Co-funded by the Erasmus+ Programme of the European Union

IDEAL: Intellectual Disability and Equal opportunities for Active and Long-term participation in sport

Coaching manual for training cross-country skiers with intellectual disability

Sven Blomqvist och Johan Ahlström

KU LEUVEN · International Paralympic Committee · virtus · Canterbury Christ Church University · POLITÉCNICA · HÁSKÓLINN Í REYKJAVÍK · Northumbria University NEWCASTLE · HÖGSKOLAN I GÄVLE · Józef Piłsudski University of Physical Education in Warsaw

Follow us on

Contents

Introduction

This Good Practice Guide for Nordic skiers with intellectual disability (ID) has evolved from the Project '**I**ntellectual **D**isability and **E**qual Opportunities for **A**ctive and **L**ong-term participation in sport' (IDEAL) that is co-funded by Erasmus+ of the European Union. The project included eight European partners, and its main objective was to address inequalities through increasing the quality of sport interventions and structures, empowering young people with ID and improving their physical and mental health. Our part of this project was to review and add to the resources that are available to coaches working in this area. This guide is the product of that work, and we would like to acknowledge the kind contribution of all the athletes and coaches who shared their experiences and expertise – Rebecka Sundin former coach of Parasport, Sweden, Sven Blomqvist (University of Gävle) and Johan Ahlström

To learn more about the IDEAL project visit www.idealproject.org

Using this coaching manual

The content of this manual is based on a collaboration between the Swedish Parasport Association, the Swedish Ski Association, and the University of Gävle. The purpose of the manual is to help coaches and leaders to become better coaches for cross-country skiers with ID.

Cross-country

There are many benefits to cross-country skiing, and it is a great way to be outdoors and be active in the winter. Cross-country skiing can be done throughout one's life as an exercise and in competition. It is challenging in terms of both endurance and strength. By learning different techniques in cross-country skiing, the skier can train physical and mental qualities, coordination, and improve focus; but above all, cross-country skiing should be fun.

There are two techniques in cross-country skiing – classic and skate. These differ in how to get around on snow and require different equipment to practice. It is most common to start by learning the classic technique since the diagonal technique is a good way to practice balance and be able to maneuver your skis on snow.

No endurance sport is as complex as cross-country skiing when it comes to switching between the different sub-techniques. In cycling, running, swimming and ice-skate you work with different frequencies or cadence but use the same basic techniques; in cross-country skiing, you constantly switch between the different sub-techniques depending on speed and terrain. The different sub-techniques are called gears, and you use different gears just as you do in a car. Gear 1 is used when driving slowly or up a steep hill and gear 5 is used when driving fast, e.g., on a slope or an easy riding portion. The term gears will be used for the different sub-techniques in this manual.

A competition skier can switch gears up to 150 times during a 10 km race. Which gear is best to use is determined by the speed, weather conditions, and what the terrain looks like. In addition to switching between the different gears, you can make minor adjustments within the gears such as adjustment of armrests, frequency and pole-ground angle. For example, if the speed is low, you can change the frequency by using short arm pulls and insert the poles near the ski binding; as the speed increases, you can extend the arm pulls and increase the frequency. This way you do not have to switch constantly between different gears. It is important that you teach your skiers how to perform the different techniques and be able to switch between them. Equally important is that you teach them when to use the different gears, i.e., depending on speed, terrain and different weather conditions.

Skiing technique

In addition to having good aerobic capacity and being strong in the body muscles, you need to train a number of techniques in cross-country skiing. We will discuss the different techniques later, but there are three keys that are important regardless of which technique is used in cross-country skiing.

1) **Ski balance and weight transfer**
2) **Position**
3) **Timing and interaction**

Ski balance and weight transfer
Balance is an important factor for good skiing technique. Many studies have shown that the balance ability of people with intellectual disabilities (ID) is impaired compared to the rest of the population. This means that most skiers with ID need to practice balance in order to get a better functional technique. When skiing, you need to keep the balance in motion, which is completely different from keeping the balance motionless. In addition to the skiers being in motion, balance will be affected by different glide conditions, speeds and terrain. Therefore, these place high demands on the ability to balance. When skiing, regardless of technique, the skier must be able to move the center of gravity from one ski to the other to get a good technique. This weight transfer places high demands on the balance since the skier stands on skis for the majority of the time.

The weight transfer enables a good kick from the ski that gives more power forward. In addition to this, a good weight transfer enables skiers to glide and rest longer in the gliding phase when the skier moves the weight over from one ski to the other after the kick. To lateral weight transfer, you need to be able to move the weight forward and backwards to get help from the ski poles when propelling. Then you need to be able to move the center of gravity from the skis to the poles to get help from the body weight, for example, when double poling. If the skier tires quickly in the arms when double poling, this may be because the skier does not move the center of gravity far enough forward when double poling and does not get help from the body weight and the kick.

Position
The position of the skier on the ski will affect the balance. Therefore, one should strive to have a vertical line between the foot, knee, hip and shoulders, and that the shoulders and hips should be horizontal with each other. A good position allows conditions to create power against the ground.

Timing and interaction
Timing or coordination is important so that the right things happen at the right time. Coordination between the arms and the movement of the legs need to be synchronized to work together; otherwise, there is a risk that they counteract each other. For example, if the armrest is short and tense, the leg work will also be the same; then you do not get the maximum force for the propulsion, which results in getting tired quickly. For people with ID, coordination is often impaired, and therefore, you need to work on getting timing and the interaction between the arms and legs in skiing.

Here are two good websites about different techniques with advice on ski technology.
https://nordicskilab.com/free-videos/
https://www.youtube.com/user/sportsinstructor/videos

Classic technology

There are four gears in classic skiing. Gear 1 (herringbone) is used when on steep uphill slopes, whereas gear 4 (double poling) is used in easy rides or downhill. For more advice on how to practice the various sub-techniques, see Tips and tricks per discipline (below).

Gear 1 (herringbone). This is used when the friction between the ski and snow is too small to be diagonal. You open up the skis so they form a V and edge the skis slightly. You continue as in diagonal with the opposite arm and leg working together. This then facilitates the transition to diagonal skiing.

Gear 2 (diagonal). The movement in diagonal is similar to walking and running. The big difference is that you do not have a "sliding phase" in walking or running, whereas you do have this in skiing. Therefore, the kick with the ski against the ground and pole-grip become important to be able to slide on the opposite ski. How much you can glide on the ski is affected by many factors such as the glide conditions, the terrain and the technique you are using.
https://www.youtube.com/watch?v=7axWLwnDcl8

Gear 3 (kick with double poling). This gear is a mixture of diagonal and double poling. The leg work is similar to diagonal with weight transfer and offset alternately right/left leg, whereas the upper body work is like double poling. The arms actively swing forward and the offset/kick from the leg takes occurs at the same time as the arm passes the hip. This gear is quite difficult coordination for people with ID. You also do different things with the upper body compared to the lower body, which makes it more complicated coordination-wise. Gear 3 is used in varied skiing and in light sections. The technique is very much about the timing between the kick and the double poling.
https://www.youtube.com/watch?v=yTTSR8zhb0Y

Gear 4 (double poling). The double poling technique has changed a lot due to ski tracks becoming better and the surfaces and poles getting stiffer. When double poling, the pole placement is far forward of the ski and the center of gravity/upper body has been moved forward on the ski. You have your hands close to your body so that the force from the body weight is used when setting the poles. It is important that the torso muscles are activated to withstand the force from the upper body so that you do not collapse. The movement of the poles turns just behind the hip and in this way, you get a shorter path to the starting position and can create progress in the double poling.
https://www.youtube.com/watch?v=a3CppkvhoOM

Skate technique (https://www.youtube.com/watch?v=xeyjWFYKyfc)

Skate has become increasingly popular, perhaps because it is simple. You do not need grip wax for grip as in classic, and with the harder boot and shorter skis, it has become easier to handle curves and downhill skiing. As in classic, there are gears. Gear 1 (V1) is similar to herringbone and is used on

steep uphill slopes, and gear 5 (Free skate) is used on downhill slopes and in easy rides. For more advice on how to practice the various sub-techniques, see Tips and tricks per discipline (below).
Beginner instruction
https://www.youtube.com/watch?v=I0ar7aGBnLQ

Gear 1 (Diagonal skate). This gear is very similar to the herringbone in the classic technique, but the difference is that here you try to glide on each slide from the ski you take, which is not allowed in herringbone in classic riding. Used in steep uphill slopes. https://youtu.be/BOwnnE_BGRY

Gear 2 (V1 offset). This technology is used uphill or flat and when accelerating at a standstill. It consists of a hanging side and a return side. On the hanging side, poles pulling and slide occur with the leg at the same time and on the return side; only the slide consists of the leg.
https://nordicskilab.com/courses/v1-offset-timing-what-the-science-says/

Gear 3 (V2 - One skate). This technique can be used, depending on how good you are, on a flat surface, easy uphill and steep uphill. It is perhaps the most difficult technique to learn. It requires good balance since you stand for a long time on one ski. At the same time you should get the poles in the starting position at the same time as sliding from the leg begins.
https://nordicskilab.com/courses/skate-ski-drill-the-one-skate-dance-video/

Gear 4 (V2 - Alternate). This gear is used for easily driven sections. It consists of symmetrical pole-ground angle on every other leg and push-off. Gear 4 creates a lot of power in the beginning and has a long sliding phase before the next pole-ground angle takes over.
https://www.youtube.com/watch?v=hxErUs42bBI

Gear 5 (Free skate). This gear consists of only leg skating without help from the arms. It is used for easy downhill where the speed is not too high. The technique is performed either with the arm swing or with the body in the speed position.
https://www.youtube.com/watch?v=23VaXxDSW-I

Motor coordination also affects the decision-making process since some sub-techniques require higher coordination than the others do. For example, gear 3 (V2-One skate) requires more balance compared to gear 2 (V1 offset) and gear 4 (V2-Alternate) because the center of gravity is more lateral in gear 3 than in the other two, and the support area is larger in gear 2 than in gear 3 due to that the poles are in contact with snow to a greater extent in gear 2 than either gear 3 or gear4.

An unpublished report investigated whether skiers with and without ID used different sub-techniques in competition. The results showed that skiers with ID do not change sub-technology as often as skiers without ID. According to their coaches, the reason for this was that the skiers with ID felt that they did not master the various sub-techniques well enough to use them in competition. However, they used the technique they were best at for most of the course regardless of what the terrain looked like.

Impact and implications of training ID athletes

Important to build relationships
Create relationships outside of sports by talking to the individual and get an idea of how he/she functions in other settings. Take with you these experiences and how you can benefit from these when you instruct. For example, is visual support or similar needed?

It is also important to create a relationship with the individual's skiing. As a coach, I need to learn what challenges he/she has and areas of development. You can do this most easily by observing the skier, which is easiest by riding a lap on a track and simply observing. In some cases, it may be that the active self finds it a little difficult to express their own challenges. Then I need to learn it in another way so I can get an idea of what we later need to practice.

Let things take time - have a calm appearance

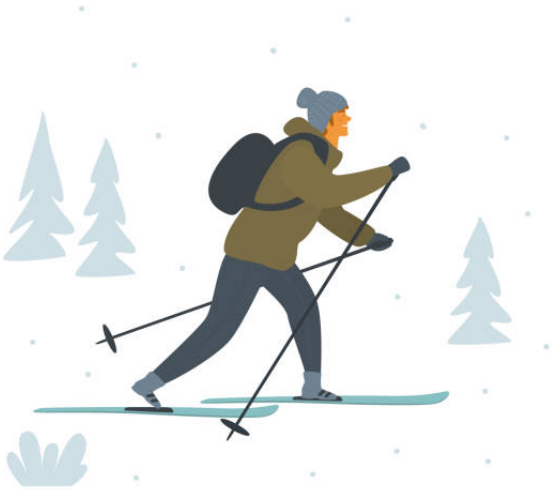
Offer the skier plenty of time to work on exercises. Do not stress just because you had planned four exercises for this particular session. If you see that an exercise is a bit challenging and needs to be worked on more, instead let the session include two exercises so the skier can learn properly from the ground. Do not have expectations that everyone should reach a certain special level. Concretize the exercises, explain clearly before, repeat instructions and feedback, use shorter sequences, and practice one thing at a time. A lot is about habit, self-confidence, security - to feel that you dare to test, try and master - adapt the training to the individuals so they can feel that they succeed with the training. People with ID generally have a harder time learning from their experiences, and they need to repeat a lot. Ask if the group understood the instructions; evaluate camps and training with the skiers - what works and what needs to be developed.

Distress advice for people with intellectual disabilities

What it takes to become a good skier depends somewhat on the distance you ride. However, one thing that is important is high oxygen uptake capacity (VO_2max). This means that the oxygen uptake ability is a crucial piece of the puzzle for developing as a cross-country skier. Another important component is body strength, especially upper body strength. Skiing has evolved such that one uses the upper body muscles more and more to get an effective technique.

Most studies indicate that people with ID have a lower VO_2max compared to age-matched people without ID (1). People with ID may also have an inability to increase proportionally heart rate with increasing metabolic demands, so-called chronotropic incompetence. Thus, the heart rate has difficulty adapting to the increased activity or requirement. This phenomenon is also common in people with cardiovascular disease, which makes it more difficult to tolerate and have an effect on exercise (2).

For people with Down syndrome, VO_2max was shown to be even lower than for those with other forms of ID. This can be explained by the fact that people with Down syndrome have low levels of physical activity, "chronotropic incompetence", decreased muscle mass, hypermobility in the joints, and hypotonic muscles that lead to a deteriorating movement economy. Further, people with Down syndrome also have a decreased maximum heart rate, which may explain the low values of VO_2max (3). This is important to be aware of as a coach and to take into account when training people with ID. It is far from everyone who has "chronotropic incompetence", but as a trainer, you should have knowledge of it when training oxygen uptake capacity for people with ID.



A meta-analysis by Shin and Park (4) examined the effects of physical exercise on heart rate, VO_2max, PER (respiratory exchange ratio), VE (pulmonary ventilation) and other physiological parameters. They found that the effect of physical exercise was as high for people with ID as for the rest of the population. A research compilation by Medonca and colleagues (3) studied the effects of exercise for people with Down syndrome, and the connection was not as clear; but in several of the included studies, it was shown that exercise had a good effect on VO_2max for people with Down syndrome.

Several studies report that muscle strength is impaired in people with ID (6-8). Muscle strength in people with Down syndrome can be up to 50 percent lower compared to the rest of the population (6, 9). Muscle weakness can make it difficult for them to perform certain sports or have difficulty with the technique. Various reasons for why people with ID have lower muscle strength than the rest of the population have been put forward, such as physical inactivity, sedentary, impaired neuromuscular ability and impaired coordination. However, a study showed that people with ID

have as good of an ability to assimilate strength training as people without ID (10). Several studies examined the effects of strength training in people with ID. One such study was a meta-analysis by Shin and Park (4). The authors were able to establish a large effect on strength development after strength training for people with ID between the ages of 8 and 60 years. A previous meta-analysis performed by Chanias and colleagues (5) also showed a large effect on muscle endurance and a moderate effect on strength development in people with ID. Li et al. (11) performed a meta-analysis of seven studies regarding people with Down syndrome and the effects of strength training, and the result was that strength training has a positive effect on muscle strength in both the lower and upper body.

A prerequisite for being able to move around safely and participate in daily activities such as skiing is a good balance ability. Several studies have shown that young, adults, and older people with ID have a reduced balance ability (12). Already in early years, the ability to balance is lower than for peers without ID, and the differences do not level out but rather increase with age (13). For older people with ID, it was seen that they develop balance problems earlier than peers without ID, and this is thought to be due to that there is a general decline in their motor skills earlier than in older people without ID (14). Several studies report that people with ID, old and young, can train their balance ability. For example, Carmeli and co-workers (15) trained people with ID(54–66 years) with a specific balance and strength training program three times a week for six months. They showed improvement in both balance ability and muscle strength. Oviedo and colleagues (16) showed that people with ID (20-60 years) who trained three times a week for 14 weeks using a program that consisted of endurance training, strength training and balance training, improved their fitness and balance ability. Giagazoglou et al. (17) trained children with ID (10 years) on a trampoline for 12 weeks and reported that the balance ability and motor skills in general improved. A meta-analysis that included four studies of balance training for people with Down syndrome showed that physical exercise had a very good effect on balance ability (11).

What you should take with you about training fitness, strength and balance is that people with ID can train these abilities with good effect. However, you need to adapt the training to the individual, and may need to train longer to have an effect, especially with technical training. As for other coordination abilities such as combining different movement with the upper body and lower body, for example, in double poling with kick, laterality, i.e. be able to make movement over the center line of the body with arms and legs e.g. when skating, it is not as clear what effect the training has. However, research indicates that people with ID can be trained, especially at a young age. These qualities are important to train to get an effective technique in skiing (18).

Cross-country skiing is an endurance sport, and as previously mentioned the ability to absorb oxygen is important. Another important thing that has to do with oxygen uptake capacity and is important from an endurance performance point of view, is how well you can use your VO_2max, i.e. the extent to which a skier can maintain high intensity for an extended period. The higher this submaximal intensity, the better the utilization rate of the skier. If you are above this level for a while, the body will produce more lactate than the body can metabolize. This means that lactate levels increase and you get tired. This submaximal intensity can be trained (aerobic capacity). Another factor that also affects endurance performance is the skier's work economy. Work economy is how much oxygen a skier consumes at a certain load. The work economy is affected by the individual's efficiency, movement patterns and the skier's technology. To some extent, the work economy can be influenced by technical training; but for the most part, it is innate (19).

Pacing

In many endurance sports, the choice of pacing strategy is an important component for optimal performance where timesaving can be achieved if the speed is adapted to the terrain, wind resistance and the individual's physiological and biomechanical abilities. Therefore, the ability to "pace" oneself becomes important. Keeping a steady high speed throughout the race and finishing with a sprint has proven to be an effective way to complete races, e.g. when running, skating and swimming. The ability to withstand fatigue is clearly important for success in skiing; and depending on the length of the competition, different strategies have been developed. During both sprint competitions and longer competitions, skiers generally use a so-called positive "pacing", i.e. after reaching top speed the athletes gradually slow down. Bilodeau et al. (1996) (20) observed that during a 50 km classic race consisting of 4 laps of equal length, the average speed on the last two laps was slower than on the first two laps.

"The pacing ability" in skiing is important. It seems that the pacing ability develops during childhood and adolescence through the development of physical maturity, the development of pre-frontal cortical (meta-) cognitive functions, and the increased experience of exercise tasks. Therefore, the coach's role is to support this development by monitoring (pacing behavior and underlying factors), giving feedback on the skier's self-regulation process, and preparing the skier for various factors that affect pacing strategy (terrain, relay/sprint, length of race, etc.) and the skier's motivation.

One of the biggest challenges that the coach encounters is working with ID and pacing for skiers . A lot is based on creating an experience and working a little reflective. Competition is probably the best training in this case. Therefore, one could recommend training competitions. Many have extreme difficulty with pacing and often drive "all in" from the start, and this does not last all the way. Or they start too slow and are not tired when they reach the finish line. A trend that has been seen is that skiers who have done many competitions have a tendency to become somewhat better at pacing.

To help the skier with the strategy, you can ride the track with the skier and talk about when to use different sub-techniques to be more efficient. In sprint, the track is short, where you can help the skier find the speed by coaching during the race when you can be in several places. In addition, the track will be easier for the skier to memorize since it is shorter and will be easier to remember. This makes it easier to know how far you have left to go. For longer distance, work with experience and practice longer intervals, practice training, and talk to skiers about how they experienced speed and fatigue. Practice how it feels in the body and not to be afraid of fatigue. For example, for distance workouts, the legs should not shake after the workout. If so, you have driven too hard and absorbed lactic acid. For longer races, the skier easily loses focus. But through training, this experience can

increases over time, and the skier can finds it easier to get the right speed from the beginning. By competing in exercise races, the skier can get help from a fellow skier (coach) of how fast to go to be able to finish, for example, a 20 km long race. The skiers get help with speed control and focus during the race, and can practice pacing. For run training competitions, go through the layout before and go through the race afterwards. However, pacing is very difficult in skiing since conditions change from day to day due to snow conditions – for example, hard tracks one day and it goes easy, and new snow the next day and the track is much heavier.

Work with balance, mobility and motor skills – build a solid foundation.

Cross-country skiing places high demands on both balance and motor skills, as well as some demands on mobility in order to be able to develop a good technique and skiing economy. Some steps can be difficult to practice on skis. Therefore, it is recommended to train balance exercises, mobility and some motor challenges outside of the regular ski sessions. This is ideal to do in connection with pre-season training. Examples of exercises can be jumps of various kinds, balance gait, etc., or exercises that put demands on several things such as transporting something or throwing a ball/pea bag. Challenge multiple senses.

Try other sports/activities in order to build a foundation. To be able to develop the skiers technique, you need to train coordination and in particular balance. Therefore, it can be a good idea to train other sports to develop these abilities and then use them in skiing. One example is running in the woods on narrow paths or unpaved terrain. This places high demands on the ability to coordinate and balance, and you get good exercise for VO_2max.

If you want to delve deeper into coaching athletes with ID, read the Handbook for Best Practice in Training Athletes with Intellectual Disabilities by Burns et al. This can be found at www.idealproject.org. There you can also find a database containing over 100 resources consisting of coaching manuals, courses (including e-learning), textbooks, journal articles, web pages and information booklets on how to coach sports for people ID.

Tips and tricks per discipline

Cognitive aspects of skiing

Intellectual disability means that it is difficult to think abstractly – the ability to make calculations and think out consequences in the mind. It takes longer to learn and understand different things. One of the main areas where athletes with ID have problems is cognition. Cognition is the process that involves thinking, and is sometimes called mental processing (read more in the Handbook for Best Practice in Training Athletes with Intellectual Disabilities, Section 3.)

Transitions between different movements have been thoroughly investigated in other areas, for example, transition from walking to running. The traditional notion that transitions minimize metabolic energy costs was recently challenged by the observation that transitions actually occur at slower speeds than the optimal energy transition rate and local factors such as muscle fatigue; and they are not just the consequence of conscious processes and/or central metabolism. In addition to decisions about change that take place consciously versus unconsciously, cross-country skiers must make these decisions constantly. Therefore, we can assume that optimization of performance in cross-country skiing requires at least some cognition from the skier.

Think about when training skiers with intellectual disabilities:

☺ Repetition of instructions and practical implementation.

☺ Give simple, short and clear instructions and bring demonstrations.

☺ Allow enough time to process the information.

☺ Help the skier maintain his attention.

☺ Check the comprehension regularly.

☺ Use several different methods when presenting ski technique to facilitate understanding.

☺ Use consistent structures and routines in connection with the training sessions.

☺ Vary your learning and think outside the box.

☺ Plan exercises based on developmental age rather than chronological age.

One example of the cognitive aspects of skiing is that cross-country skiers often switch between different sub-techniques, so-called transitions. Studies show that the total number of transitions on a 1.43 km freestyle sprint time trial varies between 21 and 34 transitions, where the three fastest skier use fewer transitions. Decisions when and how to change gears depend on the constant interplay between external factors such as track profile, topography, snow conditions, and friction, while taking into account internal factors such as perceived fatigue, aerobic capacity, skill. To optimize speed, ski efficiency and ultimately maximize performance in cross-country skiing, the skier constantly makes cognitive decisions about which gear to use and when to switch to another gear. These decisions need to be practiced. In a competition context, you can therefore work as if a leader rides with the person around the track and gives tips about gears. The experience that gives the best effect is achieved by having a discussion with the active person who can reason and try a few different gears. This can create a better ability to solve things during competition. This is not something that works with everyone, but requires that the individual is relatively high performing (i.e. competing at the Virtus level).

Things to keep in mind when instructing the skier with intellectual disabilities:

☺ **Adapt the language so that everyone understands and feels involved.**

☺ **Clarity is A and O in everything! Be specific in descriptions (instructions, planning, technical instructions) and in your body language.**

☺ **Use picture support and written clear plans (create documents, print and include, for example, the camp schedule, list of training clothes and equipment for each training session).**

☺ **Repeat instructions and repeat exercises many times.**

☺ **Praise all the attempts and all the behaviors that you want repeated.**

☺ **Have fun together! Play games and run relays during training.**

☺ **During camp, it is also usually appreciated to have a joint evening activity - this improves the community.**

☺ **Athletes can ask many and repeated questions - it is important to be patient.**

☺ **It is important to be sensitive to each individual's signals - their body language, eyes, etc. In this way, you can prevent, for example, an emotional outburst from escalating.**

When working with skiers, be clear about the purpose of the workout. Feel free to let the skiers be involved and think about the purpose. When competing, listen to the skier's needs and try to work from that. When competing, check out the competition venue and ride the track before, preferably the day before if possible. Otherwise, do this in good time before the start. Can sometimes have difficulty handling many skiers around during sprints, for example, challenge this during training. Learning by inquiry.

Layout of the training

Be clear about the purpose of the training; 'this is what we are going to do today'. Have a plan but be prepared to change based on how things are working now. Having several alternative exercises if motivation decreases, for example, train fitness and then have a slalom track/technique track at the stadium for those who lose motivation. Create the conditions for individual adaptation. For example, free yourself as a coach by writing on a Whiteboard board five assignments they can do during training. Be clear what planning is and then they can handle a lot themselves.

During camp, you can try to vary the speed passes – one sprint-focused, one with longer intervals, etc. Run a lot of impulses and relays; this does not wear out the body too much, it is fun, and it creates cohesion, exercises speed, coordination and technique as well as improve the ability to maintain attention over time.

Work out in groups or individually

To work with individual reflections, work with the skier or a small group, which is more time efficient. In the best cases, we can get two individuals to work reflections with each other. However, cross-country skiing is rarely done completely alone on a track, and surely not in competition; so group training is valuable in adapting one's skiing to others and there is a challenge in this as mentioned earlier. *Group:* May need support to get started in the beginning. A group is good because it contributes with community, support, clear frameworks and fun. One difficult thing could be the impressions that people are at different levels and with different functional variations. It is important with an adequate number of leaders. *Individual:* Gets easier to ride at speed. Both can be more difficult and easier with focus (nothing that distracts but also nothing that helps maintain attention). Training in a group is the best, and still provides opportunities to work individually.

Guide and support when the terrain changes; for example, which gear to choose on an uphill slope

As an aid, you can guide and support the skier on how to approach the terrain in the course by riding with the skier. For example, for curves on a downhill slope, if the skier is unsure, you can go downhill to create security and the skier can see what the slope and curves look like. Then let the skiers plow their way down slowly, and then increase the speed gradually until they can go the whole slope and curves without braking and have a good technique in curves by stepping through them in an efficient way. Through short and clear communication, help the skier to perform curves in a good way; "- remember the curve, have soft legs and stepping around". Allow skiers to rehearse many times and take it at their own pace. Gaining experience increases self-confidence. In addition to curves, you may need to guide the skier which gear fits best. You can do this by riding the track and discussing which gear fits best in the different sections of the track. You can also train this by making a terrain course that consists of different elements (e.g. ski on a level surface, easy uphill, steep uphill). Perform and let them test on the track and discuss and test which gear works best in the various steps. This can lead to the skier gaining experience and then making it easier to choose the right gear in the terrain. It is important that they have time to think and practice the different steps.

When technique training, keep the following in mind:

☺ Be clear, adapt the language and repeat instructions often!

Try to include as many senses as possible when explaining exercises. For example, show with your own body, video or via pictures (sight); use a song that makes it easier to determine timing in the technique (for example, go on gear 2 in time with "here comes Pippi Longstocking") (hearing); show the positions while stationary, so that the skier has time to feel how it should be when it is "right", if it feels okay for the athlete, you can also point or put your hand on the area where you want an exercise to be felt (feeling).

☺ Practice a lot of balance and coordination - use play, technique courses and relays for this (e.g. start and end each session with this).

☺ Change exercises during the training sessions to maintain the skiers' concentration and motivation. During a distance session, for example, interrupt after 20 minutes for a game, and then continue or have different technology stations/impulse stations along the course.

☺ It is also important to think about the degree of difficulty of courses, etc., so that all skiers can feel safe to practice their sport and not be limited and afraid that the track is too difficult.

☺ Double check and rehearse during the collection before each session which equipment they should bring with them so that everyone has the right things with them.

Technique exercise

Get to know the skier and their way of learning different things; for example, by imitating fits one skier, trying fits another, rhythm works for a third skier, and so on. Use different ways to instruct so you can adapt it to the skier in front of you. Divide the training sessions, e.g. by training on one gear at a time and not mixing different techniques during the same workout. Focus on one thing at a time; “we work with weight transfer so we only focus on that and do not train on, for example, pole-ground angle”. Let the skier have time to work with weight transfer. Stick to a maximum of two things per session but preferably only one. If you meet the skier more regularly, you can, for example, work a lot with weight transfer for a whole week, and then continue working on the pole-ground angle. It is important that they have time to rehearse and practice what they have trained.

Video can be a good way to show changes in skiers. For example, if you have worked for a long time on a certain technique, you can film in the beginning and then again after a while. Then it becomes clear what the change is both for the skier and for the coach. However, it can be difficult to transfer what you see on film to reality for some skiers. Filming can also be good for the coach to be able to

watch the film in peace and quiet. Then decide what needs to be improved on in the skier's technique, and think about how to instruct this to the skier. This can also be a great way to analyze each skier's technique. Video analytics can help the skiers achieve new goals. Films can increase the skier's understanding of what to do since it is clearer to watch a video of oneself than to be told about what needs to be changed. It is very easy to film with a smartphone, and then show the skier what was good and what needs to change. Exercise, and then later repeat and point out what has gotten better. It is fun to achieve goals. This raises motivation. Most people appreciate being filmed. Also, it is fun to show improvements.

Another good exercise to develop the technique of the skiers is to imitate. A skier with good technique rides first, and then your skier tries to imitate their technique. This can give your skier the opportunity to adopt frequency, cycle length (cycle length in cross-country skiing means the distance between two poles on the same side of the ski) and changes between sub-techniques. By getting help, your skier can concentrate on technique.

Break down exercises into smaller phases; try each step MANY times, and then try to put them together. Use many senses when learning.

The most important thing in ski technique is to master weight transfer between the skis, and this applies to all sub-techniques. Therefore, it is important to train balance, weight transfer, coordination and strength. This is usually done during the pre-season, and then refined during the winter season. Jump, run on uncontrolled terrains (e.g. forest trail), and work generally with strength – strength can be trained with your own body as a load.

Here is a video on how you can think when you train in diagonal riding
https://youtu.be/7URFFSSw1co

Start with weight transfers without skis. Then do weight transfers with skis with the goal of making them slide a little on each weight transfer. When you train weight transfer, ask skiers to keep their hands behind their backs so they can train their balance as well. Another tip for getting them to glide on the ski is to have only one ski, and ask them to step over on that ski, and then glide away on the snow. Repeat. Good balance exercise.

When you start to master weight transfer and glide with each weight transfer, you can stimulate it by playing football on the snow without poles, running different technique courses, slalom, standing on one leg and playing, for example, passing a ball to each other while wearing skis, relays with a ski, etc. Then you forget how to do and just do weight transfer at the same time; this is a good balance exercise. Furthermore, this can be developed by adding poles and combining weight transfer with pole-grip.

Figure. Ghost ball with one ski is a good example of how to train your balance while having fun.

Another way to train is to have one ski in the track and the other to push with. This can be a great way to practice pushing with one leg and gliding on the other ski. Place poles near the boot and off the track. Push away with the poles and with the ski you have off the track. Repeat. Watch the video: https://www.youtube.com/watch?v=53_89J4S29I

Finding the balance is linked to weight transfer. Work with the pole-ground angle. Poles should be placed along the front at the binding. Strive for a high hip position, i.e. come far forward with the hip. The line for weight transfer should be nose, knee, toe and ski tip. Practice the rhythm in each gear with, for example, songs and rhymes that the skier knows. To clarify, you can use sound when inserting poles and pushing off with legs to practice the rhythm and timing. Practice indoors before the workout to get an idea of which muscles should be used when doing this. Discuss with the skier so that you get a "receipt" that the skier understood what you meant with the video.

Even in the classic technique, it is good to train without poles. In the video, you can see how it works: https://www.youtube.com/watch?v=qCNsX7x2M9k&feature=youtu.be. If you have difficulty with the gliding technique in classic skiing, you can do an exercise where you only use one ski, and slide on the other without the ski you just pushed off with. This is also a good exercise for training balance and weight transfer. Watch the video: https://www.youtube.com/watch?v=7URFFSSw1co&feature=youtu.be

Sometimes it can be better to train without a pole since this means there will be less to hold on to, which is not as difficult for coordination for the skier. This can be easier for some who have poor coordination skills. Therefore, a good way to start the workout is with poles, then put them away and train without poles for a while. Or, have a distance that is a target of where you have to go without poles. Without poles, you have to transfer weight between the skis to get ahead and

practices balance. This is important for people with ID since they often have impaired balance. Here you can watch a video about training without poles: https://youtu.be/MdNi1JbQogk

When diagonal skiing, it is important to comprehend weight transfer. Other parts of classic skiing you need to practice on is the pole-grip, especially when double poling, but also with other sub-techniques. Some may find it difficult to release the poles in the right place with the open hand; this may have to be guided wherein you drop the poles and find the basic movement. This is good to train without skis. The key when double poling is to get the abdominal muscles to work, and this is a matter of getting up in a high position, i.e. slightly tilted forward (see picture). An exercise for finding security when double poling is to get up on your toes, arms high, and fall forward against a wall and contact with your arms quite high up; repeat this to find the technique and security for what position you should have when double poling.

The most difficult gear to master in classic riding is double poling with kick due to coordination. This technique is very much about the rhythm, and it can be practiced using commands, for example, kick, double poling, kick, double poling, etc. A common mistake the skier makes is to kick and double poling at the same time. One way to help the skier with the timing can be to go behind the skier and repeat the kick, double poling, kick, double poling, etc., so that they get a rhythm and the timing of the technique. An established rule is to try to kick at about the same time as when the arm goes past the hip on the way back. The double poling in this technique is similar to the normal double poling technique.

The only way to develop is to challenge yourself. Therefore, it will be important for you as a coach to challenge your skiers in terms of fitness, strength and technical training, for example, by riding without poles, on one leg or on gear 3. Challenge your skiers in a sensible way; for example, by training balance, they may fall but it is a clear sign that they have challenged their balance, and in the end, they will develop this so that they do not fall in the future. Then the balance has improved and the skiers have an improved condition for obtaining a better technique.

Do not be afraid to fail. Dare to try different things with your skiers to improve their conditions for skiing – a bit like trial and error. It is natural to learn by failing along the way. Do it in a playful environment and it will not be so serious if you fail sometimes. It is important to have theoretical knowledge, but it is also important to try things practically. Therefore, skiing should be mostly practical with some theoretical elements when it can increase motivation and learning ability. As a coach, try out what suits you best. Use multiple senses in learning. All individuals and groups are individual, so it is important to try.

Exercise fitness

By training fitness, the skier experiences what this entails, and thus makes it easier to find an adequate level of effort for each part of the fitness training. Otherwise, different symbols of

concrete advice can help the skier to find the right load. If you are going to train in A1 load, the skier should be able to talk unhindered at the same time as they ski. A picture can also help skiers find the right speed in the A1; "then, as a skier, you have time to see the squirrel jumping down from the tree, running over the track and up into the next tree." When training in A2 speed, the skier cannot talk unhindered, and the picture is "you see the squirrel running across the track, but do not have time to see where it goes". At A3 speed, i.e. interval training, you cannot talk and the picture is "you run on the squirrel when it runs over the track".

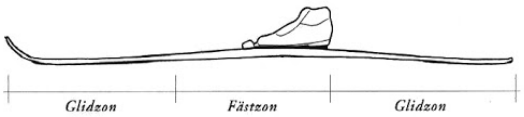
A good way to practice many different parts of skiing is to build a ski area. There, the skier can practice using different techniques, go up / down, practice turning curves, etc. This play area can be good for beginners to get in touch with cross-country skiing. There they get to try to master speed, fall, get up, stop, climb a hill, plow, turn, jump, go over bumps.

Example of a ski area (the picture is taken from Skis for children - SISU idrottsböcker)

Additions (typical for our sport)

Equipment (23)

The skis for classic technology are usually about 20-30 cm longer than the body length. For beginners, use short skis and it will be easier to handle the skis. A classic ski is divided into three zones in the middle of the ski – grip zones and front and rear gliding zones (see picture). It is important that you have the right span on the skis so you get grip on the snow when pushing off. Therefore, be careful when checking the span of the skis for those you train. A skier with better technique can have a harder span that he can push down to get a grip on the snow, while a beginner needs a softer span since it does not have such good technique and therefore cannot push down the grip zone against the snow. To make it easier for beginners, it is good to start with skis that you do not have to wax. When you get better as a skier, gliding becomes more important, and then maybe you can switch to skis you wax.



Skate skis are usually about 10-20 cm longer than the body length and are a little harder in the span than classic skis. The entire ski consists of sliding zone so you do not wax for grip.

As a rule from FIS, classic poles are 83% of the body length with boots on; and 80-83% of body length is a good benchmark (just above the armpit). For skate poles, it is best with 88-90% of body length (to the chin).

When choosing boots, it is important that they are comfortable. They should be firm and go a bit up on the ankle to keep warm. There are combination boots that you can ride both skate and classic skis.

Clothing (21)

When you are out skiing in the winter, the attire is important. You must not dress too warm and likewise not too cool. The weather conditions control the attire as well as the activity. Therefore, it may be important for you as a coach to talk ahead of time about what the training looks like so the skier can adjust the outfit. A good way to dress when skiing is the layer on layer principle.

Clothing layer 1 – Base layer. Long underwear and undershirt in a material that transports sweat away from the skin and allows you to stay dry and warm.

Clothing layer 2 – Intermediate layer. T-shirt, thin fleece sweater or functional clothing that helps you transport moisture away.

Clothing layer 3 – Surface layer. Wind overall, vest. Clothes that protect against wind, snow and rain and at the same time transport away sweat and excess heat.

Other clothing – gloves, hat, and buff headwear that protects the neck and can be pulled over the head in the cold.

Diet/Energy
• Make sure that the skiers get food at lunch/dinner/evening coffee, etc.
• Bring extra energy to your workout (e.g. raisins, bars, sports drinks).

At camp
• Hold an early evening meeting, so the skiers have the energy to participate, and then get enough sleep for the next day.
• Plan a long lunch break so that skiers have the opportunity to recover and digest all the impressions.
• Think about room division. Plan which people/personalities are suitable together.
• During camps, it is usually appreciated to have a joint evening activity; this improves the community.
• It can be important to think about which places you choose as campsites. It can differ a lot in the abilities of the athletes, and it can be extra important to have all the necessities close to the accommodation.

If you are interested in which educational paths there are in your country, then go to www.idealproject.org for more information. On the website (www.idealproject.org), there is a database where you can find more tips for those of you who coach athletes with ID. Special Olympics has published a coaching guide for cross-country skiing where you will find more tips for coaches who coach skiers with ID. http://digitalguides.specialolympics.org/crosscountryskiing/index.php#/1

Examples of Good practice

Alla på snö (All on Snow day) (https://www.skidor.com/Grenar/allapasno/omallapasno/)

During “Alla på snö “Day, children and adolescents get free access to equipment, snow facilities and guidance to explore the joy of snow. All activities take place in a safe and playful way, based on each child's own wishes, with the support of leaders and teachers that are trained in leading and coaching children and adolescents on snow. In conjunction with the municipality, the school and the ski resort, we invite the municipality's children and adolescents to take part and explore the fun, and all the beautiful, inspiring, fast-paced and cool things that can be done on snow. They get to challenge and use their balance and agility. Many enjoy the speed wind and grow with increasing skill. Participants become pleasantly tired due to both the physical effort and the concentration.

Video films from Alla på snö in Kungsberget

https://youtu.be/LmDRgMoP7Dk (The distribution of skis)

https://youtu.be/EFwgkKWzOSM (warm up)

https://youtu.be/mC1zEqZ3oRs (Fall and step up)

https://youtu.be/Onko0z2N5O4 (Training game 1)

https://youtu.be/GTA_K2tRpdI (Training game 2)

https://youtu.be/QTgleCsU6qI (Training game 3)

https://youtu.be/8vu3y3zlgRc (Training game 4)

https://youtu.be/oPuvj6za1cg (Go uphill)

https://youtu.be/6TNn9H-1lN4 (Practice going downhill)

https://youtu.be/YbbD2LQ3DyY (Downhill together)

https://youtu.be/-eltdlvfbE8 (End with a game)

https://youtu.be/WG-UAyBX-Hg (Ending)

An example of how “Alla på snö” Day is created

These actors are involved in an all on snow day:

- the municipality
- the ski resort
- Primary School
- high school
- clubs and associations within the Swedish Ski Association

Here's how it works:

A common start is that the club/association contacts the Swedish Ski Association to show their interest in participating on “Alla på snö” All on Snow Day.

Together, we look at how the organization can be built to create a functioning network on site.

Contact is established with the municipality for a presentation of “Alla på snö”. Representatives from all actors attend the meeting. The Swedish Ski Association leads the meeting and presents the project. Since all municipalities have different conditions, we tailor the project for each municipality.

The goal is to create an organization that works year after year so that “Alla på snö” becomes a recurring feature in the municipality.

The municipality is responsible for the students coming to and from the facility. They also set aside a day to train their teachers in winter activities in relation to the primary school curriculum in the Swedish Ski Association director. The ski resort is responsible for ski passes and equipment during the day. In some cases, there is a lack of equipment; then of course, we try to solve it together. The high school participates with its students who act as extra leaders during Alla på snö Day. The high school students receive a basic education in how to be leaders on snow in the form of a lecture under the auspices of the Swedish Ski Association. In addition, they get an introduction to the ski resort in line with the curriculum for high school. Students then do internships during “Alla på snö” Day by helping the children and adolescents. The club/association appoints a local project manager who has contact with the Swedish Ski Association. Before the children and adolescents arrive at the ski resort, the club invites the leaders for a tour of the resort and planning of the days. The club or local department also has an All on Snow host who has the main responsibility during Alla på snö day. In collaboration with “the local department”, the club sends an invitation to the school. In the next step, an invitation is sent to each student via the teacher where the day is described in a clear way. After an All on Snow round, students are offered to return to try-out trainings in the club, all to make it possible for more people to participate regardless of background and conditions.

Example of an All on Snow schedule:

08.00. Gathering for all leaders at the facility. Together with “Alla på snö”-host.

09.00. Gathering for the children and adolescents - tell about the day, equipment, safety rules, etc.

09.20. Divide the children and adolescents into smaller groups – alpine, length, ski jumping, sledding. Everyone should try everything!

10.00. Start with snow activities with help and support for those who need it.

11.30. Lunch

12.15–13.30. Continued snow activities.

13.30. End and summary of the day; handing out presents to the children and adolescents.

14.00. Closing and summary with the leaders who participated during the day, together with the Alla på snö host.

Here you can see several videos from an all on snow day.

Here are warm-ups, games, main steps/technical steps and exercises.

Warm-up exercises:

■ Walk, jump or run forward, backwards, sideways, light or heavy steps.

■ Walk long distances and move your arms as when cross-country skiing.

■ Stretch up and "pick apples", and bend down and "pick flowers".

■ Small jumps on the spot and sideways.

■ Knee pulls.

■ Kick yourself in the butt.

■ Twist jump.

■ Stand on one leg - shift.

■ Obstacle course where you, for example, run slalom around cones, crawl under an arch, and jump over cones or canes.

Games and relays on flat ground with or without skis

What's your name?
The children stand in a ring. A ball is thrown, rolled or sent between the children. The person who sends the ball asks what is your name? The one who receives says my name is ..... The ball must pass everyone.

Imitate animals
The leader/participants imitate an animal; the leader/participants guess and do the same.

The last couple out
The children stand two and two in a row. At the front is the "hunter" who shouts out the last couple. The couple at the back of the line runs forward on either side of the line and tries to find each other and stand at the front, without being knocked down by the "hunter". The one who is taken becomes the new "hunter".

Cockfighting
The children stand in pairs with their arms crossed on their backs. Then they jump on one leg and try to knock each other off balance.

The centipede
The children stand behind each other in one or more rows with a grasp on each other's waist. The first child is the head of the centipede and moves in different ways by, for example, running, walking on toe, walking with bent legs, jumping crow. The others "follow John" and try to do the same. At the signal "break" from the leader, the first man becomes last in the line and the game continues with the second man as head.

Poles relay
Set two or more parallel courses with the participants' ski poles. Divide the group into two or more teams. Then let the children run slalom between the poles without skis or with a ski on.

Thread the needle
Divide the group into two or more teams. The team stands in line with the legs apart (branch

standing). On signal, the first man crawls the "wire end" between the legs of the others in the joint. Immediately when the first man has passed the second man, the next man can start crawling, and so on. Everyone should crawl through, and the team that is first lined up in the order of origin wins.

Clothespin litter
The children each get a clothespin that they attach to the jacket from the waist and back. Now they have to protect their own clothespin and at the same time take the clothespin from their friend. When you have taken a clothespin, you attach it to your own jacket. If you yourself have none left, a new one is picked up from the leader.

Dipping ball
Make a goal on each short side. Divide the group into two teams. The team must pass the ball between them by throwing the ball. You must not move with the ball. When you catch the ball, you touch it in the ground before throwing it on to a team member. The goal is made by touching the ball in the goal. A variation can be that you kick the ball.

Poles relay
The group is divided into 2 to 4 teams depending on the number of children. A course is marked with four cones. A team is placed in the middle at each cone. On a given signal, one on each team goes out onto the track, runs a lap, and returns to the center to change to another person. Note! One must go around the team's "starting cone" both on the way out and on the way back.

More games and exercises

■ Ski different courses with sticks, cones, arches, short sticks, etc.

■ Ski in jumps or in the woods.

■ Follow John where you jump, spin, roll, pedal, sing, flap, fly, etc.

■ Ski backwards. Choose very simple terrain and a safe place!

■ Hold a cane between each other. Two and two with an ordinary plastic stick between the two. One can raise or lower the cane and the other follows the turns.

■ Ski over terrain waves, organ tramples, bumps, jumps, velodromes, etc.

■ Police: The leader (police) stands below the group and shows red or green light, right or left with the arms. The children stop, go straight, to the right or to the left on the police’s signals.

■ Disconnect senses: For example, ski and close your eyes or cover your ears. Balance is challenged and uses other senses when one is disconnected

■ Ski and sing, breathe or count for rhythm and movement in the ride.

■ Live slalom: The children in the group are the gates in the track. The last man goes around his friends (the gates) and forms a new gate at the front, and so on. Keep good distance between the riders and call for caution when turning around your friend.

■ Challenges: Give the children challenges such as how far can you slide, how high can you jump, how long can you balance on a ski, etc.

■ Round track - Make a round track where different techniques are used, e.g. diagonal, stacking, shearing, performing. - Slalom between cones. - Throw balls in a bucket or hit trees. - Back around cones or trees.

Referenser

1. Oppewal A, Hilgenkamp TI, van Wijck R, Evenhuis HM. Cardiorespiratory fitness in individuals with intellectual disabilities--a review. Res Dev Disabil. 2013 Oct;34(10):3301-16.
2. Brubaker PH, Kitzman DW. Chronotropic incompetence: causes, consequences, and management. Circulation. 2011 Mar 8;123(9):1010-20.
3. Mendonca GV, Pereira FD, Fernhall B. Reduced exercise capacity in persons with Down syndrome: cause, effect, and management. Ther Clin Risk Manag. 2010;6:601-10.
4. Shin IS, Park EY. Meta-analysis of the effect of exercise programs for individuals with intellectual disabilities. Res Dev Disabil. 2012 Nov-Dec;33(6):1937-47.
5. Chanias, A. K., Reid, G., & Hoover, M. L. (1998). Exercise effects on health-related physical fitness of individuals with an intellectual disability: A meta-analysis. Adapted Physical Activity Quarterly, 15, 119–140.
6. Croce RV, Pitetti KH, Horvat M, Miller J. Peak torque, average power, and hamstrings/quadriceps ratios in nondisabled adults and adults with mental retardation. Arch Phys Med Rehabil. 1996 Apr;77(4):369-72.
7. Horvat M, Pitetti KH, Croce R. Isokinetic torque, average power, and flexion/extension ratios in nondisabled adults and adults with mental retardation. J Orthop Sports Phys Ther. 1997 Jun;25(6):395-9.
8. van de Vliet P, Rintala P, Frojd K, Verellen J, van Houtte S, Daly DJ, et al. Physical fitness profile of elite athletes with intellectual disability. Scand J Med Sci Sports. 2006 Dec;16(6):417-25.
9. Pitetti KH, Climstein M, Mays MJ, Barrett PJ. Isokinetic arm and leg strength of adults with Down syndrome: a comparative study. Arch Phys Med Rehabil. 1992 Sep;73(9):847-50.
10. Mendonca GV, Pereira FD, Fernhall B. Effects of combined aerobic and resistance exercise training in adults with and without Down syndrome. Arch Phys Med Rehabil. 2011 Jan;92(1):37-45.·

11. Li C, Chen S, Meng How Y, Zhang AL. Benefits of physical exercise intervention on fitness of individuals with Down syndrome: a systematic review of randomized-controlled trials. Int J Rehabil Res. 2013 Sep;36(3):187-95.
12. Blomqvist S, Olsson J, Wallin L, Wester A, Rehn B. Adolescents with intellectual disability have reduced postural balance and muscle performance in trunk and lower limbs compared to peers without intellectual disability. Res Dev Disabil. 2013 Jan;34(1):198-206.
13. Lahtinen U, Rintala P, Malin A. Physical performance of individuals with intellectual disability: a 30 year follow up. Adapt Phys Activ Q. 2007 Apr;24(2):125-43.
14.Smith BA, Ulrich BD. Early onset of stabilizing strategies for gait and obstacles: older adults with Down syndrome. Gait Posture. 2008 Oct;28(3):448-55.
15. Carmeli E, Zinger-Vaknin T, Morad M, Merrick J. Can physical training have an effect on well-being in adults with mild intellectual disability? Mech Ageing Dev. 2005 Feb;126(2):299-304.
16. Oviedo GR, Guerra-Balic M, Baynard T, Javierre C. Effects of aerobic, resistance and balance training in adults with intellectual disabilities. Res Dev Disabil. 2014 Nov;35(11):2624-34.
17. Giagazoglou P, Kokaridas D, Sidiropoulou M, Patsiaouras A, Karra C, Neofotistou K. Effects of a trampoline exercise intervention on motor performance and balance ability of children with intellectual disabilities. Res Dev Disabil. 2013 Sep;34(9):2701-7.

18. Blomqvist S, Van Biesen D, Vanlandewijck Y. Gear selection between techniques in freestyle cross-country skiing in athletes with intellectual impairment: A pilot study. *International Journal of Sports Science & Coaching*. 2018;13(6):1150-1155. doi:10.1177/1747954118798233
19. Höök, M och Larsson, J. (2016). Skidor för ungdomar. SISU Idrottsböcker.
20. Bilodeau, B., Rundell, K.W., Roy, B. and Boulay, M. (1996). Kinematics of cross-country ski racing. *Medicine and Science in Sports and Exercise,* **28**(1), 128-38.
21. Nordahl, S. Bli en stjärna på skidor (2017) SISU Idrottsböcker.
22. Ljung, L (2015). Grunder i längdskidåkning – klassisk och skejt. SISU Idrottsböcker.