

Preventing and treating obesity in pediatrics through physical activity

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Abstract The prevalence of juvenile obesity is increasing worldwide. Throughout Europe, ca. 20% are affected, in Germany 15%. Many modifiable and nonmodifiable causes have been determined and included, but are not limited to genetic, familiar, and lifestyle factors. In addition, obesity disproportionately affects minority and low socioeconomic status groups. Juvenile obesity increases the risk of having multiple cardiovascular and metabolic diseases, psychosocial problems, and a variety of other co-morbidities. The burden upon the health services cannot yet be estimated. Therefore, there is a need for preventive and therapeutic counter-measures. Until now, most approaches focus on changing the behaviour of individuals in diet and exercise. Based on the existing data researchers agree that programmes should start as early as possible and involve children's environment (family, peers etc.). In conclusion, a positive public health approach including political, environmental, sociocultural, and educational strategies offer the best chance of preventing and reducing juvenile obesity.

Keywords Obesity · Children · Prevention · Prenatal programming · Physical activity

Introduction

The prevalence of juvenile overweight and obesity in developed and developing countries is increasing. In

Germany approx. 1.9 million children and adolescents are overweight, and among these 800 000 are obese [1]. In the USA the number increased from around 5% in the 60s/70s to 17% in 2003/04 [2]. In Europe approx. 5% of the children aged 5–17 year are concerned [3]. This upward trend of prevalence of obesity comes along with an observed dysbalance between food intake and energy expenditure. Data show that factors contributing to the increase are a sedentary lifestyle or lack of physical activity, high caloric intake, genetic disposition as well as parents', mainly maternal, overweight, low or high birth weight, and smoking during pregnancy [4]. Among researchers it is more or less agreed that these risk factors are closely associated with the threat of overweight whereas literature gives few evidence that breastfeeding, nicotine abstention and enough sleep could be considered as protecting factors [5]. Already during and shortly after pregnancy implementing preventive and health promoting measures may be a very beneficial strategy. This recommendation could be seen at least as a result of an increased knowledge of the significance of prenatal metabolic imprinting. Moreover, maternal health and nutritional status during pregnancy and breastfeeding phase seem to have far-reaching central and peripheral effects on regulation of energy balance of children [6]. Based on these findings adequate concepts should be developed and introduced for those who are concerned. Existing programmes, primarily designed for (pre)school children do not show consistent results with regard to potential lifestyle changes [7]. Further data gained from therapeutical actions when facing juvenile obesity show the same tendency [8]. In most cases multi-modal strategies are applied concentrating on the family's environment, but this apparently is not the "silver bullet" yet. Community-based, preventive interventions seem to work best [9] which focus on changing structures like creating a

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healthy environment e.g. inviting for being active. The present article seeks to highlight latest preventive, selected therapeutical aspects of juvenile obesity as well as resulting recommendations from sports medicine point of view.

Definition and diagnostics

Obesity is described as a state in which the percentage of adipose tissue in the body rises above normal levels. Usually the body mass index (BMI) is determined to diagnose “obesity”. For children and adolescents age- and sex-specific reference values are used for classification, first published in Germany in 2001. The data are based on a metaanalysis comprising 17 studies which have been conducted between 1985 and 1999 [10]. Values greater than the 90th percentile indicate overweight whereas those greater than the 97th percentile indicate obesity. For representation of the extent and as parameter in therapy the standard deviation score of BMI (SDS-BMI and Z-score, respectively) is applied. Since BMI is not normally distributed it has to be corrected by using the LMS method. Internationally, BMI is mostly classified via the growth charts of the Centers for Disease Control and Prevention [11]. Children and adolescents with a BMI in the 85th percentile to less than 95th percentile by age and sex are classified as overweight and those with a BMI in the 95th percentile or higher as obese. Generally, BMI is known to be less reliable for making accurate muscle and fat mass calculations. Not surprisingly advanced measuring methods should be used for risk stratification and in particular they should consider the special role of visceral adipose tissue. Therefore, in epidemiologic studies waist circumference is determined [12]. Waist circumference has to be measured in the mid between the iliac crest and the rib cage during expiration [13]. Additional ways for measuring body fat-mass like underwater weight, CT (computed tomography), MRI (magnet resonance imaging) and DEXA (dual-energy x-ray absorptiometry) are complicated and expensive, and require expert skills. A good alternative could be the bioimpedance analysis (BIA), widely used as a method of assessing body composition. BIA uses a low level electrical current which passes through the body to measure the impedance to flow to estimate total body water and, subsequently, distinguish between fat-free mass and fat mass. It is simple, saves time and shows high-level interrelationships with other methods of obesity assessment [14, 15]. However, the accuracy of BIA has yet to be proven in children and juveniles because it was originally designed for adult measurements. Unlike obesity in adults, juvenile obesity measurements require different approaches and should not solely depend on body composition measurements, but also take growth into account [16].

Overall, those earlier mentioned equipment-based methods would be more precise to measure and more valid to assess body composition, but especially in epidemiologic studies the determination of BMI combined with measuring waist circumference are more practical and economic methods. However, it has to be stressed that, where required, for classifying and for comparison with other studies different reference ranges might be considered.

Co-morbidities and (patho-) physiological role of visceral fat tissue

Childhood obesity is already associated with a variety of potential co-morbidities (metabolic, cardiovascular, psychosocial, orthopaedic, etc.) and involved in the development of atherosclerosis in young subjects (between 15 and 34 year old) [17]. Excessive white adipose tissue seems to play an important role in the aetiology [18], because it is no longer considered a depot for energy storage in the form of triglycerides, but is a secretory organ that releases factors, known as adipokines, capable of regulating several physiological and pathophysiological processes [summarised in 18, 19], like leptin, adiponectin, interleukin-6 (IL-6), retinol-binding protein-4 (RBP4), resistin, vaspin, adipocyte fatty acid binding protein (AFABP), fibroblast growth factor 21 (FGF21), angiotensinogen, tumour necrosis factor alpha (TNF- α), plasminogen activator inhibitor-1 etc. They are supposed to be involved in the development of metabolic and vascular complications of obesity. If changes in the secretion of adipokines could represent the mechanistic link between excessive fat mass and functional disorders of other tissues such as liver and muscles is a central theme of research.

Cumulative evidence suggests that the origins of obesity may occur during foetal development [20]. In this respect, the concept of “developmental programming” was introduced and supported by experimental and epidemiological data. These findings have highlighted the possibility that metabolic imprinting already takes place intrauterine in critical windows of development and might influence the functionality of organs and organ systems of the offspring by specific factors (i.e. nutrition, hormones or physical activity) and thus lead to a permanent determination [21]. A range of epidemiologic and experimental animal studies have shown that mainly maternal nutrition status plays a decisive role during these phases [22]. Oken and Gillman (2003) [23] reported that epidemiologic studies have revealed an increase of prevalence of childhood obesity and metabolic syndrome due to maternal overweight. Rats’ pups exposed to fat-rich diet during pregnancy and lactation displayed higher body weight, hyperglycaemia, and higher values of hepatic lipids [24]. Comparable to that in a mouse

model with overfed mice the pups turned out to be more obese and inactive than their controls [25]. However, to date findings are controversial. An overfed animal can have a normal weight offspring as well.

The underlying mechanisms are not yet fully understood, but increased attention is put to leptin which has been identified as one of the key substances. In 1994 research focusing on gene mutation leading to overweight in mice revealed leptin as central appetite regulating hormone [26]. Leptin is secreted via adipocytes and its concentration increases proportionally to the amount of adipose tissue. High levels of leptin reduce the desire for food. Moreover, activation of the sympathetic nervous system via activation of receptors in the hypothalamus causes increasing energy expenditure. Concentration of leptin rises proportionally to adipose tissue, and leptin levels in females are 1.5–3fold higher than in males [27, 28]. During pregnancy leptin is also produced by the placenta [29]. After delivery the amount of leptin (values) decreases rapidly and reaches values comparable to those of non pregnant women. However, it is yet not really understood which role leptin plays during pregnancy as it can be assumed that pregnancy may reflect a leptin-resistant state. Despite increasing leptin levels neither a decrease in appetite nor a rise in energy expenditure can be observed [30]. An animal study on underfed offspring of mice revealed an early and excessive neonatal increase in leptin levels [31]. Iatrogenically induced in a control group such a rise led to an increased prevalence of obesity provoked by fat rich nutrition. These findings show that the leptin level as well as the production point of time seems to play a decisive role in the development of metabolic systems and their neural/central nervous control.

Conversely, animal models demonstrated that physical activity resulted in a reduction of body weight and fat mass. This effect could also be found when rats were later exposed to fat-rich diets. Therefore, it is postulated that physical activity introduced at an early age influences metabolic pathways, especially in relation to an increase in leptin sensitivity [32].

Selected preventive aspects

Therefore, it becomes apparent that prevention is important. At first potentially developing co-morbidities should be prevented, above all psycho-social pressure and limited quality of life of the subjects concerned [33]. Therefore, an early detection of potential comorbidities (screening for non alcoholic fatty liver disease, vascular dysfunction, intima-media thickness etc., blood lipids, glucose tolerance test etc.) is an important clinical objective to identify those at risk for subsequent cardiovascular and metabolic morbidity

and events, and to initiate effective counter measures. Until now, cardiovascular and metabolic screening is recommended for adults, especially in people with a family history of cardiovascular and metabolic conditions, in the growing body of juvenile obesity predictive diagnostics will play an increasing role [34, 35]. Additionally, obese children and adolescents are more likely to become obese as adults with obesity-related co-morbidities [36]. In this context possible cost consequences for the health system have to be considered, although there is no evidence so far that preventive strategies reduce healthcare costs. As obesity is a highly complex disorder with a multifactorial aetiology performing physical activity is the only way to acutely and chronically increase energy expenditure and thus reaching a balance between food intake and energy consumption.

Only a few data exist concerning lifestyle changing measures during pregnancy. To date during pregnancy too little efforts are taken for preventive measures on childhood obesity, despite the fact that the phenomenon of metabolic imprinting seems to be a very important aspect. Women usually are more amenable to changing their life patterns while they are pregnant [37]. Especially physical activity is supposed to have an impact on weight gain and carbohydrate metabolism during pregnancy [38]. Streuling et al. [39] investigated these aspects in a meta-analysis comprising four randomised controlled and five non randomised controlled trials with 1549 women enrolled. Combined programmes including nutritional counselling and physical activity were most effective and resulted in the lowest weight gain in the intervention groups (–0.22 units).

Most of the measures take place at (pre)school age. A recently performed Cochrane analysis comprising 26 published studies demonstrated the effect of school-based exercise interventions for promoting physical activity and fitness [40]. Some of the results showed an increase of duration of performed exercise, of maximal oxygen uptake, and thus, fitness, as well as a reduction of time watching TV and of whole cholesterol. No effect could be observed, however, concerning the parameters leisure time activities, blood pressure, heart frequency, and body mass index. Among kindergarten children improved learning effects, a smaller rise of BMI, and an improvement of motor performance capacity was reported. But all data considered the results are inconsistent [41, 42]. Based on these findings what recommendations can be drawn? At least the time window where children start to implement physical activity in their life should be chosen as early as possible and parents should consequently be part of this measure as overweight of the parents often represents a risk factor for their children to develop overweight on the one hand and due to their role as model on the other hand [43].

Since 2008 until now there have been over 30 published reviews and meta-analyses on interventions concerning the

prevention of juvenile obesity (randomised and controlled trials). In summary, community-based programmes that target environments and upstream determinants seem to be more effective than personalised treatments [44].

For instance, Romp & Chomp is a community-wide, multisetting, multistrategy intervention conducted in Australia from 2004 to 2008 [45]. The intervention occurred in a large regional city (Geelong) with a target group of 12,000 children and focused on community capacity building and environmental (political, sociocultural, and physical) changes to increase healthy eating and active play in early-childhood care and educational settings. There was a significantly lower mean BMI and lower prevalence of overweight/obesity in some subsamples compared to the controls. In addition, the intervention led to a significantly lower intake of packaged snacks, fruit juice, and soft drinks. However, time, effort and costs can be very high depending on the complexity of the measure. Furthermore, support of political and economic stakeholders is absolutely necessary. It has to be noted that the social and cultural shifts that support healthy eating and physical activity occur differentially, and special efforts are needed to reduce the socioeconomic gradients associated with childhood obesity [9].

Recommendations—physical activity

Physical activity and aerobic fitness are positively related to a healthier cardiovascular risk profile in youth [46, 47], independent of specific training concepts. For all target groups mentioned in this paper more or less evidence-based recommendations exist for physical activity. Directly addressing pregnant women without health risks the RCOG [48] recommends to exercise daily for 30 min at moderate intensities, mostly in the range of 60–70% of maximal heart frequency, sometimes subdivided by age from maximal 125 to 140 beats/min. Preschool aged children, that means from 0 to 5(6) yrs, should have at least 2 hours of moderate to intensive exercise a day [49], older children around 60 min [50]. Although those recommendations are not taking individual interests, predisposition or fitness level into account, in terms of motivating pregnant women, children and adolescents advices should focus on their personal interests. In addition, under preventive conditions no check-up is necessary.

According to the American Academy of Paediatrics [51] children less than 2 year of age should not watch TV, and those who are older not more than 2 h maximum. No television or any other audio visual media should be placed in the sleeping/playing area of children, although for the latter conclusion published data is not as consistent as for TV watching. Additional 15 min of daily exercise among

12-yr old children led to a lower body fat mass at the age of 14 (11.9% less with boys, 9.8% with girls) [52]. Adjusted to reflect regional conditions our working group developed the children's activity pyramid (s. Table 1; [53]). Here, the method of "calculation of portions" was adopted for activity and the recommendations are composed of 15 min lasting units. The analysis of the ongoing study reveal that 2 h of exercise and leisure time activity should be accumulated. The basis consists of daily routine activities (aim 30–60 min). The TV screen time was limited from zero to 1–2 h a day, depending on age.

Factors influencing performing physical activity

In order to promote physical activity as a measure for prevention and therapy in an optimal way the factors have to be considered which can have a positive or negative impact on the acceptance of exercising. There is an interplay of environmental influences, family lifestyle, and genetic determinants which have an impact on the fact to which extent each individual prefers being physically active or inactive. In the Quebec Family Study the heritability for moderate/intense physical activity was reported in the range of 16%, for daily routine activity of 19%, and for inactivity in the range of 25% [54].

Especially in pregnant women a considerable discrepancy between recommendations and the really performed physical activities can be observed [55, 56].

In a cross-sectional study conducted by Petersen et al. [56] less than one fifth of the women followed the recommendations to perform moderate exercise during pregnancy. Women describe fear of foetal injuries, indisposition, and fatigue [57] as reasons for non-compliance to the advice, but also a lack of attractive programmes [58]. Obviously, it is very important to know these barriers and take them into consideration when developing special concepts.

On the basis of data interpreting of 108 studies Sallis et al. [59] could identify 40 variables influencing physical activity behaviour in 3–12 year old children, and 48 variables in adolescents (13–18 year). Among children primarily gender male, parental body weight, individual attitude and experience, potential barriers, motivation, health status, accessibility and time spent with playing outside are the most remarkable factors. Among adolescents the following influencing factors were found: gender male, ethnic origin, age, self-perception of physical activity competence, depression, experience, sports clubs, sensation seeking, after-school activities, family support (parents, brothers and sisters), but also support of others, accessibility.

Further to this van der Horst et al. [60] analysed 60 studies for factors linked to physical inactivity. Sedentary

Table 1 Recommendation for the children's activity pyramid [53]

	Duration	Intensity	Heart rate ^a	Examples
Daily activities	6× at least 5–10 min	–	–	Go to school by foot or bicycle; housework, e.g. raking leaves, tidy the room, vacuum cleaning
Moderate activities	4× 15 min=one hour	Not sweating or panting	Approx. 130 to <160 beats/minute	Physical education lessons, organised sports; Leisure activities like playing with friends or family members (swimming, inline skating, hide and seek) ^b
Intensive activities	2× 15 min=30 min	Sweating or panting	≥160 beats beats/minute	
Inactivity/media consumption	4× 15 min (less than 12 years) 4× 30 min (more than 12 years)	–	–	Television, media use (PC, video games) ^c

^a Heart rate—not obligatory

^b The classification of these examples to moderate or intensive activities depends on the self-reported intensity (sweating or panting)

^c Obligatory, creative or relaxing activities like school time, drawing, reading and creative hobbies are excluded

activities like watching TV and reading were classified as inactivity whereas having moderate exercise less than 1 h a day or having intensive exercise less than three times a week were considered insufficiently active. Among children (4–12 year) inactivity and insufficient activity correlated positively with age, single mother or father, resident of a town, and correlated negatively with ethnic origin, self-confidence, parent's physical activity behaviour, and family support. Among adolescents (13–18 year) there was a positive correlation with gender male, their own BMI, presence of depression, TV consumption, and a negative correlation with age, ethnic origin, socio-economic status and parental education level. Robbins et al. [61] investigated the barriers and the perceived benefit with regard to physical activity. 206 children aged 11–14 year were enrolled and scaling was offered from 1 (= "not at all") to 4 (= "very much"). Table 2 shows the list of potential barriers, Table 3 the described benefit. These aspects should be taken into account in the design of preventive (and therapeutic) programmes.

Selected therapeutic aspects

Nowadays programmes designed for therapy of juvenile obesity do have a multi-modal and interdisciplinary approach. The treatment consists of training, both theoretical and practical, including oecotrophologic, psychologic-pedagogic and medical lessons as well as working with the parents, but implementing physical activity plays a decisive role. However, to date there is no single "silver bullet" in therapy [8]. Best results were achieved with programmes focusing on young children, on a multi-modal approach including behavioural-therapeutic elements, as well as on

integration of the children's environment. From sports medical point of view the term "sports" has to be distinguished from that of competitive sports and high elite sports. In general, the subjects concerned do have motor deficits and a significantly reduced performance capacity compared to their peers [62]. Therefore, it is not the major goal of the programmes to enhance physical and motor performance capacity and energy expenditure, but to encourage participation in sports activities and playing outside to help children and adolescents to (re-)experience and/or modify behavioural processes [33, 63]. To promote health and well-being this multi-dimensional approach of sports therapy appears very effective in terms of the salutogenic model as a model focusing on factors that support human health and well-being, rather than on factors that cause disease which cannot be clearly stated for the other approaches. At first view the aim is to reduce potential barriers, but in the long term it is intended to enhance time spent with everyday and leisure activities and thus modify children's lifestyle. Not rarely those children and adolescents who have experienced negative side effects have again be brought closer to physical activities and have to be encouraged to integrate them into their daily routine. Remarkably, in addition to the beneficial outcome for physical health both, the body scheme and self-perception of the children and adolescents, respectively, improve. The feeling of joy when playing with other children or exercising with them, experiencing the own performance capacity or that of the whole group consisting of other children with the same or similar problems reflects the chance to help the often socially isolated, obese child to improve quality of life and to make contacts and to find friends. Additionally, transfer opportunities should be opened for those days where no therapy takes place in

Table 2 Barriers to physical activity perceived by middle school boys and girls—Mean scores and standard deviations ($N=206$; [61]); demographics. Response choices for the scales included: 1 (not at all true), 2 (not very true), 3 (sort of true), and 4 (very true)

Boys	Mean score (standard-deviation)	Girls	Mean score (standard-deviation)
I have minor aches and pains from activity	2.14 (1.01)	I have minor aches and pains from activity	2.29 (1.04)
I am tired	2.10 (0.98)	I am tired	2.26 (1.01)
I am too busy	2.07 (0.95)	I am too busy	2.22 (1.09)
I had a bad day at school	2.05 (1.10)	I am not motivated or feeling too lazy to exercise at the time	2.18 (1.07)
I feel self-conscious or concerned about my looks when I exercise	2.05 (1.06)	I feel self-conscious or concerned about my looks when I exercise	2.13 (1.12)
I am not motivated or feeling too lazy to exercise at the time	1.95 (0.93)	I have to exercise alone	1.95 (1.14)
I have to exercise alone	1.85 (1.11)	It is very hard work	1.90 (1.03)
It is very hard work	1.78 (0.91)	I had a bad day at school	1.85 (0.96)
I am afraid to fail	1.77 (1.06)	I am afraid to fail	1.78 (1.08)

order to provide regular time windows for physical activities during and especially after termination of the therapy. This applies also for regulation of using audio-visual media (like TV, computer, video games) [64].

In principle for therapy the same recommendations are applied as for prevention [65]. Yet for successful treatment of adult obesity significantly greater amounts of physical activity are required to maintain or even to reduce weight [66] and presumably for treatment of juvenile obesity higher goals should be set. Atlantis et al. [67] suggest 155–180 min/day of aerobic exercise at moderate to intensive levels in order to achieve beneficial effects. Nevertheless, it is of less interest which kind of exercise/sport people follow, the benefit and prognostic value seems to be nearly the same in all types of sport [68]. Therefore, the most important factor is the individual predisposition

and motivation, not to participate in specific exercise or training programmes.

The results of different national and international programmes demonstrate that besides a reduction of BMI and BMI-SDS primarily an improvement of performance capacity and the individual's perception of "self" can be established. McGovern et al. [69] integrated 61 studies in their meta analysis and observed that determination of body composition (i.e. of body fat mass or lean fat mass) is an additional important factor, because this parameter showed significant improvements after intervention which could not be measured in body mass index (BMI) only. Due to the fact that the mentioned co-morbidities associated with obesity are correlated to body composition, mainly to visceral fat tissue [70], it is strongly recommended not only to measure weight status, but to register potential

Table 3 Benefits of physical activity perceived by middle school boys and girls—Mean scores and standard deviations ($N=206$; [61]). Response choices for the scales included: 1 (not at all true), 2 (not very true), 3 (sort of true), and 4 (very true)

Boys	Mean score (standard-deviation)	Girls	Mean score (standard-deviation)
Improve or have more athletic skill	3.50 (0.87)	Take care of myself, stay in shape, and be healthier	3.63 (0.63)
Take care of myself, stay in shape, and be healthier	3.41 (0.76)	Have a chance to play or be active	3.42 (0.83)
Have a chance to play or be active	3.32 (0.83)	Prove to myself what I can do physically	3.37 (0.87)
Have more energy	3.28 (0.86)	Have more energy	3.33 (0.92)
Have fun or be part of a fun group or activity	3.18 (0.93)	Improve or have more athletic skill	3.28 (0.93)
Make me happier	3.17 (0.96)	Make me happier	3.26 (0.90)
Prove to myself what I can do physically	3.17 (0.94)	Have fun or be part of a fun group or activity	3.25 (1.04)
Looks better	3.14 (0.94)	Looks better	2.98 (1.13)
Spend time with family, friends, or team members	2.90 (0.99)	Spend time with family, friends, or team members	2.95 (1.03)
Have other people see my athletic skill or fitness	2.71 (1.03)	Have other people see my athletic skill or fitness	2.53 (1.11)

surrogate parameters. Moreover, continuous verification of motivation and, if necessary, of regular participation (i.e. on the part of cost-bearers, regular course participation confirmation) is an effective measure to increase effectiveness. Particularly beneficial is the idea to introduce children into existing courses in sports clubs or to integrate them in pre-programmes before the real programme starts. An example for this is Obeldicks [71]. Using these opportunities on the one hand the time gap till the beginning of the programme is bridged and on the other hand first little activities as well as pre-checking motivation can be initiated. One problem which should not be underestimated regarding the long-term success is the missing of adequate after-treatment. Reduction of BMI-SDS or even BMI does not automatically come along with reaching normal weight or overweight. Very often the patients are still obese when treatment is terminated. An improvement of motor performance capacity does not give clear evidence that over the years acquired disorders have reached normal status, but only an improved status, because treatment has been beneficial for the situation of the patient. Sometimes children and the families are not aware of these facts and therefore, they have to obtain detailed information prior to and also after the programme in order to avoid to create false hope which could lead to frustration. Up to now only very few clubs or other sport organisations are really prepared to manage the special situation of obese children and adolescents. This existing gap in healthcare underlines the importance of encouraging the patients to have self organised exercise in everyday life and leisure time.

Conclusion and outlook

Health benefits of physical activity are accepted without any doubt and the demand for promotion is evident. These measures should start as early as possible, during pregnancy at the best, at pre-school at the latest and they should integrate the children's and adolescent's family and environment. In therapy additional modular interventions like nutrition counselling, working with parents, dealing with psycho-social aspects are absolutely necessary. For this reason, the principal protagonists in the context of prevention and treatment of juvenile obesity should be integrated; summarised the following points should be considered:

- Professional groups: Within a medical setting general practitioners/gynaecologists/paediatricians play an important role in the detection and care of possible comorbidities. In addition, they should motivate their patients to an active/healthy lifestyle. For this reason, it is important that these professionals can identify

coherencies, but also know evidence-based recommendations for the particular target audience. One helpful technique is the motivational interview that can be implemented very easily into practice. In school-based settings or kindergarten, beside physical education programmes teachers and educators should offer a wide variety of physical activities during the whole day, not only to develop children's motor skills but also to motivate them to lead a healthy lifestyle. Therefore, it has to be ensured that these environments are appropriate for the necessary requirements.

- Parents: First of all, parents need to get aware of their functions as a role model. Not only they will benefit from exercising themselves, their offspring will profit also. Therefore, they are an important partner in promoting a healthy lifestyle, especially in young children. Appropriate education programmes can contribute to a more conscious lifestyle.
- Children/adolescents: On one hand in all settings in which children live, all actors need to be aware of their function as a role model, but also use their space of action in regard to a healthy lifestyle. Children must be offered alternatives to unhealthy behaviour; appropriate school subjects, as well as extra-curricular activities could contribute to that.
- The most important partners are the so-called stakeholders including politics, which can, in the form of municipal programmes, create appropriate conditions for all of the groups mentioned above.

But there are still (at least) three remaining questions: 1) Are current recommendations concerning activity/inactivity effective enough to counteract the development of obesity? 2) How should they be interpreted for those who are already overweight/obese? and finally 3) How can special groups like girls, people with a migration background, socially weak persons, elderly and adolescents as well as pregnant women be addressed?

Ad 1)

When answering this question it has to be considered that the majority of investigations report that apparently at least before puberty the current recommendation to perform physical activity 60 min/day is fulfilled. Nevertheless the prevalence of juvenile obesity is rising considerably. Taking into account that physical activity is sufficient to elicit health benefits it should be critically questioned if the recommended amount really meets the requirements. According to the findings of the European Youth Heart Study Andersen et al. [72] claim 90 min rather than 60. On the basis of national results the children's activity pyramid with significantly higher target values was designed (s. Table 1). Following current literature

it seems to be desirable that not only mean values are used without any criticism, but to concentrate on potential risk groups to be able to individually adjust target values for duration of activity and for TV consumption. Besides an increased amount of physical activity in the debate on obesity a reduction of time watching TV is apparently important and should always be an essential part of measures and recommendations [73].

Ad 2)

Physical activity—structured, not structured, in everyday life and/or leisure time—is nowadays in most concepts part of therapeutic measures. According to findings and recommendations concerning adult obesity greater amounts of physical activity are necessary in the long term if it is aimed to stabilise or even to reduce weight. However, for this clientele further investigations have to be initiated to clarify details such as intensity, duration, frequency of exercise, and appropriate kinds of sport, motivation etc. These studies should not focus on BMI only, but as well on body composition and other surrogate parameters of health like blood pressure, lipids, blood glucose, insulin, adipokines, etc. as well as fitness and motor performance capacity. In the discussion “what do concerned individuals need?” infrastructural conditions should be approached from different angles, too. Until today, especially there is no adequate after-treatment and it is not equally accessible to all areas. When participation in outpatient or stationary programmes has terminated children and adolescents often face the problem that they cannot be easily integrated in existing sport courses because over the years they have acquired motor deficits, or have gained negative experiences or due to the fact that sports club are usually performance-oriented.

Ad 3)

Finally in this question for special target groups the “well-known” risk groups focusing on overweight/obesity are represented. Sometimes the number of course offers is insufficient or they are not used in an optimal way, for example during pregnancy. Unfortunately, the latter fact apparently is attributable to pregnant women who believe in myth or are afraid to exercise. Overall it has become evident that it is a society-wide problem which is not only limited to the discussion on energy balance as it depends on educational and economic aspects as well. From the point of view of research it is important to have deep insight into the target groups to understand their needs and take actions to turn this insight into an adjusted and feasible programme design (“participation and tailoring”).

Concretely, all principles of health promotion, quality management, and project management have to be

considered. For orientation, the model for planning and transfer into practice of preventive and health promoting measures can be used [74, 75]. Relationship measures like community-based programmes promise to be beneficial and they could set in motion a trend reversal. In this context, the support of political and economic stakeholders is necessary and asked for. However, they should not be satisfied with single actions, competitions or election periods, but should aim at achieving sustained structural change in the sense of creating an anti-obesogenic and activity inviting environment.

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