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ORIGINAL PAPER

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Medical care of obese children and adolescents

APV: a standardised multicentre documentation derived to study initial presentation and cardiovascular risk factors in patients transferred to specialised treatment institutions

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Abstract So far in Europe, no studies have been published on the structuring of medical care for obese children and adolescents. Besides anthropometric parameters, evaluations of the cardiovascular risk factors hypertension, dyslipidaemia, impaired glucose metabolism and treatment modalities were documented in a standardised multicentre evaluation survey (APV) of 18 primarily outpatient and nine rehabilitation institutions. In total, 3837 children (aged 2–20 years) took part in the years 2000 up to March 2003, of whom 1985 were treated in outpatient institutions and 1852 in rehabilitation institutions. Of these children, 10% were overweight, 37% obese, 49% extremely obese and 4% of normal weight at initial presentation. The frequencies of diagnostic procedures performed and documented were low (measurement of blood pressure 43%, lipids 40%, glucose metabolism 21%). In the subgroup of obese children who were screened for cardiovascular risk factors, 23% suffered from hypertension, 11% displayed increased cholesterol, 9% increased low-density lipoprotein-cholesterol, 29% increased triglycerides, 11% decreased high-density lipoprotein-cholesterol and 6% had impaired glucose metabolism. *Conclusion*: Despite the high prevalence of cardiovascular risk factors in obese children and adolescents confirmed in this report, diagnostic procedures failed in a considerable percentage even in specialised treatment centres for obese children and adolescents. In future, the feedback based on standardised evaluation of diagnostic and treatment procedures should aim to improve the quality of medical care.

Keywords Cardiovascular risk factors · Childhood · Medical care · Obesity · Quality of assessment

Abbreviations BMI: body mass index · HDL: high-density lipoprotein · LDL: low-density lipoprotein · SDS: standard deviation score

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Introduction

The world-wide increasing prevalence of obesity in childhood and adolescence poses an ever-increasing problem [10]. Since childhood obesity affects both health and social integration, an efficient management is

urgently needed [10, 31]. Obese subjects are frequently characterised by hypertension, impaired glucose metabolism, reduced high-density-lipoprotein (HDL) cholesterol, increased total cholesterol, low-density-lipoprotein (LDL) cholesterol and triglycerides (metabolic syndrome) [14]. Such a metabolic profile increases the long-term risk for cardiovascular disease and non insulin dependent diabetes [3]. Despite the prevalence of obesity in childhood, the atherogenic risk factors in paediatric obesity have only been investigated in a few large studies, primarily from North America [7, 29, 33].

Current guidelines suggest the measurement of blood pressure in connection with lipids (triglycerides, cholesterol, LDL- and HDL-cholesterol) and a screening for impaired glucose metabolism in obese children and adolescents as diagnostic procedures [2, 4, 18]. A long-term therapy consisting of a combination of physical exercise, nutrition education and behaviour therapy is recommended for obese children or children with rapid weight gain [4, 10, 13, 18], although the long-term efficiency of this treatment has not yet been proven [11, 26].

A survey in the United States demonstrated a lack of medical centres for obese children and adolescents [5, 6]. Diagnostic procedures and existing treatment plans often do not interact with current recommendations [5, 6]. In Europe, the quality of medical care of obese children and adolescents has not yet been addressed. In order to study the current situation in a European country and with the aim of improving the future quality of medical care, the "APV" initiative was initiated in the year 2000 under the auspices of the "AGA", the German working group on paediatric obesity. The aims of this initiative of specialised inpatient and outpatient centres are (1) to document the medical care of obese children and adolescents in Germany, (2) to evaluate if diagnostic and treatment procedures conform to the current guidelines and (3) to develop a quality management system for obesity care. This report presents a baseline evaluation of nearly 4000 children and adolescents referred to the participating centres.

Subjects and methods

A computer software based on the Foxpro 6.2 compiler was developed for standardised prospective documentation of children and adolescents with overweight or obesity. Besides anthropometric parameters, cardiovascular risk factors (hypertension, dyslipidaemia, impaired glucose metabolism), family background and treatment modalities are documented longitudinally by the software. The software allows standardised patient reports as well as local aggregation of data and patient selection according to multiple criteria. Twice yearly, the participating centres export anonymous longitudinal data for centralised evaluation. Each participating centre complies with their local data management guidelines.

All 175 treatment centres for obese children and adolescents in Germany, based on the survey of the German working group on paediatric obesity (AGA) [24], were invited to take part in the "APV" documentation system and the joint evaluation project.

The participating institutions receive feedback on their results in comparison to the whole group. Regulations describe access to the data and rules for publication. These rules were unanimously approved by all members in the group and published on the apv-homepage (http://www.a-p-v.de). A demo version of the software is also available on this site.

This report takes into account the data of children and adolescents aged 2 to 20 years accumulated prior to March 2003.A total of 27 institutions (18 primarily outpatient and 9 rehabilitation institutions) provided data. These institutions offer a multi-professional standardised treatment protocol consisting of physical exercise, behaviour and nutritional therapy in compliance with the AGA guidelines [18]. In the outpatient setting, treatment was carried out over a 3 to 12-month period, in the rehabilitation institutions over a 3 to 8-week period, and up to 6 months in selected cases suffering from extreme obesity.

The weight status was recorded as body mass index (BMI) and the BMI standard deviation score (SDS-BMI) using the LMS method [8]: the M and S values correspond to the median and coefficient of variation of BMI for German children at each age and gender, whereas the L value allows for the substantial age-dependent skewness in the distribution of BMI [20]. The assumption underlying the LMS method is that after Box-Cox power transformation, the data at each age are normally distributed [8]. Overweight was defined according to the BMI 90th percentile, obesity according to the BMI 97th percentile and extreme obesity according to the BMI 99.5th percentile as recommend by the European Childhood Obesity Group (ECOG) and the German working group for obesity (AGA) [18, 20].

Cardiovascular risk factors (blood pressure, cholesterol, LDL- and HDL-cholesterol, triglycerides, blood glucose and oral glucose tolerance test) were recorded in compliance with German guidelines for obese children [18]. Cut off points of 5.6 mmol/l (220 mg/dl) for cholesterol, 3.9 mmol/l (150 mg/dl) for LDL-cholesterol, 0.9 mmol/l (35 mg/dl) for HDL-cholesterol, 1.7 mmol/l (150 mg/dl) for triglycerides, 7.0 mmol/l (126 mg/dl) for fasting blood glucose and 7.8 mmol/l (140 mg/dl) and 11.1 mmol/l (200 mg/dl) for blood glucose after 2 h in the oral glucose tolerance test were used according to the WHO recommendations [1] and the guidelines of the German paediatric working group on metabolic disorders [17]. Hypertension was defined as blood pressure above the 95th percentile according to the second task force report [28].

The SAS 8.0 statistic software package was used for descriptive data evaluation. Non parametric statistical tests (Mann Whitney U-test/Wilcoxon test) were used. A P value <0.05 was considered as significant. Data are presented as median and 25th and 75th percentiles.

Results

A total of 3837 children and adolescents were included in the documentation of whom 1985 were treated in outpatient clinics and 1852 in rehabilitation institutions (Table 1). The degree of overweight in the different treatment settings is demonstrated in Fig. 1. Rehabilitation institutions treated significant older and more obese subjects (Table 1).

In 2131 patients, follow-up data over a mean of 3 months (range 1–11 months) were available. SDS-BMI decreased significantly ($P<0.0001$) from +2.47 (+2.09–+2.84) SDS to +2.15 (+1.71–+2.60) SDS. SDS-height decreased slightly but significantly ($P<0.0001$) from +0.54 (-0.14–+1.23) SDS to +0.46 (-0.23–+1.13) SDS. A follow-up of a least 1 year was available in 441 patients. In this group, SDS-BMI decreased significantly ($P<0.0001$) from +2.63 (+2.24–+3.12) SDS to +2.33 (+1.80–+2.89) SDS.

The frequencies of diagnostic procedures recorded (measurement of blood pressure, lipids, blood glucose

Table 1 Age, gender, degree of overweight, weight and height in the total group and in outpatient and rehabilitation institutions (data given as median and 25th and 75th percentiles)

	Total ($n=3837$)	Outpatient ($n=1985$)	Rehabilitation ($n=1852$)	P
Age (years)	13.0 (10.6–14.9)	11.4 (9.1–13.2)	14.4 (12.9–15.6)	<0.0001
Gender	42% boys	46% boys	39% boys	<0.0001
SDS-BMI	+2.57 (+2.16–+3.02)	+2.47 (+2.12–+2.81)	+2.72 (+2.23–+3.25)	<0.0001
SDS-weight	+2.55 (+2.00–+3.16)	+2.40 (+1.96–+2.86)	+2.78 (+2.08–+3.49)	<0.0001
SDS-height	+0.53 (−0.16–+1.24)	+0.63 (−0.04–+1.33)	+0.47 (−0.26–+1.14)	<0.0001

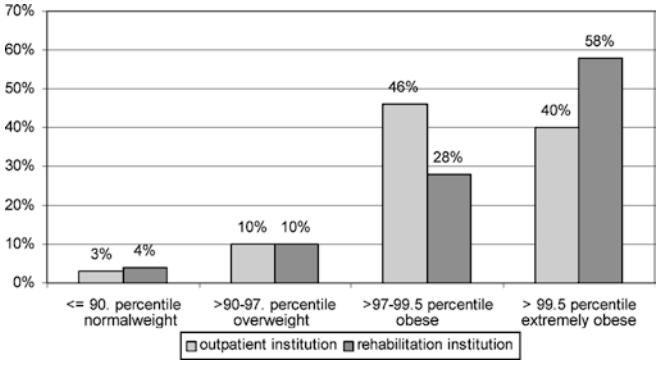

Fig. 1 Distribution of degree of overweight at initial presentation in the outpatient ($n=1985$) and rehabilitation institutions ($n=1852$)

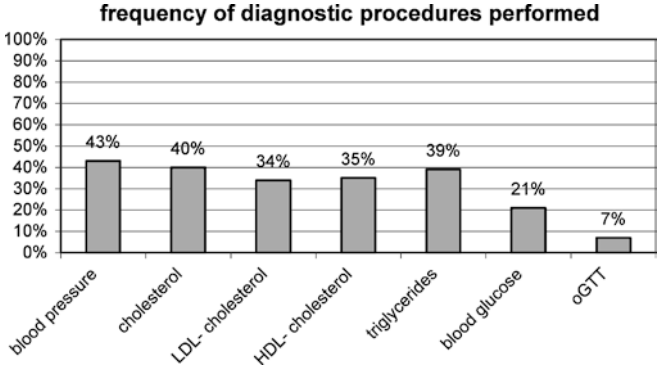

Fig. 2 Frequency of diagnostic procedures performed in the total patient group ($n=3837$)

and oral glucose tolerance test) are demonstrated in Fig. 2. Blood pressure was recorded in less than 50% of the patients, screening for dyslipidaemia in up to 40% and at least one blood glucose measurement in 21% of the patients.

Among those patients who were screened for risk factors, the frequency of hypertension, dyslipidaemia and impaired glucose metabolism is shown in Fig. 3. These percentages did not change significantly when only obese and extremely obese patients (BMI >97th percentile) were evaluated and the normal weight and overweight patients were excluded.

Despite a significantly higher percentage in decreased HDL-cholesterol and increased triglycerides in children ≥12 years, there were no significant differences in the cardiovascular risk factors according to gender or age (Table 2). Blood glucose >11.1 mmol/l in the oral glucose tolerance test was recorded only in children ≥12 years (Table 2).

Discussion

This is the first study of a large collective based on multicentre cooperation in Europe to address the quality of medical care of obese children and adolescents. Of the children and adolescents transferred to specialised treatment institutions, 50% were older than 13 years and extremely obese. Rehabilitation institutions treated more obese and older children explicable by the treatment concept with a separation of children from their family background. Only few centres offer treatment for young children. Girls were predominant in the participating treatment institutions reflecting the greater psychological impairment of obesity in females [13].

Up to 4% of all children were of normal weight and 10% were overweight but not obese at initial presentation. Probably a rapid increase in weight was the indication for therapy despite a treatment not matching the recommendations. The accumulation of extremely obese subjects may be explained by the specialisation of treatment institutions. However, treatment of obesity in younger children, in boys and in patients not extremely obese may be more effective [12, 13, 27]. Therefore, the timing of referral to specialised treatment institutions, as emphasised in our survey, should be critically reflected based on cost and benefit analysis.

The effectiveness of obesity treatment has to be evaluated in large collectives with long-term follow-up. These studies are so far lacking in childhood [10, 11, 24, 26]. In concordance with other studies, our investigation points out the weight loss and the trend to normalisation of accelerated height due to a multi-professional treatment [10, 11, 13]. An improvement in cardiovascular risk factors is to be suspected not before a reduction in SDS-BMI of at least 0.5 [23]. This degree of weight loss was not achieved in most of the children studied. In future, the documentation system "APV" will allow recording of weight status and the cardiovascular risk factor profile in a large multicentre collective over several years to validate and improve treatment programmes for obese children and adolescents.

In our study, recommended diagnostic procedures were often missed in a cohort of specialised medical centres pointing to a considerable gap between guidelines and reality in medical care of obese children and adolescents. These results are similar to the treatment

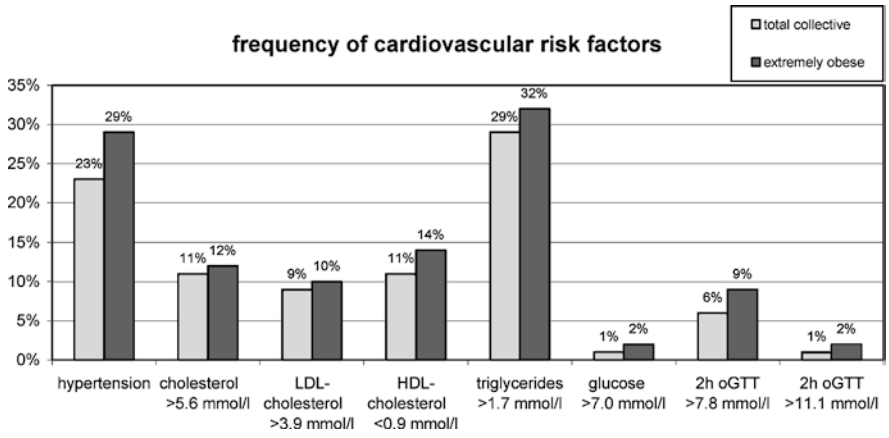

Fig. 3 Frequency of hypertension ($n = 1636/688$), dyslipidaemia ($n = 1347/535$) and impaired glucose metabolism ($n = 789/328$ fasting glucose, $n = 251/127$ oral glucose tolerance tests) (n = number of diagnostic procedures performed in total collective/number of diagnostic procedures performed in extremely obese children)

quality usually offered in Germany as discovered by the survey of the German working group on paediatric obesity (AGA) [24]. Measurement of lipids, blood pressure and glucose metabolism were documented in less than 50% of patients. A study in the United States featured measurement of lipids in approximately 50% and glucose metabolism in 15% to 29% of obese children and adolescents presenting in specialised treatment centres for obesity, whereas blood pressure was recorded in over 90% [6]. In contrast to our survey based on patient documentation, the United States study was based on a questionnaire sent to treatment centres, which probably led to overestimating the quality of medical care.

Another explanation of the poor quality of diagnostic procedures is the fact that the measurements may have been performed but not documented. In future, a nation-wide documentation system like "APV" can help to improve diagnostic procedures, since centres not conforming to the recommendations obtain feedback on the missing procedures. This could improve the quality of care as previously demonstrated with the DPV documentation software in patients with diabetes mellitus [19].

Diagnosis of cardiovascular risk factors is necessary to initiate treatment, especially if weight loss cannot be achieved or if weight loss is not sufficient to improve these risk factors. Our study demonstrates that hypertension, dyslipidaemia and impaired glucose metabolism are already present in a collective of obese, predominantly Caucasian, children and adolescents. The limitations of our study are that the methods used for the measurement of blood pressure, lipids and blood glucose may differ, the indications for diagnostic procedures seem to vary between the institutions, the non cross-sectional study design and the selection of specialised treatment centres. Therefore, the frequency of cardiovascular risk factors in our study should be interpreted with cautioun.

In agreement with previous reports [15, 21], 25% of our obese children and adolescents suffered from hypertension, whereas a few studies consisting of predominantly small samples demonstrated hypertension in up to 40% of obese children and adolescents [7, 9, 25]. Increased levels of triglycerides, cholesterol and LDL-cholesterol have been described in 10% to 40% of obese children and adolescents, whereas decreased levels of HDL-cholesterol were found in up to 10% [7, 9, 21, 25, 33] according to our data. In concordance with the few reports in the Caucasian population [32], impaired glucose metabolism (6%) and silent diabetes mellitus (~1%) was rarely diagnosed compared to studies in the United States detecting impaired glucose tolerance in 25% and silent diabetes mellitus in 4% of the screened obese children and adolescents [30]. Differences could be explained by the different ethnic subgroups. The incidence of impaired glucose metabolism is increased in particular ethnic groups like Hispanics and Afro-Americans living in the United States [2]. Most of our children with silent diabetes mellitus were male in contrast to reports of other studies in childhood [2, 22]. The small number of children with diabetes in our cohort may explain this difference.

The increase of insulin resistance at onset of puberty explains the occurrence of diabetes mellitus, hypertri-

Table 2 Cardiovascular risk factors according to gender and age (number of screened subjects)

	Male	Female	*P*	Age < 12 years	Age ≥12 years	*P*
Hypertension	23% (760)	22% (876)	0.541	22% (839)	24% (797)	0.267
Cholesterol > 5.6 mmol/l	13% (701)	10% (819)	0.069	10% (769)	13% (751)	0.170
LDL-cholesterol > 3.9 mmol/l	10% (593)	8% (708)	0.136	8% (663)	10% (638)	0.276
HDL-cholesterol < 0.9 mmol/l	13% (612)	10% (735)	0.122	9% (678)	14% (669)	0.001
Triglycerides > 1.7 mmol/l	28% (689)	30% (814)	0.586	25% (762)	33% (741)	< 0.001
Blood glucose > 7.0 mmol/l	2% (348)	1% (441)	0.189	1% (375)	2% (414)	0.176
2 h oGTT > 7.8 mmol/l	4% (123)	7% (128)	0.307	6% (84)	5% (167)	0.855
2 h oGTT > 11.1 mmol/l	1% (123)	0% (128)	0.148	0% (84)	1% (167)	0.315

glyceridaemia and low HDL-cholesterol in our study, predominantly in children older than 11 years [2]. Despite these facts, the cardiovascular risk factors showed no correlation with age or gender according to most other studies in childhood [7, 29]. The cardiovascular risk factors in obese children remain without treatment into adulthood and lead to increased mortality and morbidity [16].

In conclusion, management structures for the medical care of obese children and adolescents in Germany are still insufficient. In future, the standardised evaluation of diagnostic and treatment procedures will hopefully improve the quality of medical care for this group of patients.

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