

Abnormal eating behaviour and eating disorders in children and adolescents with type 1 diabetes: causes and frequency

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Summary

It is not yet clear from current study results whether patients with type 1 diabetes are at increased risk of eating disorders. Possible causes for impaired eating behaviour in type 1 diabetes might include specific nutritional requirements and an increase in weight caused by insulin, leading to body dissatisfaction. The care and teaching of young patients with type 1 diabetes should concentrate on the primary and secondary prevention of impaired eating behaviour.

Keywords: Type 1 diabetes mellitus, eating behaviour, eating disorders, children and adolescents

answered 2 or more of the questions in the SCOFF questionnaire positively.

The prevalence of manifested eating disorders is much less than that of abnormal eating behaviour. In a current estimate, it is assumed that c. 0.4 % of women aged between 15 and 35 years are affected by anorexia nervosa [5]. The prevalence of bulimia nervosa is just over 1 %, for binge eating disorder (eating disorder with binging) c. 1.6 % and for atypical eating disorders (Eating Disorder Not Otherwise Specified [EDNOS]) at 2–14 %. Men are much more rarely affected than women.

Introduction

Abnormal eating behaviour and eating disorders in the general population

Symptoms of eating disorders occur widely in children and adolescents in Germany. In the basic section of the Survey on the Health of Children and Adolescents (KiGGS, 2003–2006; representative for Germany), one fifth of children and adolescents aged between 11 and 17 years exhibited an eating disorder according to the SCOFF questionnaire [1] (♦ Table 1), which is a screening instrument for the identification of the symptoms of eating disorders [2–4]. If at least 2 of the 5 questions are affirmed (with a “yes”) an eating disorder is suspected and this must be clarified by medical investigations and qualified psychological and psychiatric diagnostic testing. In the KiGGS, 28.9 % of the girls and 15.2 % of the boys

Abnormal eating behaviour and eating disorders in type 1 diabetes

Since the 1980s, it has been suspected that individuals with type 1 diabetes suffer disproportionately often from abnormal eating behaviour or clinically manifested eating disorders [6]. DANEMAN et al. developed a model to describe hypotheses for the link between type 1 diabetes and abnormal eating or weight-related behaviours [7] (♦ Figure 1).

According to this model, insulin therapy may trigger eating disorders, as it causes an increase in weight. This is particularly the case at the start of diabetes treatment,

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but also later, as insulin resistance may increase during puberty [8–11], in addition to the general increase in weight during puberty [12]. This increase in weight can cause body dissatisfaction and a drive for thinness, which can lead to so-called “restrained eating behaviour” (dieting), interrupted by recurring attacks of eating [7].

Nutrition and the composition of foods are important themes in the training and therapy of diabetics. On the other hand, the necessity of worrying continuously about foods, the estimation of carbohydrate units and the adjustment of the insulin dose can encourage the development of eating disorders [7, 13–15]. Additional individual, familial and socio-cultural factors (e. g. social structure in the family, experiences of overweight and/or diet behaviour in the own environment or ideals of slim-

1. Do you vomit when you feel unpleasantly full?
2. Do you sometimes worry because you can't stop eating?
3. Have you recently lost more than 6 kg in 3 months?
4. Do you think that you are too fat, while other people think that you are too thin?
5. Would you say that eating has a great influence on your life?
<i>If at least two questions are answered with "yes", this is a suspected case of an eating disorder.</i>

Table 1: The SCOFF questionnaire [1]

ness in society [16, 17]) can also cause or prevent the development of abnormal eating behaviour, depending on their type or constellation. In contrast to individuals with healthy metabolism, patients with type 1 diabetes have an additional method to lose weight or to avoid weight increase. If the physiologically necessary insulin dose is reduced, or even completely omitted (so-called “insulin purging”), the

blood glucose concentration increase and more glucose is eliminated over the kidneys (glucosuria) [5, 11, 18, 19]. In an American study, 10.3 % female and 1.4 % male adolescents with type 1 diabetes stated that they had omitted insulin injections in order to control their weight. For the same reason, 7.4 % of the female and 1.4 % of the male adolescents with type 1 diabetes had reduced their insulin dose [20].

(continuation p. 62)

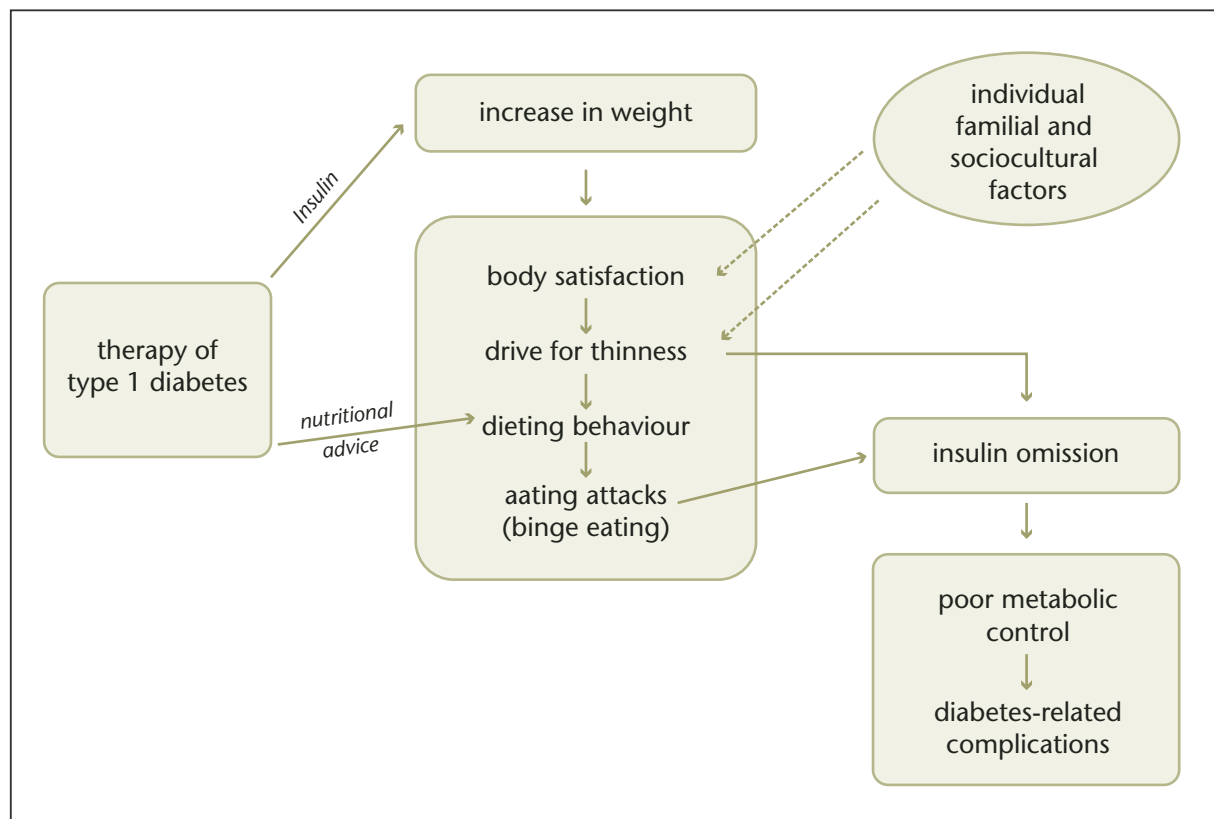


Figure 1: Model for the connections between type 1 diabetes and eating disorders (taken from [7])

Autor, Year, Country	Study Design	Study Population	Survey Instrument	Result (type 1 diabetes vs. no diabetes)
PINAR et al., 2005, Turkey [27]	case control study, age matched	45 adolescents with type 1 diabetes (12–18 years) 55 subjects of same age without diabetes	questionnaire (Eating Attitudes Test [EAT], Body Image Scale [BIS]), no information on diagnostic criteria	overall value EAT: 33.57 vs. 21.76 ($p < 0.001$), significantly higher values in girls with diabetes (not given), but not in boys (7.05 vs. 31.57, $p > 0.05$) abnormal eating behaviour: 68.9 % vs. 21.8 % overall value BIS: 153.97 vs. 158.25 ($p > 0.05$)
ENGSTRÖM et al., 1999, Sweden [25]	case control study, age matched	89 female adolescents with type 1 diabetes (14–18 years), 94 % intensified insulin therapy 89 subjects of same age without diabetes	two stage survey procedure: 1. questionnaire (Eating Disorder Inventory [EDI]) 2. diagnostic interview (Assessment of Anorexia–Bulimia – Teenager version [BAB-T]) DSM-IV criteria	stage 1: 16.9 % vs. 2.2 % with abnormal eating behaviour ($p < 0.01$) stage 2: eating disorders: 6.9 % of volunteers with diabetes (EDNOS), no eating disorder in the control group
COLTON et al., 2004, Canada [14]	case control study, age matched	101 girls with type 1 diabetes (9–14 years) 303 subjects of same age without diabetes	diagnostic interview (Children’s Eating Disorder Examination [cEDE]) DSM-IV criteria and additional criteria for EDNOS	total value cEDE: 0.31 vs. 0.26 ($p = 0.58$) anorexia, bulimia: in no group binge eating disorder: 3 % vs. 0.3 % ($p < 0.05$) EDNOS or subclinical eating disorder: 8 % vs. 1 % ($p = 0.001$) signs of abnormal eating behaviour: during the last month, 16 % of both groups with at least one sign, currently 8 % vs. 1 % with more than one sign
JONES et al., 2000, Canada [13]	case control study, age matched	356 female adolescents with type 1 diabetes (12–19 years) 1098 subjects of same age without diabetes	Two stage survey procedure: 1. questionnaire (Eating Disorder Inventory [EDI], Eating Attitudes Test [EAT-26]) 2. diagnostic interview (Eating Disorder Examination [EDE]) DSM-IV criteria and additional criteria for EDNOS	stage 1: 52 % vs. 48 % with suspected eating disorders Stage 2: eating disorders: 10 % vs. 4 %, odds ratio 2.4 (95 % confidence interval 1.5–3.7, $p < 0.001$) abnormal eating behaviour: 14 % vs. 8 %, odds ratio 1.9 (95 % confidence interval 1.3–2.8, $p < 0.001$)

Autor, Year, Country	Study Design	Study Population	Survey Instrument	Result (type 1 diabetes vs. no diabetes)
SMITH et al., 2008, Great Britain [28]	case control study, age matched	40 female adolescents with type 1 diabetes 76 subjects of same age without diabetes	questionnaire (Eating Disorder Examination Questionnaire [EDE-Q]) DSM-IV criteria	total eating disorders: significantly more frequent in type 1 diabetes, odds ratio 3.22 (95 % confidence interval 1.04–10.18, $p < 0.05$) anorexia: in neither group bulimia: 15.0 % vs. 5.3 % binge eating disorder: 12.5 % vs. 5.3 %
SVENSSON et al., 2003, Sweden [26]	case control study, age matched	109 male adolescents with type 1 diabetes (14–18 years), intensified insulin therapy 139 subjects of same age without diabetes	two stage survey procedure: 1. questionnaire (Eating Disorder Inventory for Children [EDI-C]) 2. diagnostic interview (rating of anorexia and bulimia, version for adolescents [RAB-T]) DSM-IV criteria	stage 1: values EDI-C subscales: body dissatisfaction: 3.05 vs. 2.38 ($p > 0.05$) bulimia: 1.14 vs. 1.48 ($p = 0.002$) drive for thinness: 1.18 vs. 0.53 ($p = 0.01$) no significant difference in other subscales of the EDI-C stage 2: eating disorders: no case of eating disorder in either group
GARCÍA-REYNA et al. 2003/2004, Spain [22, 30]	case control study, age matched	98 adolescents with type 1 diabetes (12–16 years) 575 subjects of same age without diabetes	two stage survey procedure: 1. questionnaire (Eating Attitudes Test [EAT-40]) 2. diagnostic interview (Eating Disorder Examination [EDE]) DSM-IV criteria	stage 1: 13.3 % vs. 9.9 % with abnormal eating behaviour stage 2: anorexia, bulimia: no case in either group EDNOS: boys: 1.7 vs. 0.9 %, odds ratio 1.7 (95 % confidence interval 0.2–17.6), girls: 5.3 % vs. 1.6 %, odds ratio 3.2 (95 % confidence interval 0.62–17.2) subclinical eating disorders: boys: 10 % vs. 4.4 %, odds ratio 2.4 (95 % confidence interval 0.9–6.6), girls: 10.5 % vs. 9.9 %, odds ratio 1.1 (95 % confidence interval 0.4–3.2)
MELTZER et al., 2001, USA [29]	cross-sectional study	152 adolescents with type 1 diabetes (11–19 years), conventional insulin therapy (2 injections daily) standard values from 1 373 volunteers from another study	questionnaire (Eating Disorder Inventory [EDI]), 3 subscales: body dissatisfaction, bulimia, drive for thinness. no information on diagnostic criteria	EDI values: body dissatisfaction: 4.0 vs. 4.3 for boys ($p > 0.05$), 8.6 vs. 11.3 for girls ($p < 0.05$) bulimia: 0.7 vs. 1.2 for boys ($p < 0.05$), 1.8 vs. 2.1 for girls ($p > 0.05$) drive for thinness: 2.3 vs. 1.7 for boys ($p > 0.05$), 6.6 vs. 5.6 for girls ($p > 0.05$)

Autor, Year, Country	Study Design	Study Population	Survey Instrument	Result (type 1 diabetes vs. no diabetes)
ACKARD et al. 2008, USA [20]	case control study, matched by similarity (propensity matching)	143 adolescents with type 1 diabetes (12–21 years) 4 746 subjects of same age without diabetes	own questionnaire	eating disorder: boys: 1.8 % vs. 0.3 % (p = 0.864), girls: 1.6 % vs. 0.4 % (p = 0.560)

Table 2: Overview of current studies
 DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, 4th edition
 EDNOS = Eating Disorder Not Otherwise Specified

(continued from p. 59)

Effects on health

Even in people with healthy metabolism, an eating disorder has major effects on health [5]. However, in patients with both type 1 diabetes and eating disorders, there is also an increased risk of acute loss of metabolic control due to omitted insulin injections [21, 22]. If metabolic control is poor, there is also an increased risk of secondary diseases related to diabetes [23, 24].

Results from comparative studies

The results will now be presented from comparative studies on the frequency of eating disorders in type 1 diabetes. The selected studies were published in 1999 or later and listed in the Medline database. They were performed in Europe or in industrial countries outside Europe.

It has not yet been conclusively demonstrated whether patients with type 1 diabetes are actually at greater risk of disturbed eating behaviour or eating disorders than are people with healthy metabolism. Some studies fully, or at least partially, confirm the link between type 1 diabetes and the development of

symptoms of an eating disorder or clinically manifested eating disorders [13, 14, 25–28]. However, other studies have failed to find a significant connection [20, 22, 29, 30]. ♦ Table 2 gives an overview of the study results during the last 15 years, which will now be explained.

A Turkish study compared the prevalence of disturbed eating behaviour in volunteers with and without type 1 diabetes [27]. The survey instruments were two questionnaires (Eating Attitudes Test [EAT], Body Image Scale [BIS]). Girls with diabetes had significantly higher total values than girls without diabetes, but there was no difference between the two groups for boys. In all, 68.9 % of adolescents with diabetes, but only 21.8 % without diabetes, exhibited abnormal eating behaviour.

In four other studies, the comparison was restricted to girls. ENGSTRÖM et al. (1999) reported that abnormal eating behaviour was more frequent in female adolescents with type 1 diabetes than in controls of the same age without diabetes [25]. The survey procedure had two stages. In the first stage, the volunteers completed a questionnaire (Eating Disorder In-

ventory [EDI]). If the results were abnormal, they were then requested to undergo a diagnostic interview (Assessment of Anorexia–Bulimia – Teenager Version [BAB-T]). It was found that the symptoms of an eating disorder were significantly more common in adolescents with type 1 diabetes: 16.9 % of girls with diabetes and 2.2 % of the control group had abnormal questionnaire results. In the diagnostic interview, an EDNOS was detected in 6.9 % of the girls with diabetes, but no eating disorder was found in the control group. Moreover, COLTON et al. found no person with anorexia or bulimia in either of their two groups, although girls with type 1 diabetes significantly more often suffered from subclinical eating disorders and EDNOS (8 % vs. 1 %, p = 0.001) or from binge eating disorder (3 % vs. 0.3 %; p = 0.05) [14].

In a Canadian study, female adolescents with type 1 diabetes were compared with metabolically healthy subjects of the same age, with respect to the prevalence of eating disorders [13]. Just as in ENGSTRÖM et al. [25], this study employed a two stage survey procedure. 52 % of the girls with diabetes and 48 % of the healthy controls had abnormal re-

sults in the questionnaire. After the diagnostic interview, 10 % of the girls with diabetes, but only 4 % of the girls without diabetes, were classified as having an eating disorder. Thus, patients with diabetes had a 2.4-fold increase in the risk (odds) of an eating disorder. There was also a significant difference between the two groups with respect to subclinical eating disorders – 14 % vs. 8 %, risk increased 1.9-fold in diabetes.

In Great Britain, girls with type 1 diabetes had a 3.2-fold increased risk (odds) of an eating disorder in comparison with girls without diabetes [28]. In this study too, no cases of anorexia were identified, although 15 % of the girls with diabetes and 5.3 % of the girls without diabetes fulfilled the diagnostic criteria for bulimia. The corresponding figures for binge eating disorder were 12.5 % vs. 5.3 %, respectively.

SVENSSON et al. [26] only studied male adolescents. In comparison to the control group without diabetes, boys with diabetes exhibited fewer signs of bulimia, but a greater drive for thinness. Differences in the drive for thinness might possibly be due to differences in BMI (22.4 kg/m² in type 1 diabetes vs. 21.6 kg/m² in the comparator group). There was no significant difference between the two groups with respect to the other subcategories in the questionnaire used (Eating Disorder Inventory for Children [EDIC]) – body dissatisfaction, inferiority feelings, perfectionism, distrust of others, uncertainty in perceiving feelings, anxiety about growing up, asceticism, impulse regulation, social uncertainty.

The results of the above studies (at least partially) support the idea that eating disorders or abnormal eating behaviour are more frequent in type

1 diabetes. However, there are other studies in which this link could not be demonstrated.

In Spain, adolescents with and without type 1 diabetes were compared with a two stage survey procedure [22, 30]. The result of the questionnaire (Eating Attitudes Test [EAT]) was abnormal for 13.3 % of adolescents with diabetes and 9.9 % of adolescents without diabetes. No case of anorexia or bulimia was found among the volunteers who subsequently took part in the diagnostic interview (Eating Disorder Examination [EDE]). Both boys and girls with diabetes more frequently fulfilled the criteria for “eating disorder not otherwise specified” (EDNOS). However, the difference between participants with and without diabetes was not statistically significant. The same applied to subclinical eating disorders, for which the difference between boys with and without diabetes was greater than the corresponding difference for girls.

In the USA, boys and girls with type 1 diabetes were less dissatisfied with their bodies than adolescents of the same age without diabetes; for girls, the difference was statistically significant [29]. As regards signs of bulimia, boys with diabetes had significantly better questionnaire values than the comparator group; there was no significant difference for girls. For the category drive for thinness, the values for boys and girls with diabetes were higher, but the differences were not statistically significant.

In another study performed in the USA and published in 2008, adolescents with type 1 diabetes were more frequently affected by eating disorders than were subjects of the same age but without diabetes (boys:

1.8 % vs. 0.3 %, girls: 1.6 % vs. 0.4 %), but the differences were not significant in either gender [20].

Cause of the heterogenous study results

The different results on the prevalence of disturbed eating behaviour and eating disorders could be explained – at least partially – by differences in study design, in the study populations (e.g. age, duration of diabetes, diabetes therapy, psychological support provided to the patients), as well as by the different instruments used to survey abnormal eating behaviour and the symptoms of an eating disorder (individual questionnaire, combination of different questionnaires, two stage survey, with questionnaire followed by an interview).

Summary of study results (meta-analysis)

In their systematic literature review and meta-analysis, YOUNG et al. summarised the results of 13 empirical studies, including most of the studies discussed in the present article [18]. In all studies, standardised survey instruments were used to classify eating disorders or abnormal eating behaviour and the same criteria were used for the diagnosis of eating disorders. The publication period was between 1999 and 2011. In the first step, the meta-analysis found a significant difference in the prevalence of eating disorders (7.0 % in volunteers with type 1 diabetes vs. 2.8 % in volunteers without type 1 diabetes) and abnormal eating behaviour (39.3 % in volunteers with type 1 vs. 32.5 % in volunteers without type 1 diabetes). In the second step, the analysis was restricted to studies in which diabetes-adapted measuring instruments were used.



The purpose was then to avoid wrongly interpreting therapy-related changes in nutrition and habits as symptoms of an eating disorder. After the pooled evaluation of the remaining studies, there was no longer any significant difference between the prevalence of the symptoms of eating disorders or manifested eating disorders in individuals with and without type 1 diabetes. This implies that if survey instruments are used that are not modified for diabetes, then therapies for diabetes may be misinterpreted as symptoms of an eating disorder.

The meta-analysis also showed that the metabolic control of patients with type 1 diabetes accompanied by an eating disorder or abnormal eating behaviour was significantly worse than in patients with type 1 diabetes and no problems with eating disorders [18].

Conclusion

It has not yet been conclusively shown whether eating disorders are more common in individuals with type 1 diabetes than in the normal population. Nevertheless, the care and training of young patients with type 1 diabetes should pay attention to the primary and secondary prevention of abnormal eating behaviour. Frequent metabolic imbalance for no clear reason, poor metabolic control, severe and recurrent episodes of hypoglycaemia or growth disorders may indicate problems with eating disorders. If this is suspected, a child and adolescent psychotherapist or psychiatrist should be consulted, in order to supply therapy as early as possible and thus to avoid secondary physical and psychological diseases.

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Conflict of Interests

The authors declare no conflict of interests according to the guidelines of the International Committee of Medical Journal Editors.

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