“Fitkids” - Development of a 12-week strength training program

Professional Assignment
Thesis

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Guide

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Preface

This guide was conceived within the scope of a Professional Assignment Project of two 3rd year ESP students.

At the beginning of this project, the purpose of the group was to make videos related to physical tests done in the realm of physiotherapy. This suggestion had been provided by the school itself.

However, one of us, during the Clinical Internship, spent time at a physiotherapy practice that was working with an interesting youth program, called ‘Fitkids’. This program works with kids (who were referred by specialists), and aims towards prevention and management of chronic disorders, illnesses, or impairments – especially obesity.

Even though this program is not strictly related to our original choice, we decided to re-orientate our focus on child obesity and its management instead, because obesity is a serious health, which impairs or limits one’s physical capabilities. Furthermore, with this program we have the opportunity to see a treatment approach in children, which is also fascinating. Thus, this Project Assignment Plan is an external research assignment about obesity in children and its management in physiotherapy with particular focus on strength training.

Our client, who works as a physiotherapist within the program of ‘Fitkids’, explained to us that, even though the ‘Fitkids’ guidelines recommend the use of strength training and tests, these are often overlooked, due to old misconceptions about the subject.

Therefore, she asked us to perform research on the subject – is strength training safe and beneficial for children – and, if so, to build up a 12 week strength training program.

This guide consists of some of the results of our research (background that includes recent literature on childhood obesity and strength training for children) and, since we got to a positive answer for the main question, a 12 week strength program for kids.

Hopefully, this will be helpful for those who just began working with ‘Fitkids’ or have any doubts about the inclusion of strength training in the program.
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Acknowledgments

In an endeavour such as this one, one need the support, at various levels, of several people. We are, of course, no exception, hence this page.

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Thanks to our coach for this project, Bob van den Berg, for his guidance and feedback.

**Personal Acknowledgments:**

**Susana:**
Even though our client has already been mentioned as someone we’re thankful to, I’d like the opportunity to not only thank her for all the support dedicated to this project, but also to wish all the best, to her and her two little dragons.

I would like to express my deep gratitude to some of my colleagues, namely Julianna Hagenbrock, Nekpen Tokunbo, Verena Schneeweis, Kirsten Scholten (and her lovely parents), Steen Petersen, Tobias Reinicke, Paula Valentine, Janina Richter, Ruth Froitzheim, Joel van Vliet and many others, not only for giving me feedback on the project, but also for giving me the strength I needed throughout the whole process. I do apologize if I forgot any name, which I’m sure I did; however, in my mind I’ll always remember those who helped me. I am well aware that, if not with their support, I would very likely have not finished this product.

Moreover, I would like to appreciate my family’s support. Thank you for making me feel you are right here with me, even though you’re so far away.

**Frank:**
I would like to thank all the persons involved in the development of this text, especially our client for giving us the opportunity to work with her and for all the advice and information provided to us.

Finally, special thanks go to my parents, my girlfriend, and my sisters for all the love and support they gave all along this period.
1. Introduction

Obesity and, in particular, childhood obesity, is becoming each time more an issue that must not be disregarded.

Statistics (van den Hurk, 2003) show that this is a problem with growing tendencies throughout the whole world, including the Netherlands.

There are, according to the Dutch Guidelines on Obesity, several different ‘fronts’ to attack this problem:
- An individually tailored and improved diet, which will reduce energy intake;
- An increase on physical activity and
- If necessary, psychological intervention.

Regarding the second suggestion, physical activity, these guidelines suggest that the Dutch Standard Healthy exercise (Health, 2006), which advises children until 18 year old to exercise 1 daily hour (moderately intense exercise, 5-8 MET) and, at least twice a week, to perform activities that improve or maintain physical fitness, such as strength, agility and coordination, should be promoted.

In this guide, strength training will be mostly addressed.

‘Fitkids’ is a program, inserted in several Dutch clinics, which aims helping obese children, regarding treatment, maintenance and prevention of this and other problems, such as respiratory pathologies (e.g. asthma) and diabetes (see website www.fitkids.nu for more information).

The program counts, already, with several guidelines on exercising, nutrition, etc.

However, there seems to be a general lack of available strength training programs in the ‘Fitkids’ Guidelines (which may be retrieved at the aforementioned website), which sometimes leads to a disregard towards this kind of training.

This guide will give the reader (which, is this case, will be a PT student or physiotherapist who encounter this specific program at their internship or clinic) an overview on recent literature, about childhood obesity and strength training for kids – is it safe and/ or beneficial?
A strength training program for kids is also included in this guide, described in a way to be inserted into the ‘Fitkids’ preexisting sessions.

After reading this guide, the reader will have remembered and/or learnt about obesity and training and, by doing so, will hopefully provide better care to these children. Also, since information is given about ‘Fitkids’, the reader will feel more comfortable and aware of what this program means and consists of.

Moreover, it is necessary to remember that dealing with children is not the same as dealing with adults; they will have to think of the exercise as something fun to do, instead of as an obligation. The examples given in this guide are an attempt at turning something boring into something children will look forward to – this issue will be addressed to in this guide as well.
2. Obesity

“It is health that is real wealth and not pieces of silver and gold” (Mahatma Ghandi, Indian Philosopher, 1869-1948.)

Some years ago, someone who was overweight or even obese was regarded as someone who possessed a strong health. However, nowadays it has been proved that overweight and obesity have several negative consequences.

Obesity is one of the problems most commonly associated with the current western lifestyle (see definition of obesity further in this chapter). Due to bad diet habits and a sedentary life, patients who suffer from obesity are each time more, and bring with them a high number of complications associated with this pathology, premature aging and even death.

In addition, obese people have to deal as well with social pressure: often people are made fun of and discriminated, which may lead to psychological problems in the future.

Studies and recent statistic research show that there has been an alarming grown in obesity patients during the last 10 years, especially in Canada, England and USA.

According to the American National Center for Health statistics, the number of obese people in the US raised, between 1962 and 2000, from 13% to 31%. It also shows that childhood obesity has more than tripled during the last two decades.

The US surgeon general report states that morbid obesity is liable for thousands of deaths every year.

In the Netherlands, according to the European Association for the Study of Obesity, obesity in men rose gradually from 4.9% to 8.5% while in women it went from 6.2% to 9.3% from the late 1970s to the mid-1990s. In 2006, the Kenniscentrum Overgewicht (knowledge centre for obesity, in the Netherlands) revealed that it has prevalence in the order of 51% of men and 42% of women.

Fortunately, this problem may be prevented in a large scale, if the correct changes in lifestyle are implemented in time.
2.1 Definition

Obesity is defined as an increase of body fat composition. This increase is translated into an increase of weight and, even though not all weight increase is due to an increase of adipose tissue, in medical practice obesity is related to the patient's weight.

As will be further discussed in the Diagnosis section, someone who has a BMI of >25 or more than 20% of their theoretic ideal weight, is considered obese. Table 2 (see Measurement Tools – Anthropometry) takes into account height, age and gender. Of course, there are exceptions to there diagnostic techniques, which will be described later.

2.2 Health Risks

Obesity may have several health repercussions, such as may be seen on Table 1.

<table>
<thead>
<tr>
<th>Disease/ Type of disease</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Diabetes Mellitus (Type II) About 50% of obese children in Europe and Asia (Schober 2005, Ehtisham 2004, Rami 2003) | - MI  
- Angina Pectoris  
- Thoracic Oppression  
- Cardiac Insufficiency  
- Thromboflebitis  
- High blood pressure  
- Cardiac insufficiency  
- Etc. |
| Cardiovascular | - Testicular  
- Ovarian  
- GH  
- Prolactin  
- Thyroid  
- Etc. |

Table 1: Diseases that may come as a repercussion of obesity.
| Cancer | - Increase of mortality  
|        | - Statistical increase of prostate and colon cancer risk in men  
|        | - Statistical increase of endometrial, ovary and breast cancer risk in women  
| Respiratory | - Alveolar hypoventilation  
|            | - Increase in pneumonia and chronic bronchitis incidence  
|            | - Picwick syndrome  
| Metabolic (About 25% of European obese children, from 6-16 years (Invitti 2006)) | - Hyperglycemia and resistance to insulin  
|            | - Hypercholesterolemia  
|            | - Hypertriglyceridemia  
|            | - Hyperuricemia  
| Osteoarticular | - Flattening of the feet  
|              | - Flattening of the spine’s vertebral bodies, with neuralgias and spondilytis  
|              | - Generalized arthrosis, especially in ankles, knees and hips  
|              | - Muscular atrophy  
| Digestive Problems |  
| Renal Problems |  
| Cutaneous Problems |  
| Sexual Problems |  
| Neurological | - Cephalaeas  
|              | - Insomnia  
|              | - Etc.  
| Hematological Problems |  
| Psychological Problems | - Social Pressure  

2.3 Diagnosis: Measurement tools and tests

As was previously mentioned, not all weight increases are due to an increase of body fat. For this reason, defining this disease and creating measurement tools in order to provide a correct diagnosis brought several difficulties.

It is not just about the weight increase, since someone who is very muscular may be heavier than other people – which don’t mean they are obese.

Obesity is generally measured through overweight indicators, such as BMI, or through percentage and adipose tissue distribution in the organism.

Diagnosis methods

- Electrical bioimpedance
- Subcutaneous fat folds measurement
- Waist-hip measurement
- Waist circumference measurement
- BMI: The BMI (Body Mass Index), also known as Quetelet Index, relates weight and height through the following quotient:

\[
BMI = \frac{\text{Weight (Kg)}}{\text{Height}^2 \text{ (m)}}
\]

This Index has the advantage that both components (weight and height) may be easily determined, with great precision.

The World Health Organization (WHO) and the Spanish Society of Obese Studies consider the following table, in order to define the level of obesity according to the BMI:

<table>
<thead>
<tr>
<th>Level of Obesity</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>BMI = &lt; 20 kg/m²</td>
</tr>
<tr>
<td>Normal</td>
<td>BMI = 20-25 kg/m²</td>
</tr>
<tr>
<td>Obesity Grade I  (Overweight)</td>
<td>BMI = 26-29.9 kg/m²</td>
</tr>
<tr>
<td>Obesity Grade II</td>
<td>BMI = 30-34.9 kg/m²</td>
</tr>
</tbody>
</table>
It is known, however, that this Index may be inaccurate, especially with very muscular people and pregnant women.

2.4 Multidisciplinary management

It is advised by the Kwaliteitsinstituut voor de Gezondheidzorg CBO Guidelines, regarding diagnosis and treatment of obesity in adults and children (2008), that obesity is dealt with by a multidisciplinary team, which may include:

- a physician, who will make the diagnosis and refer the patient to all the other multidisciplinary team’s members, according to necessary;
- a psychologist, who will work with the patient and help him/her understanding what really is going on, and how to deal with the pressure of struggling with such a problem;
- A dietitian/ nutritionist, who will plan food and nutrition programs and, if necessary, supervise them. They will promote healthy eating and suggest dietary modifications.
- an exercise specialist (physiotherapist, exercise physiologist), who will identify the main problems and, accordingly, develop an exercise plan and supervise it; the physiotherapist will, moreover, work on keeping the ROM on the most affected joints (ankles, knees, hips), by means of mobilization, etc.
- a nurse, who may be needed in case the patient needs some sort of regular medication or if the patient is in such a state that becomes dependent and has no one who can take care of him/her;
- counselors who may help not only the patient but, in case of childhood obesity, give advice to the parents on how to deal with this problem.

2.5 Conclusion

Obesity is a serious problem, which affects not only the person who suffers from it, but as well those in their surroundings. There are several causes associated to it and not only does it bring social pressure, it also may lead to several secondary health problems and, in extreme cases, to death.
There are, nowadays, several diagnosis methods and, once someone is diagnosed with this disease, they should seek help as soon as possible. With the correct help and will power, this problem may be overcome.
3. Childhood Obesity

Several specialists who have addressed this problem and are still interested in childhood obesity are yet to agree on the moment when this disorder “begins”. There are, so far, three different basic theories:

- Early months of life – to some specialists, it starts very early, depending on kind of food the child receives.
- When beginning to walk – to other specialists, one can only refer to childhood obesity after the 1st year, when the child is able to walk.
- 3 years of age – other specialists believe childhood obesity is only established after their 3rd birthday, as whatever overweight they had before this date was not a risk factor.

3.1 Implications of obesity in children: health risks

Childhood obesity, just like adult obesity, may result in several other pathologies, such as:

Table 3: Diseases that may come as a repercussion of childhood obesity.

<table>
<thead>
<tr>
<th>Disease/ Type of disease</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Diabetes Mellitus (Type II) About 50% of obese children in Europe and Asia (Schober 2005, Ehtisham 2004, Rami 2003) | - Septic hip necrosis, due to weight excess  
- Extremity varus  
- Knee arthrosis |
| Orthopedic | - Lung insufficiency  
- Obstructive apnea |
| Respiratory | - Advanced bone aging  
- Increase stature  
- Advanced menstrual period |
| Skin | - Striation  
- Cellulites |
Cardiovascular
- High blood pressure
- Increase of cardiac volume
- Dyslipidemia
- “Bad” Cholesterol increase (LDL)
- “Good” Cholesterol decrease (HDL)
- Triglyceride increase
- Atherosclerosis

Psychological
- School bullying
- Loss of self-esteem
- Clinical depression
- Change of body scheme perception

Others
- Resistance to insulin
- Diabetes
- Higher frequency of gall stones

3.2 Diagnosis: Measurement tools and tests

All the measurement tools and tests mentioned above (see page 10) may be used to diagnose childhood obesity.

Until the 3rd birthday, the weight-size Index may be used as well: this technique measures the total body mass of the child, but finds its limitation as it doesn’t take into account the fat mass – it doesn’t differentiate a kid who has an excess of fat from one who’s exceptionally musculated.

In relation to the BMI (see page 11), Table 4, created by Cole T et al, may be followed:

<table>
<thead>
<tr>
<th>Age</th>
<th>BMI 25 kg/m²</th>
<th>BMI 30 kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>2</td>
<td>18,41</td>
<td>18,02</td>
</tr>
<tr>
<td>2 ½</td>
<td>18,13</td>
<td>17,76</td>
</tr>
</tbody>
</table>

Table 4: BMI table, created by Cole et al., specifically modified for children.
| 3   | 17,89 | 17,56 | 19,57 | 19,36 |
| 3½  | 17,69 | 17,40 | 19,39 | 19,23 |
| 4   | 17,55 | 17,28 | 19,29 | 19,15 |
| 4½  | 17,47 | 17,19 | 19,26 | 19,12 |
| 5   | 17,42 | 17,15 | 19,30 | 19,17 |
| 5½  | 17,45 | 17,20 | 19,47 | 19,34 |
| 6   | 17,55 | 17,34 | 19,78 | 19,65 |
| 6½  | 17,71 | 17,53 | 20,23 | 20,08 |
| 7   | 17,92 | 17,75 | 20,63 | 20,51 |
| 7½  | 18,16 | 18,03 | 21,09 | 21,01 |
| 8   | 18,44 | 18,35 | 21,60 | 21,57 |
| 8½  | 18,76 | 18,69 | 22,17 | 22,18 |
| 9   | 19,10 | 19,07 | 22,77 | 22,81 |
| 9½  | 19,46 | 19,45 | 23,39 | 23,46 |
| 10  | 19,84 | 19,86 | 24,00 | 24,11 |
| 10½ | 20,20 | 20,29 | 24,57 | 24,77 |
| 11  | 20,55 | 20,74 | 25,10 | 25,42 |
| 11½ | 20,89 | 21,20 | 25,58 | 26,05 |
| 12  | 21,22 | 21,68 | 26,02 | 26,67 |
| 12½ | 21,56 | 22,14 | 26,43 | 27,24 |
| 13  | 21,91 | 22,58 | 26,84 | 27,76 |
| 13½ | 22,27 | 22,98 | 27,25 | 28,20 |
| 14  | 22,62 | 23,34 | 27,63 | 28,57 |
| 14½ | 22,96 | 23,66 | 27,98 | 28,87 |
| 15  | 23,29 | 23,94 | 28,30 | 29,11 |
| 15½ | 23,60 | 24,17 | 28,60 | 29,29 |
| 16  | 23,90 | 24,37 | 28,88 | 29,43 |
| 16½ | 24,19 | 24,54 | 29,14 | 29,56 |
| 17  | 24,46 | 24,70 | 29,41 | 29,69 |
| 17½ | 24,73 | 24,85 | 29,70 | 29,84 |
| 18  | 25    | 25    | 30    | 30    |

The BMI has, however, some limitations.
For example, parents should be aware of the fact that their kid is growing up, hence there may be some discrepancies between his/her weight and the theoretical BMI. Gaining weight during childhood and adolescence, for some periods, is absolutely normal. Nevertheless, if these discrepancies are still present after a considerable amount of time, a doctor should be consulted.

In the Netherlands, a study directed by Hurk K et al, in 2003, showed that on average, 14.5% of the boys and 17.5% of the girls were overweight (including obesity), which is a substantial increase since 1980 (boys 3.9%, girls 6.9%) and 1997 (boys 9.7%, girls 13.0%).

Similarly, 2.6% of the boys and 3.3% of the girls aged 4–16 years were obese, which is much higher than in 1980 (boys 0.2%, girls 0.5%) and 1997 (boys 1.2%, girls 2.0%). At the age of 4, 12.3% of the boys and 16.2% of the girls were already overweight.

This problem has reached such a dimension that the Dutch Cardiology Foundation and the Consumer’s Union have proposed to the government that TV commercials to sweets and fast-food should be forbidden from 7am to 9pm, in order not to influence children.

### 3.3 Conclusion

Obesity is not limited to adults; each time more, children are victims of this disease. Whereas some years ago parents would be proud for their kids to look ‘chubby’, as a sign of being healthy, now they should be aware and, when having doubts, should take their children to the doctor.

With all the available measurement tools, a clear diagnosis may be done.

Considering the problems and health risks obesity carries, the faster the treatment begins, the better.
4. ‘Fitkids’ Program

The aim of this chapter is to discuss about the general aspects about the ‘Fitkids’ program. This will give the reader an idea of the program’s objectives and treatment approach, so that he can understand the steps taken from first patient contact to the end of an ‘ideal’ full treatment program.

The chapter is also intended to lead the reader to the main subject of this guide, namely the ‘Fitkids’ treatment program.

However, the reader should note that the treatment / counseling of children with a chronic illness or disability or a chronic disease is commonly provided, as previously mentioned, by a multidisciplinary team, often composed of a pediatrician or specialist (children) physiotherapist and a counselor or social worker. Therefore, the psycho-social aspects will not be discussed in detail. The main focus is about the training strategy and guidelines used by the ‘Fitkids’ program.

Finally, it should be noted that the program is not meant to be an alternative sports institute or anything similar, but only aimed at being a temporary intervention strategy, lasting a maximum of six to twelve months.

4.1 Introduction to ‘Fitkids’

Obesity affects each year more and more young adults and children world- and nationwide. Until recently, however, treatment has been quite ineffective in tackling this issue.

Luckily, nowadays with new healthcare programs like ‘Fitkids’, physiotherapists in the Netherlands can offer very attracting exercise programs for children and teenagers with chronic disorders, such as asthma, obesity, and diabetes; and the number of kids and parents interested in this program has been considered quite positive.

In fact, ‘Fitkids’ is offered in more than 95 centers in the Netherlands. The target groups of the ‘Fitkids’ program are children with physical or mental impairment and children with a chronic illness or chronic disease. To guarantee good quality of management the
‘Fitkids’ program equips their physiotherapists with very detailed guidelines they can follow and also with useful informative brochures for their patients.

More specifically, these guidelines, which are based on professional opinions and scientific literature, provide specific points that the physiotherapists should follow: intake / testing / training / construction in the time / evaluation / information. All this ensures a high-quality, standard treatment.

The entire program lasts up to 1 year. Hopefully, by the end of the program the child finds a reasonable manner to tackle his/hers overweight problem, such as a changing customs or willingly joining a fitness club.

The program consists of 2 to 4 periods, each one lasting 3 months. The initial period(s) make up what is called the ‘treatment trajectory’ which focuses on introducing and treating the children; while the final period(s) is part of the so-called "outflow path’ which focuses more on specific physical activities (i.e., games, sports).

Table 5: ‘Fitkids’ periods.

<table>
<thead>
<tr>
<th>4 periods of 3 months</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st period:</strong> 2 x 1 hours per week; group therapy</td>
<td></td>
</tr>
<tr>
<td>1 intake (including intake Effort Test)</td>
<td></td>
</tr>
<tr>
<td>1 x test after 3 months</td>
<td></td>
</tr>
<tr>
<td><strong>2nd period:</strong> 2 x 1 hours per week; group therapy</td>
<td></td>
</tr>
<tr>
<td>1 x test after 6 months</td>
<td></td>
</tr>
<tr>
<td><strong>3rd period:</strong> 1 x 1 hours per week; group therapy</td>
<td></td>
</tr>
<tr>
<td>1 x test after 9 months</td>
<td></td>
</tr>
<tr>
<td><strong>4th period:</strong> 1 x 1 hours per week; medical fitness test</td>
<td></td>
</tr>
<tr>
<td>1 x test after 12 months (exercise test outflow)</td>
<td></td>
</tr>
<tr>
<td>1 x assessment and report</td>
<td></td>
</tr>
</tbody>
</table>

Note that the strength training treatment plan proposed in later chapters of this guide is only planned for a period of 12 weeks.
4.2 Participants Ratio/ Group Size/ Age and Gender

At the beginning of each treatment period, any child with a medical referral from a GP or specialist is well accepted to take part of the ‘Fitkids’ program. However, among children between the ages of 6 and 18, there are considerable differences in physical capacities that must be taken into account. Furthermore, differences in gender are often evident at the level of interests in sports. For these reasons, the whole ‘Fitkids’ group must be subdivided according to age and gender. Usually, children under the age of 11 make one group of males and females, while youngster between the ages of 12 and 18 are divided into two groups according to the genders. Then, each group has a training session of one hour twice a week.

Having big groups can influence positively on the children’s experience. However, some children with greater disability will need more attention and guidance than other children with mild impairments. Furthermore, with large groups it is very likely that, when playing a, for example, each child have a longer waiting time, than what it would be in smaller groups. ‘Fitkids’, therefore, advises to limit the number of participants to a maximum of ten children per group (in one treatment session).

4.3 Objectives of ‘Fitkids’

The primary objective of the ‘Fitkids’ program is to teach the children a new "lifestyle", which includes any type of physical activity. To achieve this much emphasis is put on their current lifestyle, in particular the time spent in activities with little exercise involved, such as watching TV or playing videogames in contrast with the hours spent of physical activity.

However, the therapist must make sure that each child enjoys the program in general, which means that there must always be a fun component when exercising, so that in the end it is positive stimulus for the child. In such manner, the child learns that, despite its restrictions, he can indeed join activities and sports, and hopefully he/she will continue to be active and, thus, have also long-term positive effects on his/her health.

In short, the ‘Fitkids’ program must:

- Promote general fitness,
- Have a positive impact on the rehabilitation and well-being,
• Enhance self-esteem, confidence and social contact. All of which, leads to a better participation / integration into society,

• Ensure that the child, instead of watching TV or sitting behind the computer, incorporates daily physical activity into his/her lifestyle, and

• Promote membership at a sports- or gym-club

By participating in the program, it is expected that the child increases the amount of time spent in daily physical activities. This is important because by doing so not only he/she will improve his/her health and quality of life but, also, his/her participation level at school.

Also, by promoting a healthier life-style, the risk of having health problems decreases. This is important for the insurances, because the child will need less care in the future, which will result in fewer costs for healthcare insurances and systems in general.

4.4 Diagnostic Process

Referral

Kids are admitted to the ‘Fitkids’ program only if they are referred by a GP or by a specialist (i.e., pediatrician). And the diagnosis of chronic illness or disability or a chronic disease is usually done by a general practitioner or by a pediatrician. In other words, the kids are referred directly by a GP or a specialist. The general indication for ‘Fitkids’ is: “A chronic illness or disability or a chronic disease with...”:

• a physically inactive life and
• overweight, and obesity, or
• low self-esteem, low self confidence
• fatigue

Intake procedure

Before the child can take part in the program, he/she has to go through an intake procedure, done by a physiotherapist in the presence of the child’s parents. During this procedure an intake questionnaire must be filled in and physical tests (e.g., anthropometry, gross motor skills and physical performance) are done to determine a safe training level and the degree of fitness of the child.
This same process is repeated at the end of the program as the ‘final evaluation’. This is done to ensure the relevance intermediate and because of time limitations.

**Final Results**

With the findings of the intake process the therapist must decide whether there is an indication for therapy. If the child is not suitable to the program, the PT must communicate this decision to both, the child’s parents and general physician. One important condition for the ‘Fitkids’ program is that both, child and parent(s) must be motivated to participate with the program. If the PT considers the child to meet the inclusion criteria, then he will proceed to the following step, the therapeutic process and make a treatment plan that focuses on the ‘Fitkids’ general goals and the child’s personal objectives and needs.

**4.5 Therapeutic Process**

*General structure of a ‘Fitkids’ training session*

Each group of children has a one-hour training session twice a week. The session is usually composed of the following five parts:

- Warming-up (5 minutes)
- Conditioning/Endurance training Part 1 (15 minutes)
- Intermezzo (games and strength training: 20 minutes)
- Conditioning/Endurance training Part 2 (15 minutes)
- Cooling-down (5 minutes)

**4.6 Conclusion**

In recent years, the importance of strength training for both younger and older populations has received increased attention, and a growing number of children and adolescents are experiencing the benefits of strength training (Faigenbaum et al., 1999). Contrary to traditional belief that strength training is dangerous for children or that it could lead to bone plate disturbances, the American College of Sports Medicine (ACSM) contends
that strength training can be a safe and effective activity for this age group, provided that the program is properly designed and competently supervised.

Resistance training, in particular, is being incorporated into weight-control programs for overweight children, such as the ‘Fitkids’ program here in the Netherlands, as an activity to increase the metabolic rate without high impact.
5. Training in Children and Adolescents

Physical exercise – training – puts the human organism through a series of changes that will lead to a better functioning of all its organs and systems. These changes will, moreover, give you a higher physical and psychological capacity (“Mens sana in corpore sano”), resulting in a higher quality of life.

The goal of this chapter is to remind the reader about the basics of training, as well as giving them an overview of how these basics apply to children, according to ‘Fitkids’ protocols.

5.1 Training Principles

Specificity

Specificity is an important principle in strength training, which states that the exercise must be specific to the required type of strength, and is therefore related to the particular demands of an event (e.g., game, training) or of a daily life activity.

To understand this principle one must know that, to improve the range of movement for a particular joint action, one must perform exercises that involve that (specific) joint action.

In regards to velocity, training at low velocity increases low velocity strength substantially but has little effect on high velocity strength (Coyle and Fleming, 1980).

Slow velocity training may be of value in stimulating maximum adaptation within the muscle. Muscle growth (and increase in contractile strength) is related to the amount of tension developed within the muscle (Goldberg, 1975).

Overload

A muscle will only strengthen when forced to operate beyond its customary intensity. As training develops and the training stimulus is gradually raised, the load must be also progressively increased in order to permit further adaptive responses. Overload can be progressed by:

- increasing the resistance (e.g. adding 1kg to the dumbbell)
- increasing the number of repetitions (while maintaining load constant)
• increasing the number of sets of the exercise (work)
• increasing the intensity: more work in the same time, (i.e. reducing the recovery periods)

The safety of children should always be of primary importance. The main causal factor for injuries is the incorrect application of the exercises. Monitoring and proper guidance prevents this. Therefore, during resistance training, children should never lift ‘heavy’ weights.

**Recovery and Adaptation**

The body will react to the training loads imposed by increasing its ability to cope with those loads. Rest is required in order for the body to recover from the training and to allow physiologic adaptation to take place. This occurs during the recovery period after the training session is completed.

**Reversibility or Detraining**

Unfortunately, gains in strength, muscle size, or power are lost 6 weeks after resistance training is discontinued (Faigenbaum A, 2000).

**Warm-up and Cool-down**

All training sessions of the ‘Fitkids’ program include a warm-up and a cool-down phase. Physiological reasons for warming-up exercises (according to Foss & Keteyian, 1998) are:

• Increases in body and muscle temperatures, which increase enzyme activity and also causes metabolic reactions in the energy associated;
• Increases blood flow and oxygen availability; and
• Reduction of contraction and reflex time.

Furthermore, performing a mild cool-down after strenuous exercise keeps the muscle pump still active. This reduces the risk of delayed muscle stiffness or "soreness", but also reduces the risk of dizziness (Foss & Keteyian, 1998) during and/or after training.

**5.2 Training Modalities**

The general physical condition can vary very much among children and adolescents. There is also a noticeable between the interests of the males and those of the females which become
even more evident after puberty. Therefore, when implementing a training program for children, the PT should always take into consideration the children’s’ age and gender. Other relevant features relevant to the PT are the development of strength and coordination in the child.

Each ‘Fitkids’ session includes a period (i.e., 20 minutes) during which the children train aerobically and another period when they train anaerobically, in the form of games or resistance training.

5.3 Conclusion

The general effects of training have been extensively discussed by several authors. There are, mainly, five principles that should be taken into account when projecting a training plan: Specificity, Overload, Recovery, Adaptation and Reversibility.

As for the structure, a ‘usual’ training session will contain a warm up, exercise, cool down and stretching component.

When working with children, it is particularly important to work with motivation; the child must look at the exercise as something fun to do, not a ‘torture session’.
6. Strength Training in Children

Strength training is a method of improving muscular strength by gradually increasing the ability to resist force through the use of free weights, machines, or the person's own body weight. Strength training sessions are designed to impose increasingly greater resistance, which in turn stimulates development of muscle strength to meet the added demand (Mosby's Medical Dictionary, 8th edition, 2009, Elsevier).

The term "resistance training" can also be used in the same context and is often used as synonymous. This type of training is both controlled and progressive, often using various methods such as free weights, individual body weight, and elastic bands.

It must be emphasized, however, that strength training (or resistance training), in this context, is a specialized form of physical conditioning distinct from the competitive sports of weightlifting and power-lifting, in which individuals attempt to lift maximal amounts of weight in competition.

6.1 Scientific evidence in support of strength training in children and adolescents

In the past, for many years, the use of resistance training to increase muscular strength and endurance in prepubescent and adolescent boys and girls was highly controversial. Boys and girls were discouraged from using free weights for fear that they might injure themselves and prematurely stop the growth process. Furthermore, many scientists speculated that resistance training would have little or no effect on the muscles of the prepubescent boys because their levels of circulating androgens were still low.

However, contrary to a popular misconception, there is no evidence that an age-appropriate strength training program, done under qualified supervision, is detrimental to a child. On the contrary, in more recent years research has shown strength training helps children maintain a healthy body weight, benefits skeletal and joint development as well as improves sports performance (Aerobics and Fitness Association of America AFAA, 2010). ACSM
reported that strength training programs can prevent as many as 50 percent of all preadolescent sports injuries. Furthermore, Dr. Avery Faigenbaum, a leading research scientist in the children and strength training field, recently reported that for over 17 years he and colleagues conducted strength training classes for children, ages six to 12, without a single injury. And several studies have been conducted in which both prepubescent and adolescent children have participated in resistance training. From these studies, Kraemer and Fleck (1993) have also concluded that the risk of injury is very low. In fact, resistance training might offer some protection against injury, for example, by strengthening the muscles that cross a joint.

### 6.2 Benefits

Strength training in children and adolescents encourages a healthy lifestyle and builds confidence through successful completions of exercise, continued strength gains. Throughout the scientific literature, strength training has been shown to improve coordination by improving motor skills and sports performance. Especially in younger children, most strength gains are the result of improved technique, muscle fiber recruitment, and coordination as opposed to muscle enlargement (Faigenbaum et al., 2002).

Among its general developmental benefits, strength training also can result in an increase in bone mineral density, thereby decreasing the risk of developing osteoporosis later in life. In 1994, Welton and colleagues showed the skeleton is most responsive to strength training benefits during growth. This means strength training is most beneficial for young women before the age of 16 and young men before the age of 18 (Aerobics and Fitness Association of America AFAA, 2010).

In addition to decreasing the risk of osteoporosis, strength training (Aerobics and Fitness Association of America AFAA, 2010):

- Strengthens ligaments and tendons
- Readies soft tissues to produce the forces associated with play, making them more pliable and resistant to external forces
- Improves motor fitness skills, such as jumping and sprinting, which are often required in sports performance.
Furthermore, regular training has no apparent effect on growth in height. It does, however, affect weight and body composition. Generally, regular training results in (Wilmore et Costill, 1994).

- Lower total body fat
- Higher fat-free mass, and
- Higher total body mass

During adolescence, training-induced strength gains may be associated with increases in muscle size, but this is unlikely to happen in prepubescent children who lack adequate levels of muscle-building hormones. Although the issue of childhood obesity is complex, youth strength training programs may also play an important role in effective weight loss strategies (Faigenbaum et al., 1999).

Similar to other physical activity, strength training has been shown to have also a beneficial effect on several measurable health indices, such as cardiovascular fitness, body composition, bone mineral density, blood lipid profiles, and mental health (Faigenbaum A., 2000) and self-esteem.

The AAP (American Academy of Pediatrics) stated that a regular strength-training program may improve sports performance and prevent injuries, as well as lead to a more energetic accomplishment of ADLs.

### 6.3 Safety measures

Safety measures are especially important in strength training because of the risk of injury. If safety standards for youth strength training such as competent supervision, qualified instruction, safe equipment and age-specific training guidelines are not followed, there is the potential for serious injury (i.e., muscle strain). In fact, muscle strains account for 40% to 70% of all strength-training injuries, with the hand, low back, and upper trunk being commonly injured areas (Risser et al., 1990).
Most injuries, however, occur on home equipment with unsafe behavior and unsupervised settings. Injury rates in settings with strict supervision and proper technique are lower than those that occur in other sports or general recess play at school (Risser et al., 1991).

Therefore, all youth strength training programs must be closely supervised by knowledgeable instructors who understand the uniqueness of children and have a sound comprehension of strength training principles and safety guidelines (e.g., proper spotting procedures).

In the case of obesity, for example, overweight children may appear to be strong because of their size but often are unconditioned with poor strength and would require the same strict supervision and guidance as is necessary with any resistance program.

Furthermore, because balance and postural control skills mature to adult levels by 7 to 8 years of age it seems logical that strength programs need not start before achievement of those skills (Harris S., 2000).

### 6.4 Recommendations

When prescribing strength training to ‘Fitkids’ children and/or adolescents, the following should be taken into account:

- The program should include at least one exercise for all major muscle groups.
- Children should learn movements without weight first, until the technique is mastered.
- When a child or adolescent gets used to the technique, resistance may gradually be increased (5 to 10% at a time).
- The child should perform one to three sets of each exercise. Each set should include 12 to 15 repetitions.
- Set weights for individual participants within developmentally appropriate boundaries.
- Specific strength training exercises should be performed firstly without weight (resistance).
- When working with progressive resistance exercise, 12 to 15 repetitions should be successfully performed before increasing resistance.
- Rest: at least 1 to 2 minutes between resistance exercises.
- Pay close attention to form., not intensity.
- Be patient. Do not expect children to learn exercises quickly.
Some useful basic guidelines for the progression of resistance exercise in children established by Kraemer and Fleck (1993) can be found in the appendix.

6.5 Goal(s)

If long-term health benefits are the goal, then an aerobic training program should be combined with strength training. With strength training we want to enhance the effects of the endurance training, which takes most of the training time of each session, by improving the effectiveness of movement through strength gains and by keeping the children relatively active throughout an entire one-hour session. To achieve this it seems more appropriate to offer dynamic exercises that train large muscle groups rather than more static activities (i.e., weight-lifting) that train only small areas of the body.

It is also important to understand that the mechanisms allowing strength changes in children are accomplished largely without or little increases in muscle size.

In fact, the primary mechanisms responsible for strength in the developing children are: increased neuromuscular recruitment and coordination of the motor unit, with perhaps some slight physiological changes in the muscle (hypertrophy) (Takken T. and Van Brussel M., 2008)

6.6 Type of training

Muscular strength and muscular endurance can be improved during the childhood years and favor the prescription of higher repetition–moderate load resistance training programs during the initial adaptation period. (Faigenbaum et al., 1999)

Thus, the training method of choice for our ‘Fitkids’ will be ‘dynamic muscle strength training’. With this method the intensity of the exercises must stay in between 60-75% of 1 RM, 12-15 repetitions and 3 sets are performed and, after each exercise, the child rests ‘actively’ (i.e., active-relief interval). When 15 repetitions and three sets can be performed, it is reasonable to add weight in 10% increments (American Academy of Pediatrics, 2008).

Strength gains can be acquired through various types of strength-training methods and equipment; however, most strength-training machines and gymnasium equipment are
designed for adult sizes and have weight increments that are too large for young children. Dumbbells require better balance control and technique but are small and portable, provide small weight increments, and can be used for strengthening sports-specific movements. The additional advantage of dumbbell exercises is that they can be done in limited space.

Most children do not have strength training experience and will need to be taught basic exercises. When instructing, keep in mind that children learn through repetition. Therefore, choose the exercises you want the child to learn and have him or her repeat them during each session until he or she has mastered them. This may take one or several weeks. Furthermore, young people who want to improve sports performance generally will benefit more from practicing and perfecting the skills of the specific activity than from strength training alone, although strength training should be part of a multifaceted approach to exercise and fitness. Thus, it is important to focus on form and technique and give the child feedback on how he or she did the exercise at the end of each repetition. Also, correct one problem at a time, think safety first and always say something positive before anything critical.

6.7 Conclusion

Whereas some years ago strength training was not considered to bring any benefit to children, due to hormonal facts, it is now proven that it may bring several advantages.

Participation in a youth strength training program, along with other physical activities such as riding a bike and swimming, gives inactive children and teenagers yet another opportunity to improve their health and well-being.

Nevertheless, there are several safety measurements that should be taken into account, before children/adolescents are allowed to perform this kind of treatment.

Unfortunately, gains in strength, muscle size, or power are lost—6 weeks after resistance training is discontinued (Faigenbaum A, 2000).

Therefore, it is important that they continue training after the program is over.
7. Suggested strength training program

7.1 Strength training

Previously, training program for children would consist mainly on aerobic training. However, several studies (Bernhardt et al 2001, Faigenbaum 2001, Faigenbaum 1996) demonstrated have demonstrated that strength training may be effective as well, even with children.

The American Academy of Pediatrics published a ‘Position statement’, which states risks and benefits of strength training for children and adolescents. It declares that strength training is a safe and effective method, as long as good techniques as safety measures are applied.

7.2 Dynamic Training

To begin with, the ‘type’ of needed strength should be determined. Depending on the number of times a functional skill can be repeated, 5 types of muscles will be distinguished. For untrained children, it is important to, in the first months, train according to ‘higher repetition/ moderate load strength, in order to provide a gradual adjustment.

Table 6: based on “Methode van het Herhalings Maximum” by Delorme and Holten, described by Vos (1997)

<table>
<thead>
<tr>
<th>Type of strength</th>
<th>Rate % 1RM</th>
<th>Repetitions</th>
<th>Series</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal Strength</td>
<td>90-95%</td>
<td>1-5</td>
<td>4-8</td>
<td>2-4 min.</td>
</tr>
<tr>
<td>Explosive Strength</td>
<td>75-85%</td>
<td>8-12</td>
<td>3-5</td>
<td>90-120 sec.</td>
</tr>
<tr>
<td>Tempo-duur strength</td>
<td>60-75%</td>
<td>12-20</td>
<td>3-5</td>
<td>45-90 sec.</td>
</tr>
<tr>
<td>Endurance strength</td>
<td>&lt;60%</td>
<td>20-50</td>
<td>3-5</td>
<td>&lt;45 sec.</td>
</tr>
<tr>
<td>Coordination</td>
<td>&lt;30%</td>
<td>30-70</td>
<td>4-6</td>
<td>&lt;45 sec.</td>
</tr>
</tbody>
</table>
**How to calculate 1 Range of motion (1RM) - Schattingstest**

This technique may be used by children of any age.

When mentioning range of motion, we are not talking about one particular joint; we are talking about a whole movement (e.g. jumping, sitting down on a chair).

Step 1: Ask the child to perform an exercise with as much weight as you think he/she can stand doing it with for 10 times.

Step 2: Count the number of repetitions and look for it on the table (see below)

The main goal, since we’ll be training kids according to ‘Tempo-duur’ strength, is to reach 60-75% of 1 RM, which means the child should be able to perform the exercise about 12 times.

**Table 7: Schattingstest by ‘Fitkids’ guidelines**

<table>
<thead>
<tr>
<th>Repetitions</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Repetition</td>
<td>100%</td>
</tr>
<tr>
<td>3 Repetitions</td>
<td>95%</td>
</tr>
<tr>
<td>5 Repetitions</td>
<td>90%</td>
</tr>
<tr>
<td>8 Repetitions</td>
<td>85%</td>
</tr>
<tr>
<td>10 Repetitions</td>
<td>80%</td>
</tr>
<tr>
<td>12 Repetitions</td>
<td>75%</td>
</tr>
<tr>
<td>15 Repetitions</td>
<td>70%</td>
</tr>
<tr>
<td>17 Repetitions</td>
<td>65%</td>
</tr>
<tr>
<td>20 Repetitions</td>
<td>60%</td>
</tr>
<tr>
<td>25 Repetitions</td>
<td>55%</td>
</tr>
<tr>
<td>30 Repetitions</td>
<td>50%</td>
</tr>
</tbody>
</table>

7.3 Testing

‘Fitkids’ guidelines count, already, with several tests in order to provide the PT with a better understanding of each particular child’s need. These exercises will test the child’s explosive
strength, arms endurance, walking velocity, agility, arm movement velocity, trunk endurance and static strength.

Since we are focusing mainly on strength training, those are the tests that will be further mentioned.

1. Jumping

Factor: Explosive leg strength

Instruction and demonstration for the child(ren)

Take off your shoes and stand behind the starting-line. Your feet must be a little apart. Bend you knees slightly and hold your arms in front of you, parallel to the ground. Swing your arms backwards, then move them back to the first position as fast possible, jumping at the same time with your feet together, as far as you can. Try to land with both your feet together, without falling backwards or forwards. The rear section of your body touching the mat is what will determine your score. You can do this twice, and the best result is the one that counts.

Material
- A rigid ground and, on top, something that will lead to a soft landing, such as a sequence of gym mats or a long one;
- Chalk (in order to indicate the starting-line)
- Measuring tape.

Estimation
Distance between the back of the foot and the starting-line, measured in centimeters. If rounding is necessary, it should always be rounded down.

Attempts and breaks
Every child should perform this exercise twice, without a break.

Tips for the PT
- Draw the starting-line on the floor, one meter away from the landing mat. Then, draw on the mat one line for every ten centimeters.
• The distance is measured from the starting-line to the rear of the body, which is the part of the body landing closer to the starting-line. Often, this will be the back of the foot.
• If the child falls backwards, an extra chance is given.

Reference Scales

<table>
<thead>
<tr>
<th>Boys</th>
<th>Jumping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Low score</td>
</tr>
<tr>
<td>12</td>
<td>&lt;152cm</td>
</tr>
<tr>
<td>13</td>
<td>&lt;153cm</td>
</tr>
<tr>
<td>14</td>
<td>&lt;158cm</td>
</tr>
<tr>
<td>15</td>
<td>&lt;170cm</td>
</tr>
<tr>
<td>16</td>
<td>&lt;182cm</td>
</tr>
</tbody>
</table>

Bron van Mechelen et al, 1991

<table>
<thead>
<tr>
<th>Girls</th>
<th>Jumping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Low score</td>
</tr>
<tr>
<td>12</td>
<td>&lt;140cm</td>
</tr>
<tr>
<td>13</td>
<td>&lt;142cm</td>
</tr>
<tr>
<td>14</td>
<td>&lt;144cm</td>
</tr>
<tr>
<td>15</td>
<td>&lt;143cm</td>
</tr>
<tr>
<td>16</td>
<td>&lt;146cm</td>
</tr>
</tbody>
</table>

Bron van Mechelen et al, 1991

2. Hanging with bent arms

Factor: Endurance strength of the arms

Instruction and demonstration for the child(ren)

All the children should be on bare feet. One or two children go under the horizontal bar and grab it. Your hands should be at shoulder width, your knuckles facing you, our fingers
facing outwards. Someone else will go behind you and hold you by your hips. On my sign, you will pull yourself up, until your chin is above the bar. The person behind you will help you going up but, on my mark, will leave you alone. That’s when the test begins. If you begin swinging, the fellow participant may try to keep you still. You must not support your chin on the bar or bounce your legs. The test will end when I see your eyes under the bar. I will first warn you, so that you can try going up again.

**Material**
- Horizontal bar ay reach height;
- Two stop-watches (if the PT wants to test 2 children at the same time);

**Estimation**
Amount of time the kid in hanging in the correct position, measured in tenths of seconds, always rounding down.

**Attempts and breaks**
This test should be performed once by each child.

**Tips for the PT**
- Some children have the tendency to place their hands further apart than should width; that ought to be corrected.
- Adjust the bar’s height as much as possible. If it is too high, this will lead to discouragement and affect the results.
- When helping the kid hanging, try to keep him/her as quiet as possible (avoid too much fluctuation of legs) and encourage them.
- Clean the bar regularly.

**Reference Scales**

<table>
<thead>
<tr>
<th>Boys</th>
<th>Hanging with bent arms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Low score</td>
</tr>
<tr>
<td>12</td>
<td>&lt;10.4sec</td>
</tr>
<tr>
<td>13</td>
<td>&lt;8.7</td>
</tr>
<tr>
<td>14</td>
<td>&lt;10.6</td>
</tr>
<tr>
<td>Age (years)</td>
<td>Low score</td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>12</td>
<td>&lt;3.9 sec</td>
</tr>
<tr>
<td>13</td>
<td>&lt;3.9</td>
</tr>
<tr>
<td>14</td>
<td>&lt;3.2</td>
</tr>
<tr>
<td>15</td>
<td>&lt;3.5</td>
</tr>
<tr>
<td>16</td>
<td>&lt;3.1</td>
</tr>
</tbody>
</table>

Bron van Mechelen et al, 1991

3. **Sit-ups**

Factor: Trunk strength

**Instruction and demonstration for the child(ren)**

We are going to perform sit-ups, a test for the belly muscles’ strength. I will do it once, first. You will seat straight on the mat, with your hands behind your head, your knees bent to 90°, your feet flat on the floor and heels placed against the edge of the mat. The PT will keep your feet in place. First, I want you to touch your knees with your elbows. Then, you will lean backwards, until all your back is touching the mat. Come back up again and touch your knees with your elbows again.

On the count of three, you will start performing this movement as fast as you can, until I tell you to stop. This test lasts 30 seconds and you can only do it once. Make sure your hands are behind your head throughout the test.

**Material**

- Two mats;
- A stopwatch

**Estimation**
The total number of completely performed sit-ups in a period of 30 seconds.

**Attempts and breaks**
This test is performed one time.
If during the test the shoulders don’t touch the mat and/or elbows don’t touch the knees and/or hands are not held behind the head, that try doesn’t count. Explain the children as they continue with the test.

**Tips for the PT**
- Throughout the duration of the test, the position of the PT should be kneeling, next to the mat;
- The PT should be holding the child’s knees in the correct position;
- After the PT gave all the information, he/she should let the child try it out once, to make sure that the instructions were well understood;
- Make sure the kid’s knees are always in a 90° angle;
- Count all the valid attempts out loud. If the child doesn’t hear you count, he/she will know there is something wrong with their performance.
- Correct the child without making them stop.

**Reference Scales**

<table>
<thead>
<tr>
<th>Boys</th>
<th>Sit-ups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Low score</td>
</tr>
<tr>
<td>12</td>
<td>&lt;19</td>
</tr>
<tr>
<td>13</td>
<td>&lt;19</td>
</tr>
<tr>
<td>14</td>
<td>&lt;20</td>
</tr>
<tr>
<td>15</td>
<td>&lt;21</td>
</tr>
<tr>
<td>16</td>
<td>&lt;21</td>
</tr>
</tbody>
</table>

Bron van Mechelen et al, 1991

<table>
<thead>
<tr>
<th>Girls</th>
<th>Sit-ups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Low score</td>
</tr>
</tbody>
</table>

Testing is, of course, vital in order to monitor the progress of the program.

As previously mentioned, all the three tests mentioned above are, already, inserted in ‘Fitkids’ guidelines. However, we believe a test that infers the arms dynamic strength is missing. Therefore, the following is a suggestion to fill that gap.

4. *Throwing Medicine Ball*

   Factor: Arms dynamic strength

   **Instruction and demonstration for the child(ren)**

   Two children will stand up right, facing each other and about 3 meters from each other. You will grab the ball with both your hands, and throw it above your head, to the child who’s standing in front of you. The other child will repeat the movement and you will do it until you are too tired to continue.

   **Material**

   - A medicine ball

   **Estimation**

   The total number of completely performed movements.

   **Attempts and breaks**

   This test is performed one time.

   If the ball isn’t brought above the head before being thrown, that movement will not count.
**Tips for the PT**

- Throughout the duration of the test, be aware that the children aren’t hyper extending their back;
- First, the children should be allowed to learn the movement with a light ball and, when mastering the movement, begin the test with a medicine ball;
- Make sure no abrupt movements are made; the movement should be minimally controlled.

**Reference Scales**

There are no Reference Scales for this exercise.

### 7.4 12 weeks Strength training plan

After performing the tests designed by the ‘Fitkids’ guidelines, children will begin their training sessions. These sessions will happen twice every week, and account with warm-up, aerobic training, strength training and cool-down.

The following table is a suggestion of what the strength training part of the program could consist of, taking into account that, for each session, only about 15 minutes are dedicated to this kind of training.

Moreover, this program is due to children from 11 to 16 years old. According to studies (Coenen et al 2001), this is when it is possible to, in 12 weeks, double strength, being strength training therefore more effective.
# 12 week strength training program (‘Fitkids’)

<table>
<thead>
<tr>
<th>Week</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Repetitions x Series</td>
<td>Difficulty</td>
<td>Repetitions x Series</td>
</tr>
<tr>
<td><strong>Week 1</strong></td>
<td>‘Burpee’ exercise (arms) 12 x 3</td>
<td>Low</td>
<td>Push-ups exercise (arms) 12 x 3</td>
</tr>
<tr>
<td></td>
<td>Pull-the-rope exercise 12 x 3</td>
<td>Low</td>
<td>Superman exercise (trunk) 12 x 3</td>
</tr>
<tr>
<td></td>
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<td>Sitting-down-and-up exercise (legs) 12 x 3</td>
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<td><strong>Week 2</strong></td>
<td>‘Burpee’ exercise (arms) 15 x 3</td>
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<td>Push-ups exercise (arms) 15 x 3</td>
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<td>Pull-the-rope exercise 15 x 3</td>
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<td><strong>Week 3</strong></td>
<td>‘Burpee’ exercise (arms) 15 x 3</td>
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<td>Air-cycling exercise (legs) 15 x 3</td>
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<td><strong>Week 4</strong></td>
<td>‘Burpee’ exercise (arms) 20 x 3</td>
<td>Medium</td>
<td>Push-ups exercise (arms) 20 x 3</td>
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<td>Pull-the-rope exercise 20 x 3</td>
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<td><strong>Week 5</strong></td>
<td>‘Burpee’ exercise (arms) 15 x 3</td>
<td>Hard</td>
<td>Push-ups exercise (arms) 15 x 3</td>
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<td>Superman exercise (trunk) 15 x 3</td>
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<td>Week 6</td>
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<td>Week 8</td>
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<td>11</td>
<td>Give-me-the-ball exercise (arms)</td>
<td>15 x 3</td>
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<td>Seat-up-stairs exercise (legs)</td>
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In between each series of each exercise, children are allowed to have around one minute as recovery time. However, it is important to keep them moving, don’t let them just sit and not move; ask them to walk around the room, throw a balloon, dance, etc.

It should be noted that the indication for repetitions and increase of difficulty are mere suggestions of the authors; these will, naturally depend from child to child.

7.5 Description of exercises

‘Burpee’ exercise

**Muscle groups involved:** Shoulder stabilizers and, in a later stage, abdominals  
**Material:** 1x Mat per child  
**Instructions:**

**Preparation:** The child will be on a horizontal position, being their hands and the tips on their feet the contact point with the mat.  
**Execution:** Keeping their hands in the same position, the children will pull one leg forwards and place that foot on the ground. Then, do the same with the opposite leg. After, they will bring both their legs back to initial position, one by one.  
**Intensity:** Bodyweight  
**Repetitions:** 12-20  
**Series:** 3  
**Supervision:** Make sure both hands should be place right under their shoulders.

**How to make it harder:** When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise in different, more challenging ways:

- Moving both their feet back and forwards, by means of hopping;
- Mixing this exercise with push-ups (one push-up, one hop...)

*Pull-the-rope exercise*

**Muscle groups involved:** Abdominals
**Material:** 1x Mat per child

**Instructions:**

**Preparation:** The child will lie, on a prone position, on a mat. Their knees should be flexed to 90º, and their feet should be flat on the floor.

**Execution:** By pretending they’re pulling a rope with their hands, the children will raise up their trunk, until they are sitting with a straight back. In the beginning, if it is not possible for the child to perform this exercise, a real rope may be used; tied around their legs, so that they can actually ‘pull the rope’ when coming up.

**Intensity:** Bodyweight

**Repetitions:** 12-20

**Series:** 3

**Supervision:** Keep feet in place. Look out for compensations, such as using only one side of the body or performing the movement too abruptly.

**How to make it harder:** When not reaching fatigue levels with this exercise, children may be asked to perform this exercise with more weight on the (e.g. a weight vest). This weight may be increased as much as the PT finds necessary, according to each child.

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**Air-Cycling exercise**

**Muscle groups involved:** Leg and hip muscles

**Material:** 1x Mat per child

**Instructions:**

**Preparation:** The child lies supine on a mat. Their hands rest on the side of their bodies.

**Execution:** By means of flexing and extending knees and hips, they will perform biking movements in the air.

**Intensity:** Bodyweight

**Repetitions:** 12-20

**Series:** 3

**Supervision:** No trunk rotation is needed.
How to make it harder: When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise but reaching their legs further. Moreover, weights may be applied on their ankles.

*Push-ups exercise*

**Muscle groups involved:** Triceps brachii, pectoralis  
**Material:** 1x Mat per child and/or stepper, on a later stage  
**Instructions:**  
**Preparation:** In order to begin this exercise with a low intensity, the push-ups will first be performed on the wall. The children will place the palms of their hands on the wall, shoulder width. Their feet will be placed about one step further from the wall.  
**Execution:** While keeping their feet away from the wall, they’ll try to reach the wall with their nose, by means of bending their elbows. When reaching the wall, go back to starting position. Repeat.  
**Intensity:** Bodyweight  
**Repetitions:** 12-20  
**Series:** 3  
**Supervision:** Keep the trunk straight.  

How to make it harder: When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise in different, more challenging positions:  
- Adopting a more horizontal position, by placing their hands on a stepper and knees on the floor;  
- Adopting an even more horizontal position, by placing their hands on the mat and knees on the floor;  
- Placing their hands on the floor, being the other point of contact with the ground the tip of their feet, instead of their knees.
Super-man exercise

Muscle groups involved: Latissimus dorsi, erector spinae, transversospinal (‘multifidi’) muscles, gluteus maximus, and hamstrings

Material: 1x mat

Instructions:
Preparation: Prone position with arms lying straight forward.
Execution: Lift head and both arms and legs off the floor as much as possible and hold that position for 20-30s. Relax for 10-15s.

Repetitions: 12-20
Series: 3

Supervision: The children are allowed to flex their knees, however, be aware that some might experience cramps when flexing.

How to make it harder: When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise, but adding weights on their ankles and wrists.

Sitting-down-and-up exercise

Muscle groups involved: Leg muscles

Material: 1 stepper/kid (or maybe more, depending on how hard this exercise is for the kid)

Instructions:
Preparation: Sitting on two steppers (one on top of the other), arms crossed, each hand touching opposite shoulder.
Execution: Get up from the steppers and go back to seating position. Repeat.

Repetitions: 12-20
Series: 3

Supervision: The children should keep their arms crossed, as it is intended for them not to use their hands as an aid for getting up
How to make it harder: When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise, but with only one stepper instead of two. When that is not enough, they may be asked to perform it without touching the stepper at all, which will require more from their legs.

**Give-me-the-ball exercise**

**Muscle groups involved:** Triceps  
**Material:** 1 medicine ball for every 2 kids  
**Instructions:**  
**Preparation:** Two children stand in front of each other.  
**Execution:** One of them holds the ball in her hands, behind her head, by means of maximally flexing her shoulders and elbows. Then, she extends her elbows, bringing the ball above her head, and giving it to the girl who’s in front of her, waiting in the same position. The second girl will do the same. Repeat.  
**Repetitions:** 12-20  
**Series:** 3  
**Supervision:** Make sure they are not compensating by using back extension.  

How to make it harder: When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise, but with heavier balls.

**Face-to-face-crunches-with-ball exercise**

**Muscle groups involved:** Abdominal muscles  
**Material:** 1x mat per child; 1 ball per couple  
**Instructions:**  
**Preparation:** Children work in pairs back-lying opposite to each other (feet-to-feet) with knees flexed.  
**Execution:** One holds a ball. At the signal the one without the ball holds the partner’s feet down to the floor, while the other child with the ball in front of his/her chest performs a sit-up
and then gives the ball to his/her partner. Then, the one who did the sit-up holds the feet, and the other does the sit-up.

**Repetitions:** 12-20  
**Series:** 3  
**Supervision:** Make sure they don’t use too much of neck flexion.

**How to make it harder:** When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise, but with smaller balls and/or a weight vest.

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**Seat-up-stairs exercise**

**Muscle groups involved:** Leg muscles  
**Material:** 2 x steppers for each child  
**Instructions:**  
**Preparation:** Steppers are placed one in front of the other. One of them is modified in order to be higher than the other.  
**Execution:** The child is asked to climb the steppers as if climbing stairs (first the lower stepper, then the higher). When reaching the higher stepper with both feet, the child will jump to the floor (both feet together), seat on the stepper, quickly get up, go around the steppers and repeat the exercise.  
**Repetitions:** 12-20  
**Series:** 3  
**Supervision:** Make sure the floor isn’t slippery, in order to avoid accidents when the child jumps to the floor.

**How to make it harder:** When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise, but higher steppers (or lower, depending on whether the harder part is climbing the steppers or sitting on them). Adding weights around their ankles or adding weight vests are other suitable ideas.
**Throw-me-the-ball exercise**

This exercise has, previously, been described as a test for dynamic strength test. However, it may, also, be used as an exercise.

**Muscle groups involved:** Arm muscles

**Material:** 1 x medicine ball per two children

**Instructions:**

*Preparation:* Two children are standing, facing each other, about 3 meters apart. One of them holds the medicine ball.

*Execution:* The child is asked to throw the ball to their partner, with an overhead throw. When receiving the ball, the other child will repeat the process.

*Repetitions:* 12-20

*Series:* 3

*Supervision:* The ball should always be thrown with an overhead movement. Make sure the children aren’t using back extension as a compensation method.

*How to make it harder:* When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise, but further away from each other, or with heavier balls.

**Touch-the-side-of-my-knee exercise**

**Muscle groups involved:** Trunk muscles (obliques)

**Material:** 1 x mat and 1 x ball for each child

**Instructions:**

*Preparation:* The child is lying supine on the mat, with extended legs.

*Execution:* The child is asked to grab the ball with both hands and, by means of raising his/her trunk of the mat, touch the lateral side of their right knee with it. Then, they will go back to lying position and repeat the movement on the other side.

*Repetitions:* 12-20

*Series:* 3

*Supervision:* Make sure the child isn’t using too much neck flexion, or abducting their legs in order to compensate.
How to make it harder: When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise, but with a smaller ball (or no ball at all). Weights may be added to the trunk and the child may be asked to reach further down.

**Invisible-chair exercise**

**Muscle groups involved:** Leg muscles  
**Material:** 1 x medicine for each child  
**Instructions:**  
**Preparation:** The child is standing, holding up the medicine ball, with extended arms.  
**Execution:** The child is asked to hold the ball overhead as they bent their knees and push their hips back, as if sitting on a chair. Return to starting position and repeat.  
**Repetitions:** 12-20  
**Series:** 3  
**Supervision:** The child’s feet should be shoulder width apart.

How to make it harder: When not reaching fatigue levels with this exercise, children may be instructed to perform the same exercise, but with a heavier ball. They may also be asked to ‘seat’ lower or even jump when reaching upwards.

NB: It is important to increase the difficulty of the exercises as time goes by; if fatigue level is not reached, the exercise is not working as it should. In order to know how hard it is for kids, the PT will have to take many details into account; not only the amount of times children can perform the exercise or their grade on their our tiredness according to a Borg’s scale; the PT will have to keep an eye on fatigue signs, such as sweat, blushed face, fast breathing pattern, etc.
8. Make it fun!

Nowadays, and especially regarding well developed countries (including the Netherlands), children have different options to entertain themselves, when comparing to 50 years ago. With technology, came Playstations and computer games, TVs, DVDs. With all these, came a sedentary lifestyle.

Whereas 50 years ago children would go outside and play, now they stay at home, sitting and being distracted by all the new technology.

Being aware of all this, and of how unfit obese children are, it is almost inevitable that they will consider any kind of sport an obligation. Especially if their parents make them do it “because the doctor says so”.

Due to that, PTs should make sure that these “physical” classes are regarded more as something fun.

Instead of forcing the child to exercise all alone and with boring and repetitive exercises, group classes should be encouraged (in order to proportionate social contact and the feeling that the child is not “alone”), as well as fun games.

By doing this, children will have a good time during the sessions and not only have a better compliance but also, at a certain point, look forward for the classes to come.

They will make friends, laugh, play and, by doing so, turn those boring exercises into a playful hour, in which they get healthier and happier.

8.1 Motivation

Motivating young people to stay engaged in regular physical activities is crucial for the improvement of their quality of life in later years, and for future health care costs as well.

The PT should produce a written training plan that helps the child to gain confidence and to be ‘active’ (internal locus of control) in the development and fulfillment of the program. For this reason the PT should find out what activities the child is most interested in, so that the
program can also result a positive, fun factor for the child (essential for a continued participation).

The goals must be realistic and clinically significant for the child. Emphasis should be put on the improvement of physical performance (i.e., endurance and strength) and general motor skills, instead of competitive activities (where there are winners and losers).

Guidelines for motivating the participation of children:

Do’s:
- Educate children and parents on the importance of fitness
- Make goals achievable
- Give frequent positive verbal feedback
- Propose fun activities
- Start with low intensity activity
- Oral feedback should be given regularly, preferably individually.
- Motivate a child to exercise as much often as possible
- Make exercise a fun, positive activity
- Do not focus entirely on skills, fitness and sport performance
- Improve basic skills like running, jumping, running, kicking and balancing
- Create non-competitive and non-threatening setting

Do not’s:
- Avoid critical or excessive demands
- Avoid comparing physical fitness composition or performances between subjects
- Be careful with giving excessive oral feedback to the introverted child
- Avoid rapid progress of activities with a high intensity.

Attention in children with:
- Passivity / non assertive
- (slightly) mentally limited children
- Lowered self-esteem
- Lack of motivation, initiative, and perseverance
9. Conclusion

Every individual should have the right to be considered equally by others and live as healthy as possible.

Unfortunately, childhood obesity is a blatant reality in the western society and it is up to the parents, as well as the necessary health care professionals, to help these children by improving their quality of life.

After many hours of research, we learnt that strength training is not only safe for children, but also beneficial when performed in combination with aerobic training.

Therefore, our suggestion is that it should definitely be implemented in ‘Fitkids’ training sessions.

We believe we reached our goal, by gathering enough literature to back-up that idea and by developing this guide, which not only gives the reader a quick overview on recent literature about childhood obesity and strength training for children, but also a suggestion for a 12 week strength training program, ready to be fit into the ‘Fitkids’ sessions.

Moreover, and once again, we would like to remind the reader that an adult work-out program should not be imposed to children; these should be fun sessions, and definitely not regarded as ‘torture’.
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