

Original Article

# Screening for Co-Morbidity in 65,397 Obese Pediatric Patients from Germany, Austria and Switzerland: Adherence to Guidelines Improved from the Year 2000 to 2010

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## Key Words

Obesity · Children · Adolescents · Co-morbidity · Screening

## Abstract

**Objective:** The aim of the study was to analyze the adherence to current guidelines for co-morbidity screening in overweight and obese pediatric patients participating in the Adipositas-Patienten-Verlaufsdokumentation (APV) initiative in three German-speaking countries. **Methods:** APV database: 181 centers from Germany, Austria and Switzerland, specialized in obesity care, contributed standardized, anonymous data of medical examinations from 65,397 patients performed between 2000 and 2010. Completeness of screening for hypertension, dyslipidemia, and impaired glucose metabolism was analyzed using adjusted means. **Results:** Mean age of the cohort was  $12.5 \pm 2.9$  years and 46.5% were male. 17.3% were overweight (>90th–97th percentile), 45.1% obese (>97th–99.5th percentile), and 37.7% extremely obese (>99.5th percentile). In 2000, blood pressure was documented for 55.1% of patients, increasing to 88.7% in 2010. The rate of lipid diagnostics also improved from 45.0 to 67.7%, and screening for diabetes rose from 32.7 to 62.3% in the same time period. Blood pressure measurements were performed more often during inpatient care (88.5%) compared to outpatient

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programs (77.5%). Screening was more complete with increasing age and increasing degree of obesity. In boys screening rate was higher than in girls. **Conclusion:** During the 11-year period, screening for co-morbidity improved significantly in overweight or obese children and adolescents. However, adherence to guidelines is still insufficient in some institutions. Quality control based on benchmarking may improve obesity care and outcome.

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## Introduction

Obesity-related cardiovascular co-morbidity is well known in adult patients and its reduction is a major goal in internal medicine [1]. The focus on diagnosis and treatment of cardiovascular co-morbidity in pediatric obesity care is less clear, despite several studies demonstrating a high frequency of cardiovascular risk factors in overweight or obese children and adolescents [2–4]. In Germany and most other European countries, the prevalence of obesity, as defined by BMI, has increased considerably among children and adolescents over the past years [5, 6], but the increase seems to stabilize at present [7, 8]. In 2006, 8.7% of German 3- to 17-year-olds were overweight, and 6.3% were obese [9]. In absolute numbers 1.9 million children and adolescents are considered to be overweight in Germany, 800,000 of them obese. There is presumably a high rate of obesity tracking into adulthood [10], and therefore a reduction of the cardiovascular risk burden caused by obesity in children and adolescents is a priority target of preventive medicine.

National and international guidelines on overweight in children and adolescents recommend multidisciplinary, behavior-oriented, long-term lifestyle interventions for obese pediatric patients (BMI  $\geq$  97th percentile) in addition to screening for features of the metabolic syndrome such as abnormal values of blood pressure, blood glucose, or lipids [11, 12]. For overweight patients (BMI >90th–97th percentile), interventions are also recommended if co-morbidity is present in the patient or in patients with a fast increase of BMI. Thus, the classification of patients in different weight groups has a strong impact on the therapeutic approach received and on the requirement for diagnostic work-up, resulting in different costs [13].

Longitudinal multicenter data on screening for cardiovascular co-morbidity in pediatric patients are still scarce. Therefore, this study aims to analyze the implementation of current guidelines on screening for co-morbidity in overweight and obese pediatric patients.

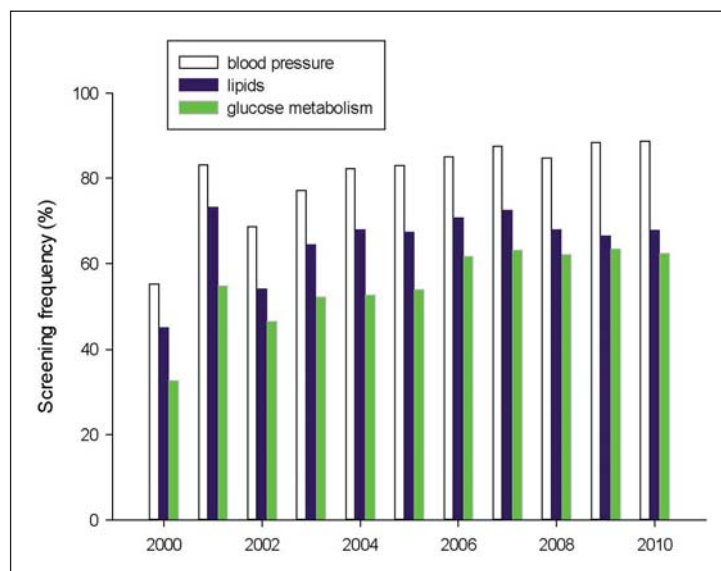
## Material and Methods

The APV initiative (Adipositas-Patienten-Verlaufsdokumentation, [www.a-p-v.de](http://www.a-p-v.de)) started in 2000 to collect routine data on overweight or obese patients presenting at specialized institutions. The APV software allows for standardized and prospective documentation of demographics, weight category, medical co-morbidity as well as treatment intensity and duration [14]. Anonymous data are transferred every 6 months for joint evaluation. Until the end of 2010, 65,397 patients from 181 treatment centers were accumulated.

For the present analysis, screening data for cardiovascular risk factors (blood pressure, lipid profile, and fasting glucose metabolism) were examined. Data from baseline examination (up to 6 weeks after initial consultation) pertaining to medical and social history, BMI, BMI-SDS, fasting lipids, and glucose were analyzed at the University of Ulm, Germany.

According to German guidelines, overweight in children is defined as BMI 90th percentile for age and sex, obesity as BMI >97th–99.5th percentile, and extreme obesity as BMI >99.5th percentile [11]. BMI-SDS was calculated based on official German reference values [15]. Migration background was defined as: patient or patient's mother and/or father with place of birth outside of Germany, Austria or Switzerland. Size of treatment center was divided into large (>100 patients per year) and small ( $\leq$ 100 patients per year).

The APV quality control initiative was approved by the Ethics Committee of the University of Ulm.



**Fig. 1.** Screening frequencies (% adjusted means) for blood pressure, lipids and fasting glucose between 2000 and 2010 (n = 65,397).

#### Statistics

Statistical analyses were performed using SAS version 9.2 (SAS Institute Inc. Cary, NC, USA). Results were reported as mean  $\pm$  SD or proportion (%). Mixed multivariable hierarchical logistic regression models with age, sex, migration background, BMI, year of treatment, and inpatient versus outpatient care parameters were used. The treatment center was included as a random categorical variable in this model. Adjusted means (LSMEANS) were used to compare treatment years. Denominator degrees of freedom were calculated according to Kenward Roger. Restricted partial likelihood was used for estimation and iterations were optimized according to Newton-Raphson. Significance was given at  $p < 0.05$ .

## Results

In total, 65,397 children and adolescents from 181 obesity care centers participated in the study. On average, 17.3% of patients were classified as overweight, 45.1% as obese, and 37.7% as extremely obese. Mean BMI-SDS was  $2.4 \pm 0.5$  and mean body weight was  $75.4 \pm 24.3$  kg. Mean age of all subjects was  $12.4 \pm 2.9$  years; 46.5% of patients were male. 25,380 patients participated in specialized outpatient treatment programs (49.5% male, mean age  $11.2 \pm 3.1$  years), while 40,017 received inpatient care in specialized rehabilitation clinics (44.6% male, mean age  $13.3 \pm 2.5$  years). 10% of all patients had a migration background (mean BMI-SDS  $2.5 \pm 0.5$ , mean body weight  $75.0 \pm 25.6$  kg).

Screening for blood pressure, lipids, and glucose increased in more recent years: blood pressure was documented for 55.1% of patients in 2000 while it amounted to 88.7% in 2010. During the 11 years of observation, the lipid diagnostics rate increased from 45.0 to 67.7%, and the examination rate for impaired glucose metabolism rose from 32.7 to 62.3%. Figure 1 shows increasing screening trends for blood pressure, lipids, and glucose metabolism over the 11-year study period.

Analysis of patient subgroups revealed higher examination rates in subjects older than 12 years compared to younger ones ( $p < 0.001$ ). Table 1 shows adjusted screening frequencies for patients under 12 years, 12–16 years and adolescents over 16 years of age. In addition, screening frequency was found to rise with increasing BMI from overweight to obesity ( $p < 0.0001$ ) (table 2). Frequency of co-morbidity screening in patients with or without migration background is shown in table 3. More children with migration background were examined

**Table 1.** Frequency of screening for co-morbidity according to age groups<sup>a</sup>

	Co-morbidity, %			p value
	<12 years (n = 25,762)	12–16 years (n = 33,063)	>16–20 years (n = 6,572)	
Blood pressure	82.9	86.4	84.7	<0.001
Lipids	64.1	68.9	77.2	<0.0001
Fasting glucose	55.7	60.0	65.7	<0.0001

<sup>a</sup>Mean values adjusted for sex, migration, weight category, treatment year and type of center.  
p = Group differences.

**Table 2.** Frequency of screening for co-morbidity according to BMI categories<sup>a</sup>

	Co-morbidity, %			p value
	overweight (n = 11,301)	obesity (n = 29,474)	extreme obesity (n = 24,622)	
Blood pressure	80.8	85.4	86.1	<0.01
Lipids	59.5	68.1	71.5	<0.0001
Fasting glucose	50.2	58.6	63.1	<0.0001

<sup>a</sup>Mean values adjusted for age, sex, migration, treatment year and type of center.  
p = Group differences.

**Table 3.** Frequency of screening for co-morbidity in patients with or without migration background<sup>a</sup>

	Co-morbidity, %		p value
	patients with migration background (n = 6,602)	patients without migration back- ground (n = 58,795)	
Blood pressure	88.3	84.5	<0.0001
Lipids	80.6	66.3	<0.0001
Fasting glucose	71.9	57.3	<0.0001

<sup>a</sup>Mean values adjusted for age, sex, weight category, treatment year and type of center.  
p = Difference of patients with versus without migration background.

**Table 4.** Frequency of screening for co-morbidity according to different forms of treatment center<sup>a</sup>

	Co-morbidity, %		p value
	inpatient treatment (n = 40,017)	outpatient treatment (n = 25,380)	
Blood pressure	88.5	77.5	<0.0001
Lipids	68.5	67.2	<0.01
Fasting glucose	59.9	57.3	<0.0001

<sup>a</sup>Mean values adjusted for age, sex, migration, weight category and treatment year.  
p = Inpatient versus outpatient institution.

**Table 5.** Frequency of screening for co-morbidity according to size of treatment center<sup>a</sup>

	Co-morbidity, %		p-value
	large center (>100 patients) (n = 43,165)	small center (≤100 patients) (n = 22,232)	
Blood pressure	88.8	75.7	<0.0001
Lipids	68.7	66.6	<0.0001
Fasting glucose	60.8	55.2	<0.0001

<sup>a</sup>Mean values adjusted for age, sex, migration, weight category and treatment year.

p = Difference between size of treatment center.

**Table 6.** Frequency of screening for co-morbidity in boys and girls<sup>a</sup>

	Co-morbidity, %		p value
	boys (n = 30,417)	girls (n = 34,980)	
Blood pressure	85.8	84.2	<0.0001
Lipids	68.8	67.3	<0.0001
Fasting glucose	60.1	57.8	<0.0001

<sup>a</sup>Mean values adjusted for age, migration, weight category, treatment year and type of center.

p value = Difference between genders.

(p < 0.0001). Moreover, there are significant differences between inpatient and outpatient treatment, with a higher screening rate in inpatients (p < 0.0001) (table 4). The frequency of co-morbidity screening in large and small treatment centers is shown in table 5. Screening in large centers was more complete than in small centers (p < 0.0001). When analyzed for gender differences, screening for co-morbidities was done more frequently in boys than in girls (p < 0.0001) (table 6).

## Discussion

The APV documentation initiative started in 2000. During the subsequent 11 years, the screening rate for co-morbidity in overweight or obese patients rose gradually. The implementation of nationwide data collection with central quality control may have caused a temporary steep rise in 2001.

Blood pressure was screened more often than lipid or glucose metabolism. It may be assumed that physicians as well as patients and their parents prefer non-invasive methods for the assessment of cardiovascular risk, and blood samples are therefore avoided. Childhood blood pressure is a strong predictor of adult blood pressure [16], and there is evidence that childhood hypertension can lead to adult hypertension [17]. Hypertension is an established risk factor for cardiovascular disease in adults [18], and the presence of childhood hypertension may contribute to the early development of coronary artery disease [19].

In the APV population blood pressure measurements have increased up to almost 90%, and lipid and glucose concentrations were determined in 70% and 64%, respectively, in

2010. These high rates are attributed to the rise of childhood obesity as well as growing awareness of cardiovascular risk. Guidelines propose the screening for obesity-related diseases [11, 12]. Physician and team training and a general increase in the awareness of prevention and risk management may contribute to the more careful examinations. The options of pharmacologic treatment for hypertension, dyslipidemia, or impaired glucose tolerance may also influence the examination frequency. The new pediatric guidelines for hypertension include a revised classification of blood pressure; they explain the evaluation of hypertension in children and give updated recommendations for lifestyle changes and anti-hypertensive drug therapy [20]. For dyslipidemia, current pediatric guidelines specify the range of normal values and cut-off for treatment [21]. Drugs with trusted safety and efficacy are available although there is no general consensus about pharmacological treatment of hyperlipidemia in children, particularly of secondary dyslipidemia [22].

Fasting blood glucose measurement is recommended in obese children and adolescents [11, 23]. In overweight subjects screening for glucose metabolism is advised when in addition to increased weight one additional risk factor (e.g. positive family history, elevated blood pressure, rapid weight gain) is present. The measurements of fasting blood glucose have increased and almost doubled over the past 11 years. The estimation of capillary blood glucose is easy and quick; the evaluation is simple. Similar to elevated blood pressure and abnormal lipid values, impaired blood glucose metabolism is improved by lifestyle changes. For pharmacological treatment of pediatric type-2 diabetes, the antidiabetic agents metformin and insulin are currently approved [24].

Significant differences in screening were found in various subgroups of patients. In obese subjects, the frequency of risk factor assessment was higher than in overweight patients. The higher rate of screening in obese patients may be due to the knowledge that in this BMI category metabolic disturbances are more common [2, 3]. Screening rate for blood pressure was lower in children younger than 12 years compared to adolescents, although the difference was small. Lipid and glucose metabolism were examined more often in adolescents. In boys the screening rate was higher than in girls. Venipuncture is stressful for children and possibly was avoided more frequently in younger patients. In patients with a migration background, risk for co-morbidities was determined more often at the screen visit. Children with migration background have a higher BMI [9], although this was not observed in our study population with exclusively overweight and obese subjects. An association between migration background and poorer health has been shown in children [25, 26]. This knowledge could have led to a more intensive care with a higher frequency of screening for cardiovascular risk factors.

Diagnostic screening in inpatient care in large treatment centers was more complete than in outpatient practices or small treatment centers. Differences in inpatient treatment, when compared to outpatient care, may be the amount of medical attention given to the patient and the increased focus on quality measurements. Only few studies investigated quality of care in pediatric systems, but it was reported that physicians from hospitals self-report higher use of evidence-based guidelines [27].

Adherence to guidelines is still insufficient in some institutions. The detection in the individual centers through benchmarking reveals the need for improvement and target addressing is possible.

### *Strength of the Study*

This is the first longitudinal study to demonstrate that the frequency of cardiovascular risk assessment in overweight and obese children and adolescents in Germany, Austria, and Switzerland has increased. The data of this large study population were collected in a standardized form in a large number of obesity treatment centers over the three countries.



### Limitations of the Study

The reasons for incomplete screenings are not fully clarified. Documentation gaps could have accounted for incomplete screening in part. The study does not represent the general population, but includes exclusively overweight and obese subjects. Only few centers participated in Austria as well as in Switzerland, and data are probably not representative for these countries.

In summary, screening for medical co-morbidities in obesity improved over the study period. The implementation of guidelines and an external benchmarking system seem to be indispensable for improving the medical care of overweight pediatric patients.

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### Participating Centers

Amrum Satteldüne Kinder-Reha, Augsburg Bunter Kreis, Bad Bodenteich Moby Dick Seeparkklinik, Bad Fallingbostal Gesundheitszentrum, Bad Frankenhausen Kinder-Reha, Bad Hersfeld Kinderklinik, Bad Kösen Kinder-Reha, Bad Kreuznach Viktoriastift, Bad Lippspringe, Auguste-Viktoria-Klinik, Bad Mergentheim Kinderklinik, Bad Neuenahr DRK Institutsambulanz, Bad Rothenfelde Kinder-Reha, Bad Orb Spessartklinik Kinder-Reha, Bad Salzungen Reha-Klinik Charlottenhall, Bad Segeberg/Neumünster junior marvelesse, Bensheim Ernährungspraxis, Berchtesgaden CJD, Berchtesgaden Klinik Schönsicht Kinder-Reha, Berlin Charité Kinderklinik, Berlin DRK Ausbildungszentrum, Berlin Lichtenberg Kinderklinik, Berlin Vivantes Behandlungszentrum SPZ, Bischofswiesen/Strub INSULA, Blaubeuren Ernährungspraxis, Böblingen Kinderarztpraxis, Bonn Ernährungsberatung KIDS Schulung, Braunschweig ernährungsmedizinisches Zentrum, Bregenz Landeskrankenhaus Kinderklinik, Bremen-Nord Kinderklinik, Bremen Zentralkrankenhaus Kinderklinik, Brügge Förderkids, Buchholz Ernährungsberatung, Bühl Praxis Ernährungsberatung, Bruchweiler Kinder-Reha, Darmstadt Kinderklinik, Datteln Vestische Kinderklinik, Düsseldorf Ernährungspraxis 'iss gut', Düsseldorf Ernährungsberatung 'richtig essen', Detmold Kinderklinik, Dieburg Ernährungsberatung KIDS Schulung, Dinslaken Kinderklinik, Dornbirn Kinderklinik, Dorsten St. Elisabethkrankenhaus, Dresden Moby Dick, Düren Gesundheitsamt, Düren sozialpädagogisches Zentrum Marienhospital, Eppingen Kinderarztpraxis, Erlangen Universitätskinderklinik, Eschede Adipositastraining KIDS, Ettenheim Kinderarztpraxis, Feldberg ITZ Caritas-Haus, Feldkirch Landeskrankenhaus Kinderklinik, Flensburg Förderkids, Frankfurt Päd. Endokrinologie, Freiburg Fitoc, Freiburg Universitätskinderklinik, Friedrichsdorf Ernährungspraxis, Fürth Kinderklinik, Göttingen KIDS Schulungsprogramm, Göttingen Universitätskinderklinik, Gaissach Fachklinik Deutsche Rentenversicherung Bayern-Süd, Garz Fachklinik CJD, Gauting, Kinderarztpraxis, Gelnhausen Ernährungsberatung, Giffers Ausbildungszentrum Guglera, Gittelde am Harz Ernährungsberatung, Gotha Helios Kinderklinik, Gröbenzell Ernährungsberatung, Hagen Allgemeines Krankenhaus, Hagen Kinderarztpraxis, Hagen Kinderklinik, Hamburg Moby Dick, Hamburg Rallye Energy, Hamburg Wilhelmstift, Hannover BKK Essanelle, Hannover Kinderklinik auf der Bult, Haßfurt Adipositasschulung Haßberge, Herdecke Kinderklinik, Herne Praxis Ernährungsmedizin, Hirschberg Praxis, Homburg CJD, Homburg Universitätskinderklinik, Kassel Kinderarztpraxis, Kiel städtisches Krankenhaus Förderkids, Kreischau Klinikum Bavaria Zscheckwitz, Köln Kinderklinik Amsterdamerstrasse Power Pänz, Köln MeLo KIDS Schulungsprogramm, Köln Netzwerk Gesundheit, Köln – Prävention UniReha GmbH, Köln Sporthochschule, Leipzig Sportmedizin, Korbach Ernährungsberatung, Leipzig Universitätskinderklinik, Lindau Forum Adipositas, Lindenberg/Lindau Adipositasschulung, Lingen Bonifatius-Hospital, Lörrach Kinderklinik, Lübeck Universitätskinderklinik, Magdeburg Städtische Kinderklinik, Magdeburg Universitätskinderklinik, Mahlow Ernährungspraxis, Menden BIG, Mönchengladbach Städt. Kinderklinik, Mühlhausen Präventionspraxis, München Adieupositas, Münster Arztpraxis, Münster Ernährungsberatung Moby Dick, Murnau Kinder-Reha,

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## Disclosure Statement

The authors declared no conflict of interest.

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