist.

reported disorder (18.8%), followed by SOC (15.1%), GAD (10.4%), and SAD (10.2%). Rates of SOC, PHOB, and anxiety disorders overall were significantly higher in boys than in girls, whereas girls were more often affected by SAD. 13.3% of the children had clinically relevant depressive symptoms with no sex difference (Table 1).

Anxiety disorders and depressive symptoms in children with and without incontinence are shown in Table 2. Both, anxiety disorders (46% vs. 32%) and clinical depressive symptoms (29% vs. 10%) were more common in children with incontinence than in those without. Children with incontinence had significantly higher rates of SAD, SOC, and PHOB, but not GAD, than the continent children (Table 2).

In Table 3, differences in rates of anxiety disorders and depressive symptoms between specific subtypes of incontinence (NE, DUI, and FI) and continent children ($n = 979$) are listed. Compared to continent children, rates of anxiety disorders were significantly higher in all subtypes of incontinence, with increasing rates from 44.6% in NE, 62.1% in DUI, and 72.2% in FI. Especially PHOB and SOC rates are significantly higher in children with NE, DUI, and FI, but no increase in rates is found for separation anxiety and GAD.

Clinically relevant depressive symptoms were reported in 26.8% of children with NE, in 50% of children with DUI, and in 61.9% of children with FI, compared to only 9.7% in continent children.

Table 4 shows differences in rates of anxiety disorders and depressive symptoms between children with or without constipation. All anxiety disorders (except for separation anxiety) were significantly more common in children with constipation. Also, clinical depressive symptoms were higher in children with constipation in contrast to those without (39.2% vs. 11.4%).

TABLE 2 Anxiety disorders and depressive symptoms in children with or without incontinence

	Incontinence ($N = 161$)	Continence ($N = 979$)	p Value[a]	OR (95% CI) (inc./cont.)
Any anxiety disorder, % (n)	46.0 (64/139)	32.2 (279/867)	0.001***	1.80 (1.25–2.59)
Separation anxiety, % (n)	15.0 (21/140)	9.2 (80/870)	0.03*	1.74 (1.04–2.93)
Social phobia, % (n)	22.5 (31/138)	13.5 (117/867)	0.006**	1.86 (1.19–2.90)
Specific phobia, % (n)	25.0 (35/140)	17.2 (150/872)	0.03*	1.60 (1.05–2.44)
Generalized anxiety, % (n)	12.9 (18/139)	9.7 (84/867)	0.24	
Clinical depressive symptoms, % (n)[b]	29.2 (47/161)	9.6 (94/979)	<0.001***	3.88 (2.60–5.80)

Abbreviations: CI, confidence interval; cont., continence; inc., incontinence; OR, odds ratio.

[a]χ^2 tests; significant results are outlined with asterisks (*p<0.05; **p< 0.01; ***p < 0.001).

[b]Sum score ≥3 in Preschool Feelings Checklist.

TABLE 3 Anxiety disorders and depressive symptoms in different types of incontinence

	NE ($N = 138$)	DUI ($N = 36$)	FI ($N = 21$)	Continence ($N = 979$)
Any anxiety disorder, % (n)	**44.6 (54/121)****	**62.1 (18/29)****	**72.2 (13/18)*****	32.2 (279/867)
Separation anxiety, % (n)	14.8 (18/122)	17.2 (5/29)[a]	16.7 (3/18)[a]	9.2 (80/870)
Social phobia, % (n)	**20.8 (25/120)****	**39.3 (11/28)**[a],****	**35.3 (6/17)**[a],**	13.5 (117/867)
Specific phobia, % (n)	**25.4 (31/122)***	**34.5 (10/29)***	**50.0 (9/18)**[a],****	17.2 (150/872)
Generalized anxiety, % (n)	11.5 (14/122)	17.9 (5/28)[a]	16.7 (3/18)[a]	9.7 (84/867)
Clinical depressive symptoms, % (n)[b]	**26.8 (37/138)*****	**50.0 (18/36)**[a],*****	**61.9 (13/21)**[a],*****	9.6 (94/979)

Note: Each group (NE, DUI, and FI) was tested against the continent group regarding rates of anxiety and depressive symptoms (χ^2 tests), significant results are outlined in bold (*p<0.05; **p< 0.01; ***p < 0.001).

Abbreviations: DUI, daytime urinary incontinence; FI, fecal incontinence NE, nocturnal enuresis.

[a]Fisher's Exact tests.

[b]Sum score ≥3 in Preschool Feelings Checklist.

TABLE 4 Anxiety disorders and depressive symptoms in children with or without constipation

	Constipation ($N = 74$)	No constipation ($N = 1180$)	p Value[a]	OR (95% CI) (const./no const.)
Any anxiety disorder, % (n)	57.9 (33/57)	33.0 (324/981)	<0.001***	2.78 (1.62–4.80)
Separation anxiety, % (n)	10.5 (6/57)	10.1 (100/987)	0.92	
Social phobia, % (n)	28.6 (16/56)	14.4 (141/980)	0.004**	2.38 (1.30–4.37)
Specific phobia, % (n)	36.8 (21/57)	17.7 (175/987)	<0.001***	2.71 (1.54–4.75)
Generalized anxiety, % (n)	21.1 (12/57)	9.9 (97/983)	0.007**	2.44 (1.25–4.76)
Clinical depressive symptoms, % (n)[b]	39.2 (29/74)	11.3 (125/1106)	<0.001***	5.06 (3.06–8.36)

Abbreviations: CI, confidence interval; Const., constipation; OR, odds ratio.

[a]χ^2 tests, significant results are outlined with asterisks (*p<0.05; **p< 0.01; ***p < 0.001).

[b]Sum score ≥3 in Preschool Feelings Checklist.

TABLE 5 Depressive symptoms in children with different number of anxiety disorders (AD)

	Clinical depressive symptoms, % (n)[a]	Mean PFC score (SD)
No anxiety disorder ($n = 696$)	4.0 (28)	0.4 (0.9)
One anxiety disorder ($n = 228$)	19.3 (44)	1.4 (1.6)
Separation anxiety ($n = 39$)	17.9 (7)	1.4 (1.8)
Social phobia ($n = 65$)	21.5 (14)	1.4 (1.4)
Specific phobia ($n = 100$)	19.9 (19)	1.3 (1.6)
Generalized anxiety ($n = 24$)	16.7 (24)	1.6 (1.9)
≥2 anxiety disorders ($n = 134$)[b]	44.0 (59)	2.9 (2.8)
Separation anxiety + other AD ($n = 69$)	46.4 (32)	3.0 (3.0)
Social phobia + other AD ($n = 93$)	49.5 (46)	3.3 (2.9)
Specific phobia + other AD ($n = 98$)	45.9 (45)	3.0 (2.9)
Generalized anxiety + other AD ($n = 85$)	47.1 (40)	3.1 (2.7)

[a]Sum score ≥3 in Preschool Feelings Checklist (PFC).

[b]Number of cases in subgroups is not distinct.

Associations between anxiety disorders and depressive symptoms are summarized in Table 5. The rate of depressive symptoms differs significantly between children with no anxiety disorder, those with one isolated anxiety disorder, and those with two or more anxiety disorders (4.0% vs. 19.3% vs. 44.0%; $\chi^2 = 178.6$; $df = 2$; $p < 0.001$). Within the group of children with only one anxiety disorder, there was no significant difference between the four different anxiety disorders, neither regarding the rates of clinically relevant depressive symptoms ($\chi^2 = 0.367$; $df = 3$; $p = 0.947$) nor regarding the PFC-score (one-way ANOVA; $F = 0.353$; $df = 3$; $p = 0.787$). In the group of children with two or more anxiety disorders, a multiple regression was calculated to assess which of the four specific anxiety disorders (GAD, SAD, PHOB, and SOC) predict significantly the PFC score. The regression analysis revealed a significant variance explanation ($R^2 = 0.137$; $F = 5.05$; $df = 4$; $p = 0.001$) with SOC ($\beta = 0.371$; $p < 0.001$) and SAD ($\beta = 0.205$; $p = 0.024$) being significant predictors of the PFC score, whereas GAD ($\beta = 0.167$; $p = 0.062$) and PHOB ($\beta = 0.140$; $p = 0.116$) are not.

Supporting Information: Table S1 shows rates of anxiety and depression in children with different frequencies of wetting and soiling (everyday/twice a week or more/once a month or more). Rates of anxiety

and depression are not higher in those children with a more severe type of incontinence, except for depressive symptoms in children with DUI.

4 | DISCUSSION

This is the first study that assessed DSM-5 anxiety disorders and their association with incontinence and depression in a large population-based sample of preschool children. All anxiety disorders and depression already occur in preschool children and rates increase dramatically when children suffer from incontinence or constipation.

The overall rates of incontinence (NE 11.9%, DUI 3.1%, and FI 1.8%) are comparable to the rates of similar population-based samples, also the higher prevalence of NE in boys is confirmed again.[15,16] Boys gain bladder continence during sleep later than girls,[23] which is probably due to genetic factors.[24]

The rate of constipation (6.3%) is slightly lower but comparable to the rates found in a recent meta-analysis (8.6% of boys and 8.9% of girls).[18] Constipation was only assessed by two questions in the present sample and, therefore, could not be diagnosed according to ROME IV criteria. Due to the incomplete definition of constipation, the real prevalence in the sample could possibly be higher. In our sample, boys were more affected in contrast to the other studies with comparable sex distribution, even in young children.[25]

The rates of DSM-5 anxiety disorders overall (34.6%) are remarkably high. In the present study, anxiety disorders were assessed by a parental questionnaire, not by clinical experts or standardized interviews, which could have led to an overestimation of the prevalence. One could speculate that own parental anxiety could have led to an overestimation of anxiety in their children. In a comparative study of a similar design, the rate of anxiety disorders according to the more stringent ICD-10 criteria was 22%.[4]

Despite these caveats, anxiety disorders are among the most common mental disorders in young children—much higher than attention-deficit/hyperactivity disorder or depressive disorders.[26] They have a multifactorial etiology and show a high tendency to persist from the age of 3–6 years without treatment,[5] impacting the lives of children and families.[26] Specific and effective treatments are available, such as cognitive behavioral therapy by variants of the parent–child interaction therapy.[26]

Also, clinically relevant depressive symptoms in this study (13.3%) were higher than in a comparable study (5.7%).[11] One potential explanation for this difference might be that parents and professionals are more sensitized towards internalizing symptoms of their children. A recent analysis of a German health insurance (DAK-Report) showed that especially the prevalence of internalizing disorders increased in children in the last years.[27] However, it remains unclear, if the real prevalence is increasing or if those symptoms are recognized earlier.

In our study, depressive symptoms and anxiety disorders are highly related. The risk of depressive symptoms increased with the number of anxiety disorders in the child. The type of anxiety disorder had only an influence on those children affected by multiple anxiety forms. SOC or SAD, in combination with other anxiety disorders, increased the risk of depressive symptoms. Children with SOC and/or SAD suffer mainly from social incapacitations, for example, they cannot meet or make friends or have social contact with peers; which can lead to withdrawal, low self-esteem, and depressive symptoms. Anxiety and depressive disorders and symptoms frequently co-exist and seem to carry an increased risk for young children. This is supported by a study of 236 5-year-old children, of whom 7.6% had combined anxiety and depression.[28] Those children were more severely incapacitated, had additional comorbid disorders, and had more peer problems. Environmental risk factors such as housing problems and family conflicts were also more common.

With respect to incontinence and anxious-depressed symptoms, the results of Equit et al.[16] were replicated. In our study, all anxiety disorders except for GAD, as well as depressive symptoms, were significantly more prevalent in children with incontinence than in continent children. While manifest disorders have a high tendency to persist, anxious and depressive symptoms in children with incontinence can occur as subclinical symptoms, for example, because of the emotional impact of incontinence, guilt, and shame. These symptoms usually improve after incontinence treatment.[29,30] In contrast, manifest anxiety disorders and major depression can also co-occur as psychiatric comorbidity that need to be treated. In both cases, those symptoms can interfere with incontinence treatment and must be identified.

Compared to the continent children, the risk of depressive symptoms was 2.5 times higher in children with NE, five times higher in those with DUI, and even six times higher in children with FI. The high rates of depressive symptoms in the sample may not only represent manifest depression, but also subclinical symptoms or parental worries and thoughts about their children. Depressive symptoms may develop, for example, as a consequence of incontinence, when children are bullied or rejected by their peers. Many children with

incontinence withdraw from social activities and have low self-esteem,[31] which can easily lead to further depressive symptoms, for example, reluctance to play or having a sad mood. Therefore, it is important to assess these symptoms thoroughly and diagnose childhood depression if necessary, for example, with the help of the diagnostic criteria for the age of 0–5 years (DC: 0–5).[8]

When looking at specific anxiety disorders in the subgroups of incontinence (NE, DUI, and FI), we see significant associations with SOC and PHOB. Those two disorders exemplify the relationship between incontinence and anxiety. Children with SOC try to avoid social situations, for example, playing/talking with other children, having sleepovers, and so forth. One can speculate that children with incontinence will also avoid social situations, out of fear of soil or wetness, being ridiculed or bullied.[32] Consequently, those children may develop a general avoidance of social situations and therefore have a higher risk of SOC.

In PHOB, circumscribed fear is related to objects or situations, for example, animals, height, and needles. Sometimes, young children can develop toilet phobia due to fear of monsters or noises in the bathroom (e.g., the flush).[33] Children, who have had negative experiences associated with toileting (e.g., aversive potty training)[34] could be at a higher risk to develop anxiety regarding toilets and bathrooms, which can increase the prevalence of PHOB.

Neurobiological changes or delays in several brain regions that are found in patients with incontinence and those with anxiety may explain the higher co-occurrence and contribute to the etiology of both disorders. A model of central nervous system involvement in bladder filling and emptying based on functional brain imaging data was proposed by Fowler and Griffiths (2010)[35]: The periaqueductal gray of the brain stem receives afferent signals from the sacral region, and has connections to other brain regions, as the hypothalamus, thalamus, insula, anterior cingulate cortex (ACC), and the PFC. In a diffusion tensor study, microstructure abnormalities and structural changes were found in the brains of children with NE, especially in the thalamus, frontal lobe, the ACC, and the insula.[36] Defects in the PFC and ACC are associated with bladder dysfunctions and urgency.[37] In patients with anxiety disorders, especially social anxiety, neuroimaging studies found changes in the amygdala, ACC, and insula.[38] In children with behavioral inhibition (BI), the risk for anxiety is increased and is associated with connectivity networks, including the ACC, insula, and orbitofrontal cortex.[39] The specific mechanism remains yet unclear, one can hypothesize if increased amygdala responses (as found in anxiety patients) influence other brain regions in the network and provoke bladder and bowel problems, for example, due to higher pelvic floor pressure.[37]

Regarding the subgroups of incontinence, children with FI carry the highest risk for anxiety and depressive symptoms of all incontinent children. This was also revealed in previous studies.[16] These children must be diagnosed in detail and comorbid disorders must be treated concurrently.

The present data did also find a significant association between internalizing disorders and constipation. All anxiety disorder rates except for SAD were higher in children with constipation. These results are in line with other findings showing that children with anxiety disorders have higher rates of functional gastrointestinal disorders (including constipation).[40] In addition, emotional problems at the age of 3 years evoke a 1.25 higher risk of having constipation in school age.[41] Functional constipation carries a genetic disposition and is triggered by somatic, as well as psychological factors, often starting in infancy and toddlerhood.[25] After a painful bowel movement, for example, caused by hard stool due to changes in nutrition intake, children start to withhold stool and avoid defecating, which can lead to chronic constipation.[42] Stressful life events are significantly higher in children with constipation, as well as in those with anxiety disorders,[43] and this could explain the association between anxiety and constipation. Further, constipation can cause anxiety of bowel movements and painful defecation, which leads to avoidance of toileting and finally causes an anxiety disorder.

Child temperament could be a further explanation for the association of anxiety and incontinence in children. Longitudinal studies showed that a difficult temperament was a risk factor for incontinence[44] and for anxiety symptoms.[45] There is also evidence that BI is a precursor of later anxiety disorders, especially SOC. BI is a temperament variant, characterized by consistent avoidance of all novel situations, not just persons as in SOC.[4] Temperament factors were not assessed in the current study but could be a mediating factor between incontinence and anxiety. Anxiety measures are correlated with the functional connectivity of a network, including the ACC, insula, and orbitofrontal cortex, which are also involved in bladder and bowel function.[39] Changes in the connectivity of the network may explain the co-occurrence of temperament, anxiety, and incontinence.

5 | STRENGTHS AND LIMITATIONS

One strength of the study is the population-based sample that allows prevalence estimation and diagnostic criteria-based questionnaires to differentiate between different DSM-5 anxiety disorders in early childhood. Also, a valid

questionnaire for depressive symptoms in preschool age and ICCS criteria for the definition of incontinence were used. Limitations are the cross-sectional study design, which does not allow identifying causal attributions. Further, symptoms were not assessed by clinical experts but by parental questionnaire, which could have led to an overestimation of diagnoses.

6 | CONCLUSION

Anxiety disorders are very common among young children. Specific DSM-5 anxiety disorders can be diagnosed. They are often accompanied by comorbid depressive symptoms. Prevalence of anxiety disorders and depressive symptoms is high in children with incontinence, especially in those with FI. The most specific anxiety disorders for incontinence are SOC and PHOB, which can be incapacitating and require professional treatment. Due to the high rates, it is important to screen all children with incontinence in all settings, for example, with specific questionnaires.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Deidentified individual participant data will not be made available.

ETHICS STATEMENT

The study was approved by the ethics committee of the Saarland Medical Association. All participants and their caregivers were informed and provided written consent before their participation in the survey. The reported study is a survey of a community sample and does not include a health-related intervention.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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