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Youths with Extreme Obesity: A High-Risk Group for Pain and Mental Health Impairments

Hannah Schmidt[a] Ingo Menrath[a] Susanna Wiegand[b] Thomas Reinehr[c] Wieland Kiess[d] Johannes Hebebrand[e] Julia von Schnurbein[f, g] Reinhard W. Holl[h] Rolf Holle[i] André Scherag[j] Martin Wabitsch[f, g] Stephanie Brandt-Heunemann[f, g]

[a]Department of Child and Adolescent Medicine, University Clinic Schleswig-Holstein (UKSH), Lübeck, Germany; [b]Ambulatory Obesity Center, Charité University Hospital Berlin, Berlin, Germany; [c]Vestische Children's Hospital Datteln, University Witten/Herdecke, Witten, Germany; [d]Department of Women and Child Health, Hospital for Children and Adolescents, University of Leipzig, Leipzig, Germany; [e]Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University Hospital Essen, Duisburg, Germany; [f]Division of Pediatric Endocrinology and Diabetes, Department of Pediatrics and Adolescent Medicine, University Medical Center Ulm, Ulm, Germany; [g]Department of Pediatrics and Adolescent Medicine, Ulm University Medical Center, German Center for Child and Adolescent Health (DZKJ), Partner Site Ulm, Ulm, Germany; [h]Institute for Epidemiology and Medical Biometry, CAQM, Ulm University, Ulm, Germany; [i]Faculty of Medicine, Institute of Medical Data Processing, Biometrics and Epidemiology (IBE), Ludwig Maximilian University Munich, Munich, Germany; [j]Institute of Medical Statistics, Computer and Data Sciences, Jena University Hospital, Jena, Germany

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Keywords
Extreme obesity · Youths · Pain · Mental health

Abstract
Introduction: Youths with extreme obesity (body mass index [BMI] ≥40) are at increased risk for physical and mental health impairments. Nevertheless, this patient group has received little attention in research. This study aimed to analyze the pain experience and mental health impairments of youths with extreme obesity compared to those with mild and moderate obesity (BMI = 30–39.9) while also considering potential gender differences. ***Methods:*** Cross-sectional data of 431 obese youths (M = 16.6 years; SD = 2.3; range = 13–25 years; 53.1% female) were analyzed. Of these, 159 (36.8%) youths had extreme obesity. Self-reported sociodemographic data, variables related to back or leg pain, depression, and health-related quality of life (HRQoL) were assessed with standardized questionnaires. Data were analyzed with univariate tests and logistic regression models. ***Results:*** Youths with extreme obesity reported more pain in the last 4 weeks (p = 0.018), increased pain-related impairments in daily life (p = 0.009), more pain-related days of absence (p = 0.030), higher depression scores (p = 0.030),

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Stephanie Brandt-Heunemann and Martin Wabitsch share the last authorship.
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Correspondence to:
Hannah Schmidt, hannah.schmidt@uksh.de
Stephanie Brandt-Heunemann, stephanie.brandt@uniklinik-ulm.de

and reduced HRQoL (p = 0.005) compared to youths with mild and moderate obesity. The association between extreme obesity and pain in the last 4 weeks remained associated after including sociodemographic variables in the regression model. In the subgroup of youth with extreme obesity (n = 159), women (n = 83) reported more pain in the last 4 weeks (p = 0.001), higher depression scores (p < 0.001), and lower HRQoL (p < 0.001) compared to men (n = 76). The association between female gender and pain remained significant in the regression models, even after controlling for sociodemographic variables and depression. ***Conclusion:*** These findings highlight the need for standardized assessments of pain and mental health, particularly in the treatment of female youths with extreme obesity. Upcoming studies should analyze the reciprocal interactions of pain and mental health, since both are important barriers to lifestyle changes and weight loss.
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Introduction

Obesity in emerging adulthood has become a significant public health concern. In Germany, 15% of the adolescents aged 14 to 17 years are overweight, with 7.8% classified as obese [1]. A slightly increased prevalence rate has been observed among young adults. The German Health Update Study (GEDA; N = 23.791) showed that 9.7% of young women and 8.9% of young men aged 18 to 29 years are obese [2]. Once obesity is manifested, there is a high risk of its persistence throughout adulthood [3]. For most patients with obesity, a normal weight is difficult to achieve. Given this increased risk for persistence, increased morbidity and mortality, and high follow-up costs in the health care system, the World Health Organization (WHO) has classified obesity as a chronic disease [4]. In addition to physical comorbidities, obesity is associated with an increased risk for mental health impairments, such as depressive symptoms and reduced health-related quality of life (HRQoL) [5, 6]. Therefore, important therapy goals are a sustainable weight stabilization and adequate treatment of the psychological burden [4].

Extreme Obesity in Adolescence and Young Adulthood: A Public Health Challenge

Following the WHO classification, the obesity grades (OG) for adults can be divided into three groups: OG I (mild obesity, body mass index [BMI]: 30–35 kg/m^2); OG II (moderate obesity, BMI: 35–40 kg/m^2), and OG III (extreme obesity, BMI of at least 40 kg/m^2) [4]. For individuals who have already faced challenges with obesity during childhood, the periods of adolescence and young adulthood are particularly critical periods, as they may contribute to further uncontrolled weight gain [7]. Navigating role transitions, detaching from parents, relating to other life priorities, and balancing autonomy with responsibility are important developmental challenges for youths. These factors could affect adherence to necessary lifestyle changes, such as diet changes and increased physical activity [8, 9]. Among youths with obesity, those with OG III represent a distinct high-risk patient group. Despite the serious long-term consequences for both physical and mental health, this patient group has received little attention in research. In clinical settings, specialized approaches addressing development-specific needs of youths with extreme obesity are lacking.

In general, low-risk conservative interventions focusing on sustainable lifestyle changes are recommended for all patients with obesity [10]. If conservative interventions fail, additional invasive interventions should be considered [10]. In the last years, several pharmacological additional invasive options have been developed, and some have shown promising results [10]. Metabolic bariatric surgery may be indicated in individual cases with multiple comorbidities after the failure of conservative treatments [10]. However, the long-term outcomes of such invasive interventions are not well understood, and additional lifestyle changes remain essential. Therefore, it is of importance to be aware of the risk factors that may interfere with the necessary lifestyle changes and lead to the chronicity of obesity.

Pain: An Important but Little Studied Aspect

A potential factor hindering the implementation of essential lifestyle changes, such as increasing physical activity, is the experience of chronic pain and related impairments in daily life [11]. Due to the high weight of individuals with extreme obesity, the risk of pain is significantly increased compared to peers with a normal weight [12]. This can be attributed to joint overlading, inflammation, misalignment, or other factors [12]. In the long term, chronic pain is strongly associated with an increased risk for limited participation in daily life [13]. Important developmental milestones may be missed because of pain-related absences from school, work, or other important fields of daily life [14, 15]. Once missed, some of these developmental steps cannot be reversed, even in later adulthood [14]. At a public health level, such pain-related absences are associated with high costs for the society. Given the potential impact of pain experience on the management of extreme obesity, implementing

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structured pain assessment is important to address patients' individual needs. However, this is currently not part of the routine treatment structure.

Gender Differences

Another important aspect related to obesity, pain, and psychological burden is the potential for gender differences. In a population of older adults, women with obesity represent a distinct risk group, reporting increased pain intensity and more psychological distress compared to men with obesity [16, 17]. To the best of our knowledge, such potential gender differences have not yet been systematically analyzed in a population of youths with extreme obesity.

Aim of the Study

The aim of this exploratory study was to analyze pain and psychological burden in a high-risk group of youths with extreme obesity under the consideration of potential gender differences. The following hypotheses were tested:

1. Youths with extreme obesity (OG III) report increased pain, elevated depression scores, and lower HRQoL compared to those with mild or moderate obesity (OG I and OG II).
2. In the subgroup of youths with extreme obesity (OG III), females represent a distinct risk group, reporting increased pain, elevated depression scores, and lower HRQoL compared to male youths.

Materials and Methods

Study Design and Procedure

The present study is a secondary analysis of the "Youth with Extreme Obesity" (YES) study. The YES study was a prospective, multicenter study aimed to improve medical care and social support structures for youths with obesity in Germany [18, 19]. A detailed description of the aim and design has been published previously [18, 19]. All participants were enrolled between June 2012 and November 2014 (baseline assessment; T0). Follow-up evaluations were carried out after 6 months (T1) and 12 months (T2). This article focuses solely on the baseline dataset, presenting the recruitment strategy, data assessment, and data analysis.

Recruitment Strategy

Inclusion criteria for participating in the YES study were a BMI of at least 30 kg/m^2, age between 14 and 24 years, and sufficient knowledge of the German language. No further exclusion criteria were defined. More information about the recruitment strategy can be found elsewhere [18, 19]. To reach both treatment-seeking and non-treatment-seeking youths, a combined recruitment strategy across the medical and vocational sector was chosen. The recruitment in the medical sector took place at five medical university hospitals in four regions of Germany (Southern Germany: Ulm; Northern Germany: Berlin; Eastern Germany: Leipzig, and Western Germany: Essen and Datteln). In the vocational sector, eligible participants were recruited by case managers in job centers (see further information in [18, 19]). Interested individuals received information about the study and were invited to an informational session. A total of 431 participants took part in the YES study.

Assessment of the Baseline Data

In the planning of the YES study, the age range spanning from adolescence to young adulthood posed a challenge in selecting appropriate screening instruments. To ensure consistency in data collection and analysis, several screening instruments were chosen that are validated for specific age ranges within the cohort (see "Limitations"). In the present article, we focus on sociodemographic data, anthropometric data, pain, obesity-specific HRQoL, and mental health (depression screening) in the baseline cohort of the YES study (n = 431).

Sociodemographic Data

Participants' gender and age were assessed with standardized single items. Parental education was measured by years of schooling, categorized as follows: low education: ≤9 years; medium education: 10–11 years, and high education: ≥12 years. In our analyses, medium and high parental education were summarized to form a reference group, against which low parental education was compared.

Anthropometric Data

Based on the participant's height and weight, the participant's BMI (kg/m^2) was calculated. Both the height and weight were measured by trained study team members with standardized equipment. Following the WHO classification for adults, participants were divided into three groups (OG I, OG II, and OG III; see Introduction) [4].

Pain

The pain experience of the participants was assessed with one filter item: "In the last 4 weeks, have you experienced back or leg pain? (yes/no)." If participants

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agreed, they were asked to answer additional items on pain-related impairments ("How distressing did you experience your back pain?", "How distressing did you experience your leg pain?") and pain-related impairments in daily life ("How much did the pain interfere with your work/school/leisure time?") on a 5-point Likert scale, ranging from "not at all" to "extremely." In addition, pain-related days of absence were assessed in a free text field.

Depression

Depression was screened with the Beck Depression Inventory II (BDI II) [20], a widely used tool to measure depressive symptoms. It consists of 21 items on a scale ranging from 0 ("not at all") to 3 ("severe"). The total sum score is classified as follows: 0–13 = no or minimal depression, 14–19 = mild depression, 20–28 = moderate depression, and 29–63 = severe depression.

Obesity-Specific HRQoL

The obesity module of the generic "Questionnaire for the assessment of health-related quality of life in children and adolescents – Revised" (KINDL-R) is a disease-specific subscale to measure obesity-specific HRQoL of children and youths with obesity. In total, 12 items can be answered on a 5-point Likert scale from "never" to "all the time." The items are allocated to the subscales "physical well-being," "emotional well-being," "self-esteem," "family," "friends," and "functional aspects" [21]. For statistical analysis, negatively worded items were reversed. Reference values from a representative German sample (n = 3,737, age = 14–17 years) are available as reported by Ravens-Sieberer et al. [21].

Statistical Analyses

Differences in baseline variables between youths with mild and moderate obesity compared to those with extreme obesity were tested with Student's t tests (continuous variables), and Pearson's χ^2 tests, or Fisher's exact tests (categorical variables). Besides, logistic regression models were calculated to assess associations between extreme obesity and pain experience in the last 4 weeks (hypothesis 1) and between extreme obesity and gender (hypothesis 2). In these regression models, we included the following sociodemographic variables as potential confounding variables: participant's age, participant's gender, and parental education. Besides, we have included the participant's depression score (based on the BDI II) as a potential confounding variable, since depression may increase pain perception (e.g., [22]). We report estimated (adjusted) odds ratios with 95% confidence intervals. Besides, Nagelkerke's R^2 was calculated. The significance level was set at $\alpha = 0.05$ (two-sided). As this was a secondary explorative study, we decided against additional adjustments for multiple testing. In addition, we would like to point out that these are correlation tests within the framework of cross-sectional analyses. All statistical analyses were performed with IBM SPSS Statistics 22.

Results

Characteristics of the Sample

Cross-sectional data from 431 youths with obesity (M = 16.6 years; SD = 2.3; 53.1% female) were analyzed. Among these participants, 159 (36.8%) were classified as having extreme obesity (BMI ≥40). Those with extreme obesity compared to mild or moderate obesity (n = 272; BMI = 30–39.9) were older ($p < 0.001$) and reported more often back or leg pain in the last 4 weeks ($p = 0.018$). They also experienced more pain-related impairments at work, school, or leisure time ($p = 0.009$) and had more pain-related days of absence at work or in school ($p = 0.009$). Besides, youths with extreme obesity reported higher levels of depression ($p = 0.030$) and lower obesity-specific HRQoL ($p = 0.005$) compared to those with mild or moderate obesity. The characteristics of the sample are displayed in Table 1.

Extreme Obesity, Pain, and Psychological Burden

In logistic regression models, extreme obesity was associated with pain, even after controlling for gender, age, and parental education (Table 2). However, when additionally adjusting for depression scores, the odds ratio between extreme obesity and pain changed to 1.44 (95% confidence interval: 0.82; 2.56; $p = 0.208$). Across all models, female youths were more likely to experience pain compared to male youths (Table 2).

Gender Differences in a Subgroup of Youths with Extreme Obesity

Before analyzing gender differences in the subgroup of youths with extreme obesity, we first analyzed potential differences in pain, depression scores, and obesity-specific HRQoL between men with mild and moderate obesity versus men with extreme obesity, as well as women with mild and moderate obesity versus women with extreme obesity. In the group of men, we found that men with mild and moderate obesity

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Table 1. Characteristics of the sample

	n	Total sample (*N* = 431)	*n*	Youths with mild and moderate obesity (BMI = 30–39.9; *n* = 272)	*n*	Youths with extreme obesity (BMI ≥40; *n* = 159)	*p* value
Demographic variables							
Age, M (SD)	431	16.6 (2.3)	272	15.9 (1.8)	159	17.7 (2.6)	<0.001
Gender (female), *n* (%)	431	229 (53.1)	272	146 (53.7)	159	83 (52.2)	0.767
Parental education (low), *n* (%)	360	118 (27.4)	233	71 (30.5)	127	47 (37.0)	0.207
Pain variables							
Back or leg pain in the last 4 weeks, *n* (%)	375	241 (57.1)	233	122 (52.4)	142	92 (64.8)	0.018
Pain-related impairments (work/school/leisure time)	240		143		97		
Not at all, *n* (%)		78 (32.5)		45 (31.5)		33 (34.0)	0.009
Few, *n* (%)		71 (29.6)		53 (37.1)		18 (18.6)	
Moderate, *n* (%)		53 (22.1)		30 (21.0)		23 (23.7)	
Much, *n* (%)		35 (14.6)		14 (9.8)		21 (21.6)	
Extreme, *n* (%)		3 (1.3)		1 (0.7)		2 (2.1)	
Pain-related days of absence (work/school) in the last 4 weeks, M (SD)	109	2.1 (4.7)	67	1.3 (3.1)	42	3.3 (6.3)	0.030
Perceived burden because of [. . .]							
(a) [. . .] back pain	216		125		91		
Not at all, *n* (%)		37 (17.1)		26 (20.8)		11 (12.1)	0.585
Few, *n* (%)		71 (32.9)		39 (31.2)		32 (35.2)	
Moderate, *n* (%)		66 (30.6)		37 (29.6)		29 (31.9)	
Much, *n* (%)		31 (14.4)		17 (13.6)		14 (15.4)	
Extreme, *n* (%)		11 (5.1)		6 (4.8)		5 (5.5)	
(b) [. . .] leg pain	210		119		91		
Not at all, *n* (%)		61 (29.0)		37 (31.1)		24 (26.4)	0.847
Few, *n* (%)		57 (27.1)		30 (25.2)		27 (29.7)	
Moderate, *n* (%)		59 (28.1)		35 (29.4)		24 (26.4)	
Much, *n* (%)		24 (11.4)		12 (10.1)		12 (13.2)	
Extreme, *n* (%)		9 (4.3)		5 (4.2)		4 (4.4)	
Mental health							
BDI II, sum score, M (SD)	324	10.3 (9.0)	203	9.5 (8.6)	121	11.7 (9.6)	0.030
Obesity-specific HRQoL, M (SD)	344	60.5 (18.1)	217	62.6 (18.2)	127	56.9 (17.5)	0.005

HRQoL, health-related quality of life; BMI, body mass index; BDI, Beck's Depression Inventory.

compared to those with extreme obesity did not differ in their depression scores ($p = 0.164$) or pain experiences ($p = 0.384$). However, those with extreme obesity reported poorer obesity-specific HRQoL compared to those with mild and moderate obesity ($p = 0.003$). In the group of women, we found that women with mild and moderate obesity compared to those with extreme obesity had higher depression scores ($p = 0.035$) and more often pain ($p = 0.014$) compared to those with mild obesity. There were no significant differences in obesity-specific HRQoL between these groups ($p = 0.204$).

In the subgroup of youths with extreme obesity ($n = 159$), females ($n = 83$) reported more often back and leg pain in the last 4 weeks ($p = 0.001$), had higher depression scores ($p < 0.001$), and exhibited lower obesity-specific HRQoL compared to males ($n = 76$; $p < 0.001$; Table 3). The female gender and pain experience remained significantly associated even after controlling for age, parental education, and depression (Table 4).

Discussion

Youths with extreme obesity are a patient cohort with an increased risk for both physical and mental health impairments. Despite this vulnerability, this patient

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Table 2. Regression models (pain and extreme obesity)

	No pain (0) versus pain (1)		*p* value
	OR	95% CI	
Model 1 (n = 343)			
Extreme obesity (OG III)	1.76	1.07; 2.89	0.027
Gender (female)	2.41	1.54; 3.75	<0.001
Age	0.97	0.87; 1.08	0.537
Low parental education	1.26	0.79; 2.02	0.338
Model 2 (n = 273)			
Extreme obesity (OG III)	1.44	0.82; 2.56	0.208
Gender (female)	1.80	1.07; 3.02	0.027
Age	0.92	0.82; 1.03	0.160
Low parental education	1.60	0.91; 2.78	0.100
Depression, BDI II sum score	1.06	1.02; 1.09	0.001

OR, odds ratio; CI, confidence interval; OG III, obesity grade III; BDI, Beck's Depression Inventory. Nagelkerke's R^2 model 1 = 0.079; model 2 = 0.130. The reference category of the variable "low parental education" is medium to high parental education.

group has received little attention in research and clinical contexts. The present article analyzed the pain experience, impairments related to back or leg pain, and mental health impairments of youths with extreme obesity by considering potential gender-specific differences.

Consistent with our first hypothesis and previous studies [23, 24], we found a positive association between extreme obesity and an increased vulnerability to mental health impairments. In this study, this was evident through increased depression scores and reduced HRQoL. Additionally, we observed that youths with extreme obesity had a higher frequency of pain in the last 4 weeks, surpassing notably even the frequency of those with mild or moderate obesity. We found that 64.8% of those with extreme obesity reported pain in the last 4 weeks. In contrast, the representative German KiGGS study found that 6.8% of boys and 9.6% of girls between 14 and 17 years reported pain at least once a week over a period of 3 months [25]. In the German Health Interview and Examination Survey for Adults (DEGS1), 9% of the young female adults between the ages of 18 and 39 reported a 24-h pain prevalence, while young male adults in the corresponding age range reported a rate of 11.4% [26]. Although in all three studies pain was assessed differently, it seems that youths with extreme obesity experience more pain than their healthy peers. Besides the frequency of pain, we also found that youths with extreme obesity had more pain-related impairments in daily life, along with an increased number of pain-related days of absence compared to those with mild or moderate obesity.

However, we did not find noticeable differences in terms of the perceived burden caused by the pain experience. A plausible explanation might be that our study group is still quite young, suggesting that the impact of pain might manifest more prominently as constraints in daily life during the middle adulthood phase.

Given the cross-sectional nature of our study design, the analysis of potential causal links between the extent of obesity and pain experience remains beyond the scope of this approach. On the one hand, youths with extreme obesity might have more pain as a direct result of the elevated body weight. As an alternative explanation, pain could be a perpetuating factor, contributing to reduced physical exercise and thereby fostering further weight gain. Regardless of considerations in terms of causal links, the increased pain experience has an impact on both the individual and the public health level: on the individual level, pain is an important barrier to the implementation of necessary lifestyle changes. For example, empirical evidence in populations with obesity shows interactions between chronic pain and reduced physical activity, although there is evidence that regular physical activity can reduce the severity and frequency of pain [27]. To improve the adherence for regular physical activity in individuals with obesity and (chronic) pain, it is recommended to implement modifications of the workout routine, such as dividing exercise into multiple sessions instead of a single prolonged session, reducing joint movements, and replacing high-impact exercises with low-impact activities [27]. Besides, individuals with chronic pain are at increased risk for adopting unhealthy nutrition behavior patterns [28]. Besides, pain experience may have a negative effect on the success of the obesity therapy: a previous study shows that patients participating in specialized weight management programs, and experiencing severe pain at baseline, showed less weight loss outcomes at the 1-year follow-up compared to those reporting none-to-mild or moderate pain [29]. On a public health level, pain has implications on a health economic level, primarily directed toward the management of secondary diseases [30]. In addition to the direct costs, high indirect costs arise due to incapacity to work because of illness or premature disability. Associations between side effects of obesity and reduced work capacity were found in previous research, for example, in a comprehensive systematic review of observational studies [31].

In line with our second exploratory hypothesis, women with extreme obesity reported more pain-related

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Table 3. Gender differences among youths with extreme obesity (n = 159)

	N	Total sample	n	Male youths with extreme obesity (n = 76)	n	Female youths with extreme obesity (n = 83)	p value
Pain							
Back or leg pain in the last 4 weeks, n (%)	142	92 (57.9)	68	35 (51.5)	74	57 (77.0)	0.001
Pain-related impairments (work/school/ leisure time)	97		39		58		
Not at all, n (%)		33 (20.8)		19 (48.7)		14 (24.1)	0.055
Few, n (%)		18 (11.3)		7 (17.9)		11 (19.0)	
Moderate, n (%)		23 (14.5)		4 (10.3)		19 (32.8)	
Much, n (%)		21 (13.2)		8 (20.1)		13 (22.4)	
Extreme, n (%)		2 (1.3)		1 (2.6)		1 (1.7)	
Pain-related days of absence (work/ school) in the last 4 weeks, M (SD)	42	3.29 (6.3)	17	3.8 (7.0)	25	3.3 (5.9)	0.689
Perceived burden because of [. . .]							
(a) [. . .] back pain	91		39		52		
Not at all, n (%)		11 (6.9)		8 (20.5)		3 (5.8)	0.610
Few, n (%)		32 (20.1)		16 (41.0)		16 (30.8)	
Moderate, n (%)		29 (18.2)		9 (23.1)		20 (38.5)	
Much, n (%)		14 (8.8)		5 (12.8)		9 (17.3)	
Extreme, n (%)		5 (3.1)		1 (2.6)		4 (7.7)	
(b) [. . .] leg pain	91		38		53		
Not at all, n (%)		24 (15.1)		13 (34.2)		11 (20.8)	0.055
Few, n (%)		27 (17.0)		11 (28.9)		16 (30.2)	
Moderate, n (%)		24 (15.1)		8 (21.1)		16 (30.2)	
Much, n (%)		12 (7.5)		4 (10.5)		8 (15.1)	
Extreme, n (%)		4 (2.5)		2 (5.3)		2 (3.8)	
Mental health							
BDI II, sum score, M (SD)	121	11.7 (9.6)	62	8.7 (6.6)	59	14.9 (11.2)	<0.001
Obesity-specific HRQoL, M (SD)	127	56.9 (17.5)	62	62.9 (15.5)	65	51.3 (17.4)	<0.001

HRQoL, health-related quality of life.

impairments and mental health impairments compared to men with extreme obesity. While not explicitly explored in our study, it is plausible that these gender differences may also appear among individuals with lower levels of obesity. Pain perception is complex and varies greatly among individuals. Using the framework of the biopsychosocial model, several factors may explain those gender differences: (1) Psychological factors or comorbidities, such as depression, can amplify the perception of pain [22]. In our sample, women had higher depression scores compared to men, suggesting potential interactions between depression and pain. (2) Sociocultural factors have a significant role in how individuals perceive and report pain. Societal expectations and gender norms can influence the communication styles to describe pain [32]. Previous research shows that women are more likely to report psychological and psychosomatic symptoms honestly and are more likely to seek medical attention and discuss their health concerns with health care providers than men [32, 33]. Men, on the other hand, may be less inclined to report pain or discomfort until it becomes severe or debilitating [32, 33]. (3) Some biological and medical conditions that cause chronic pain, such as endometriosis, fibromyalgia, and certain autoimmune disorders, are more prevalent in women [34]. Hormonal differences, particularly fluctuations in estrogen and progesterone during the menstrual cycle, can affect pain sensitivity [35]. Nevertheless, findings regarding such potential biological causes of differences in pain perception in men and women are heterogeneous. Therefore, it is important to recognize that these factors interact in complex ways, and not all women or men will fit these general trends. Pain perception is highly individual, and cultural, genetic, and personal factors all contribute to an individual's experience of pain. While women with extreme obesity

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Table 4. Regression models (gender differences in youths with extreme obesity)

	Male youths (0) versus female youths (1)		
	OR	95% CI	*p* value
Model 1 (n = 124)			
Pain	4.08	1.85; 8.97	<0.001
Age	0.94	0.81; 1.10	0.447
Low parental education	1.24	0.57; 2.68	0.593
Model 2 (n = 101)			
Pain	3.08	1.23; 7.76	0.017
Age	0.94	0.79; 1.11	0.458
Low parental education	0.92	0.37; 2.29	0.857
Depression, BDI II sum score	1.08	1.03; 1.14	0.004

OR, odds ratio; CI, confidence interval; BDI, Beck's Depression Inventory. Model 1: Nagelkerke's R^2 = 0.142; Model 2: Nagelkerke's R^2 = 0.251. The reference category of the variable "low parental education" is medium to high parental education.

constitute a specific risk group for both physical and mental health issues, it is crucial to acknowledge that men may be more inclined to underreport psychological and psychosomatic factors. Since the specific patient group of youths with extreme obesity and chronic pain suffers tremendously from the double burden, the differentiated assessment of pain in the clinical settings seems important to tailor interventions to individual needs. Indeed, evidence indicates that a combination of interventions of weight reduction and conservative pain management might be more effective to reduce pain and disability, compared to either intervention alone [36].

Limitations and Strengths

Several limitations must be considered when interpreting the findings of this study. First and most important, the age of this sample spans from adolescence to young adulthood. This variation posed challenges in selecting age-appropriate screening instruments. To ensure uniform data collection and analysis, we used several screening instruments validated for only part of the sample. A similar approach was taken for classifying obesity. Consistent with other publications based on the YES study (e.g., Felix et al., 2020) and to maintain uniform analysis, we used the WHO BMI classification for adults for all participants. This decision was made despite the WHO recommendation to use BMI-SDS for minors, as our sample includes both adolescents and young adults, and BMI and BMI-SDS values are very similar at this age. In our sample, the Pearson correlation between BMI and BMI-SDS is 0.918. Second, it is important to note that this sample exclusively comprised youths with obesity. As a result, a direct comparative analysis between youths with and without obesity concerning pain-related impairments and psychological burden was not feasible.

Third, the evaluation focused exclusively on leg and back pain. Other types of pain were not considered and could be investigated in future studies. Prospective studies might facilitate a more nuanced exploration by discerning pain attributes in terms of localization and duration of the pain. Fourth, it was not considered whether participants were currently taking medication to manage comorbidities. Such pharmacological interventions may constitute an additional confounding variable, given their potential to modulate pain perception and improve obesity-specific HRQoL. It should also be noted that the data were collected from 2012 to 2014 and may not adequately reflect new trends. Despite these limitations, a strength of this study is the sample size. To provide a representative cohort, eligible participants were recruited across four distinct regions of Germany. This study provides new insights into the relationship between pain-related impairments and psychological burden of youths with extreme obesity, taking potential gender-specific differences into consideration.

Conclusions

The sensitive developmental stages of adolescence and young adulthood are highly relevant for interventions targeting obesity. Our findings suggest that, within the subgroup of youths with extreme obesity, women represent a distinct high-risk group for both pain-related and mental health impairments. Given the potential for underreporting psychological and psychosomatic complaints among men, routine, proactive assessments for chronic pain and mental health impairments are advisable for all patients with elevated BMI. Prospective studies should analyze the reciprocal interactions between pain and psychological impairments, as both may represent important barriers to lifestyle changes and weight loss. In the long term, conducting pain intervention studies within this patient group also appears sensible.

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Statement of Ethics

The study was conducted in line with the Declaration of Helsinki, the ICH-GCP guideline (where applicable), and national regulations. Prior to enrollment, the study was approved by the Ethic Committee of the University Medical Center Ulm (89/12). Subsequent votes were obtained from the Ethic Committees of the participating medical university hospitals in Leipzig (312-12-24092012), Berlin (EA62/064/12), Essen (12-5108-BO), and Datteln (47/2012). Participation in the study was voluntary and could be terminated at any point without facing disadvantages and without providing reasons. All participants provided written informed consent to participate in this study. Additionally, parental written informed consent to participate in this study was obtained from youths under the age of 18 years.

Conflict of Interest Statement

Johannes Hebebrand has received lecture fees from Novo Nordisk and Amryt Pharmaceuticals. All other authors have no conflicts of interest to declare.

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Author Contributions

H.S., I.M., M.W., and S.B.-H. researched data and wrote the manuscript. S.W., T.R., W.K., J.H., J.S., R.H., R.W.H., and A.S. collected data, and reviewed and edited the manuscript. All authors reviewed the manuscript and approved the final manuscript to be published.

Data Availability Statement

The dataset analyzed during the current study is not publicly available, as informed consent did not include provision for public file sharing. Further inquiries can be directed to the corresponding author.

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