

Tricycle Riding.



schuchmann®

Therapy equipment for
disabled children and teens

Is riding a bike more than just having fun?

Our inspiration.

Effects of bike riding.

Muscles used by riding a bike.

Our study.

Methods.

Results.

Hands on.

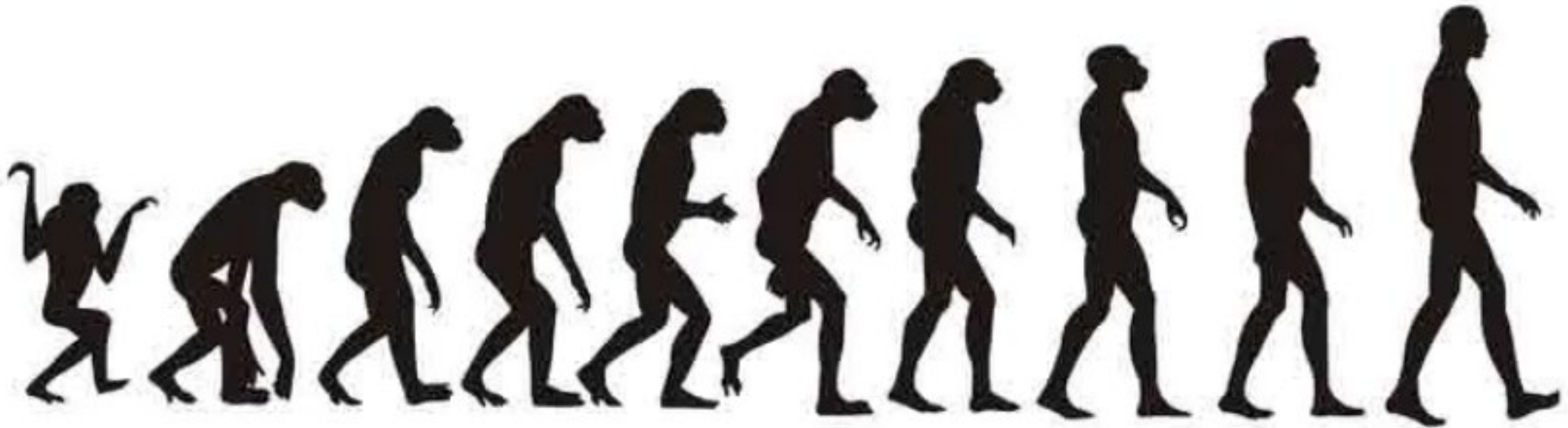




**Is riding a bike more
than just having fun?**



Walking is human.



Walking is an alternating movement of the lower extremity.



... as well as bicycle riding

The questions.



**Could bicycle riding be
used to support gait
training?**

**Where can we see the
impact on gait after
bicycle training?**

A photograph of a woman with long brown hair and sunglasses, wearing a dark polka-dot shirt, leaning over to help a young child with blonde hair. The child is sitting on a blue tricycle on a gravel path. The background is a lush, green wooded area. A large, light green semi-circular graphic is overlaid on the left side of the image, containing the text 'Our inspiration.'

Our inspiration.

Effects of bike riding.



'Leg muscle strength increases through cycling.'

(Damiano et al 2017)

'Gastrocnemius muscle is strengthened and spasticity reduced.'

(Damiano et al 2017)

'Strengthening the breathing muscles.'

(Kaufmann 2010)





'Cycling regulates muscle tension and trains the muscles in muscular strength and endurance.'

(Armstrong et.al. 2019, Kaufmann 2010)

'Cycling can help reduce psychological stress.'
(Kaufmann 2010)

'Cycling promotes self-efficacy and well-being.'
(Armstrong et al 2019)



'Reduction of obesity.'

(Kaufmann 2020)

'Diabetis prevention.'

(Ostergaard, Borrestad and
Tarp et al 2013)



‚Cycling is a training to practise walking and improve gait.’

(Zalpur 2014)

‚Independence through hands off.’

(Armstrong et al. 2019)



**Cycling promotes interaction and
communication.
Integration among peers and those of
the same age.
Fun.**

What does it take to walk?



- muscle power
- muscle endurance
- muscle strength
- ...

Muscles used by riding a bike.

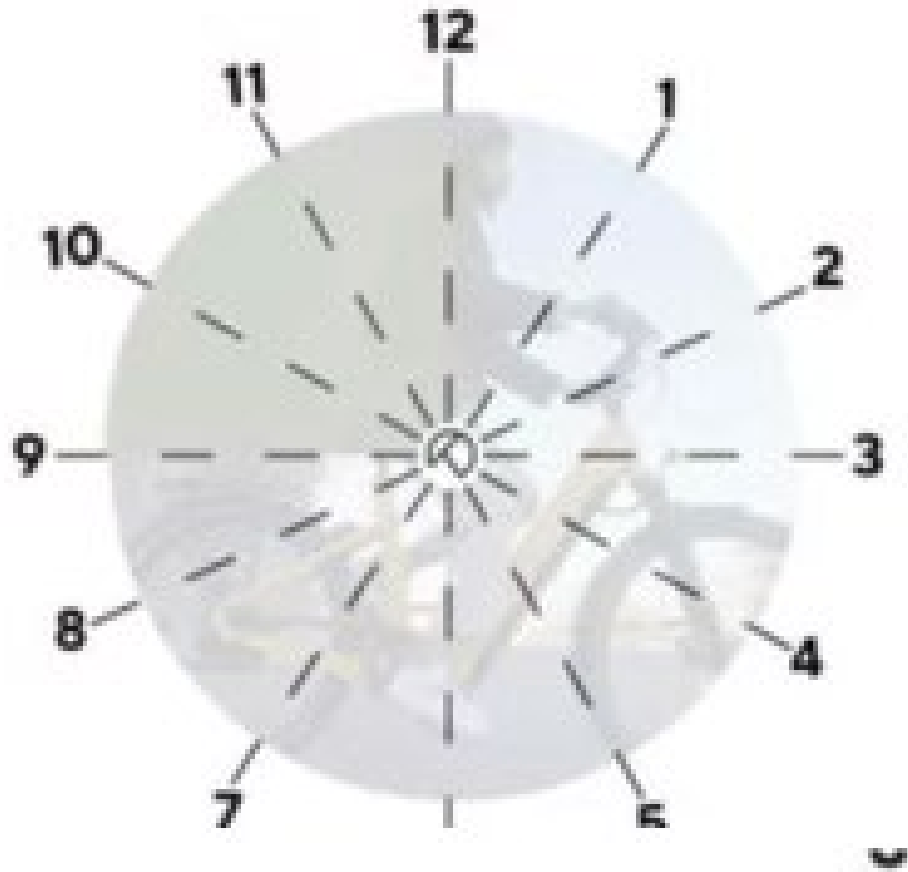


- calf muscles
- shin muscles
- thigh muscles
- hamstrings
- gluteal muscles
- arm muscles
- abdominal muscles
- back muscles

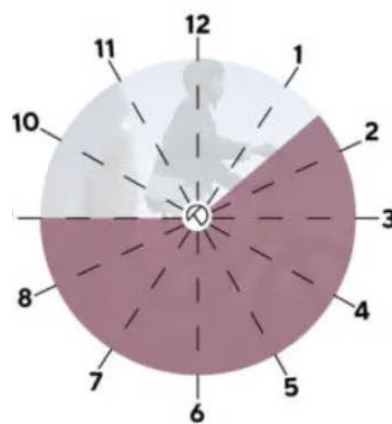
Muscles in the pedaling circle.



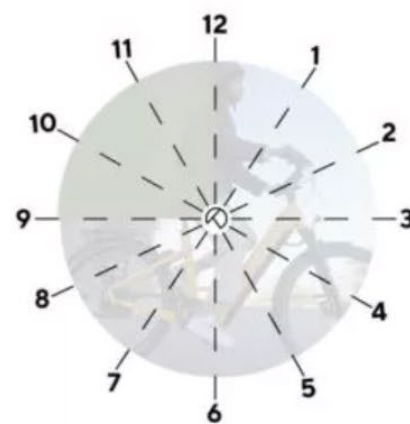
Imagine the pedaling circle as a clock face



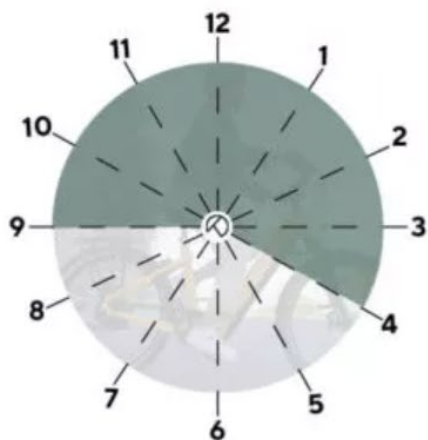
Workload of leg muscles in the pedaling circle.



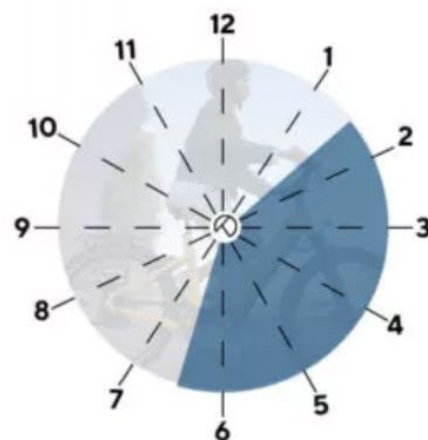
calf muscles



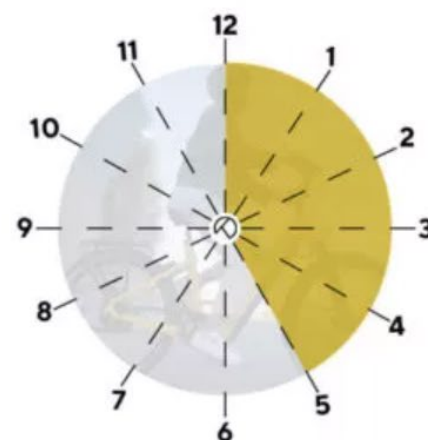
shin muscles



thigh muscles



hamstrings



gluteal muscles

Gastrocnemius.

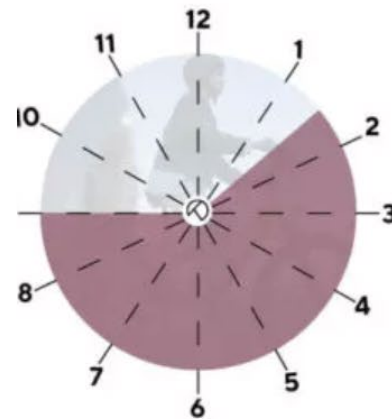
While cycling medial and lateral gastrocnemius together with the soleus take over about 20 % of kicking force.

Between 1 and 2 o'clock the muscles become active, i.e. at the beginning of the pedaling circle.

The soleus remains active until 5.00, while the medial gastrocnemius works until 6.30 and the lateral even until 9.00.



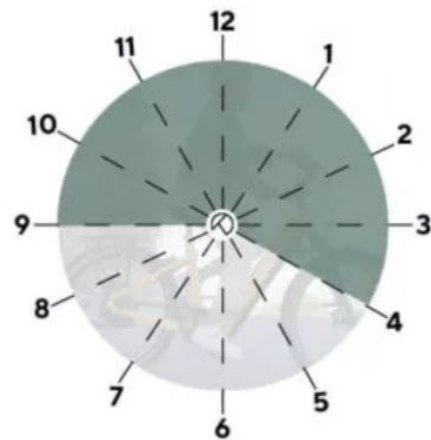
Workload of leg muscles in the pedaling circle.



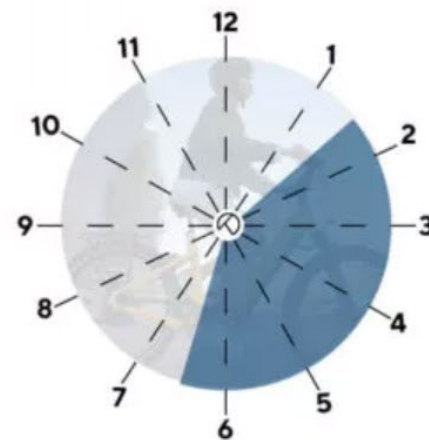
calf muscles



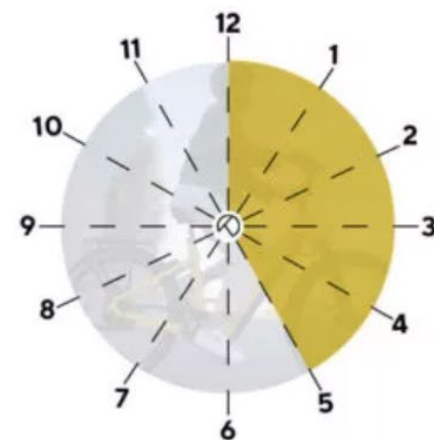
shin muscles



thigh muscles

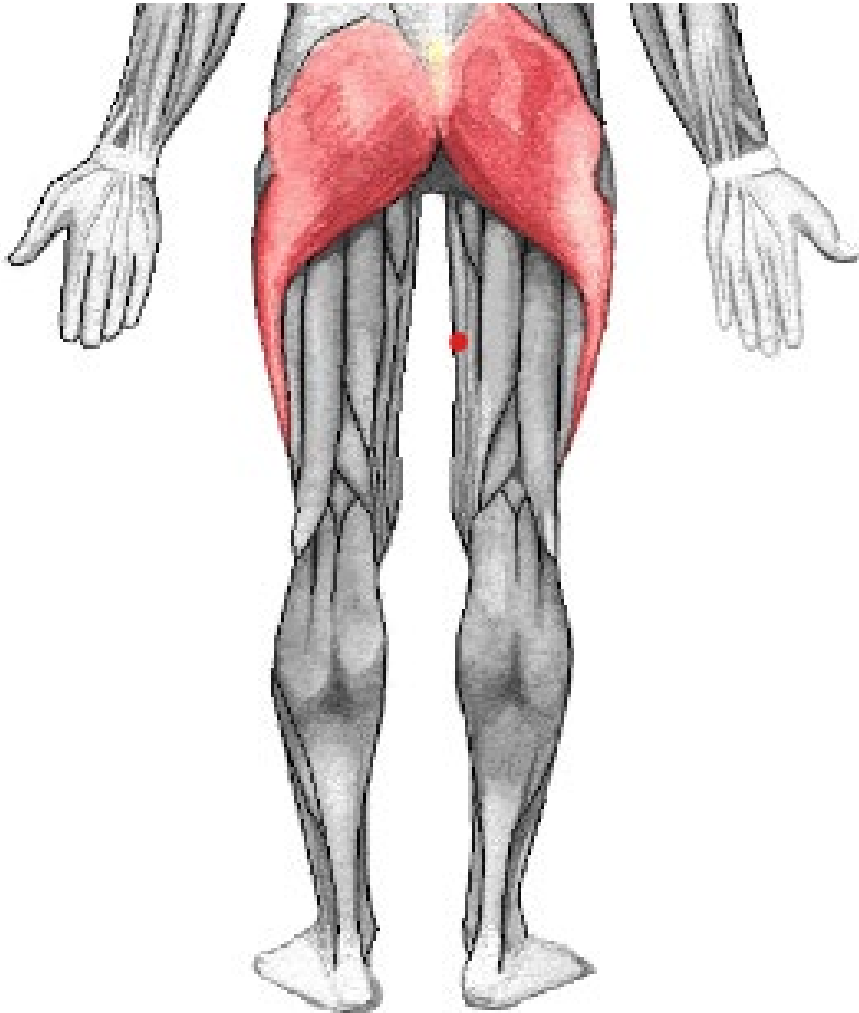


hamstrings



gluteal muscles

Gluteus maximus.



The gluteal muscle absorbs 30 per cent of your pedaling force when cycling.

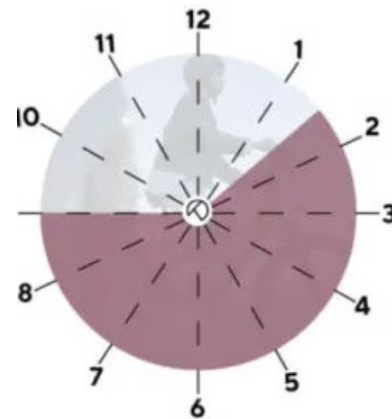
When you pedal downwards, the muscle uses all its strength.

To use the image of a clock: The gluteus maximus is most active between 12 and 5 o'clock.

However, the power muscle is not only responsible for the powerful pedal stroke, but also helps you to stabilize your hip and knee joints and keep them balanced. This is important because the joints are stressed during this phase.

A well-trained bum muscle therefore helps to bend and extend the hips correctly and assists with internal and external rotation.

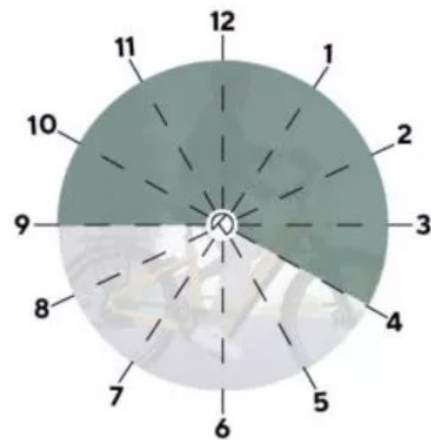
Workload of leg muscles in the pedaling circle.



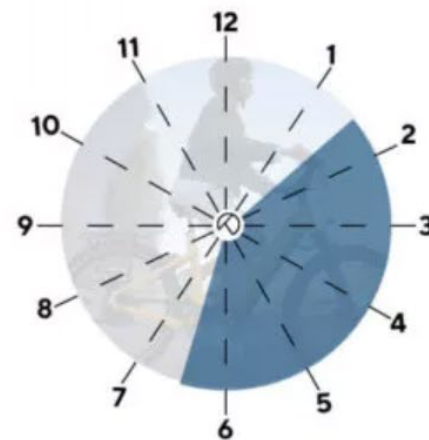
calf muscles



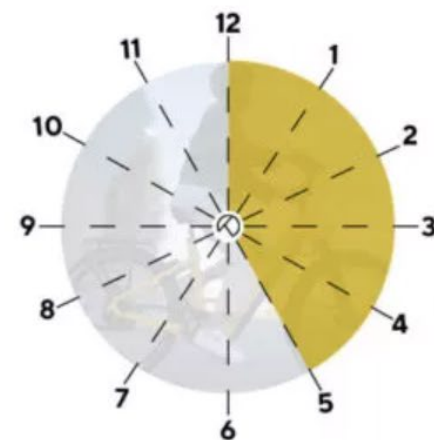
shin muscles



thigh muscles



hamstrings



gluteal muscles

Quadriceps.



Forty per cent of the pedaling force when cycling comes from the four muscles of the Quadriceps. The rectus femoris, the straight muscle of the thigh, is used the most and works from 9 to 4, to use the image of a clock.

The vastus medialis and vastus lateralis take up their work shortly before the downward movement from 11 h. They are intensively involved in the pedaling movement until 4 o'clock.

Quadriceps.

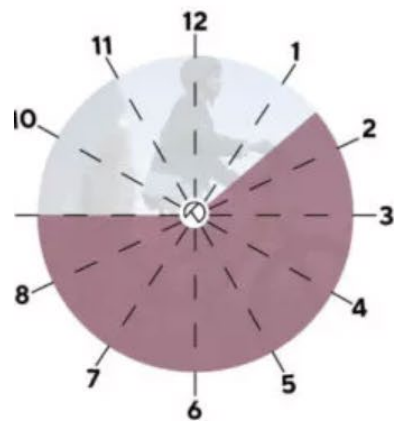


The quadriceps not only provides power when cycling but also stabilizes the knees. The rectus femoris is the only muscle of the quadriceps involved in the movement of the hip and knee joint. It is involved in the extension of the knee and flexion of the hip joint.

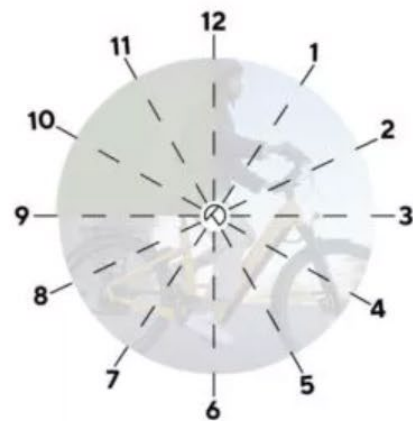
[source: Radfahren: Welche Muskeln werden trainiert?](#)

[| KALKHOFF \(kalkhoff-bikes.com\)](#)

Workload of leg muscles in the pedaling circle.



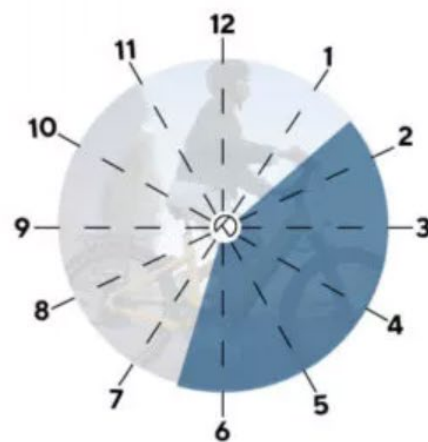
calf muscles



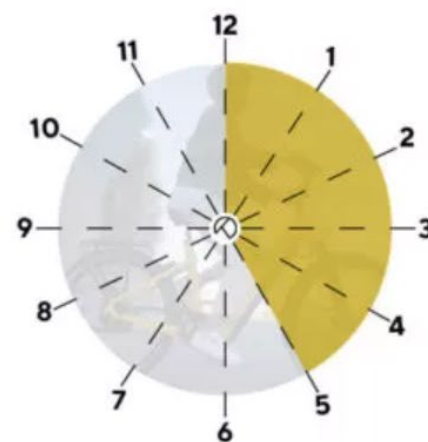
shin muscles



thigh muscles



hamstrings



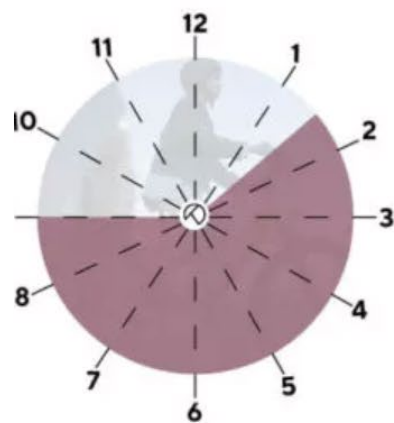
gluteal muscles

Hamstrings.

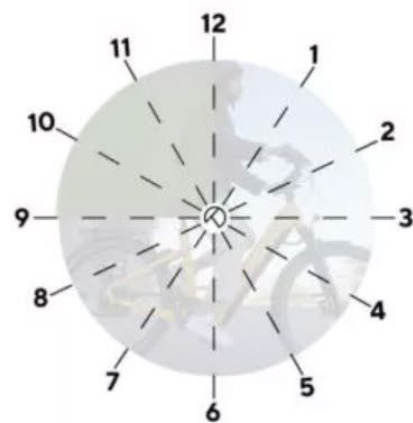
The hamstrings reach the peak of their activity between 1.30 and 6.30. The back of the thigh is therefore not necessarily the number one source of strength when cycling, but it enables the joints to move at all.



Workload of leg muscles in the pedaling circle.



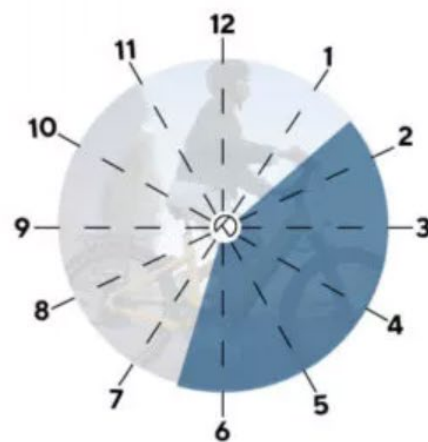
calf muscles



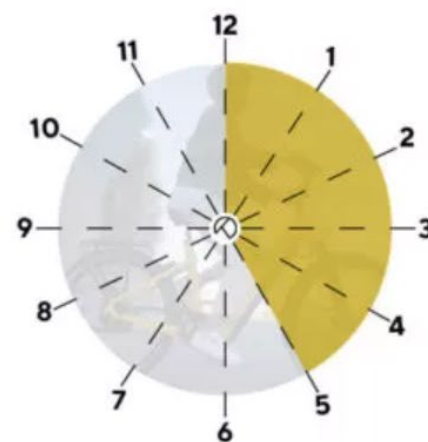
shin muscles



thigh muscles

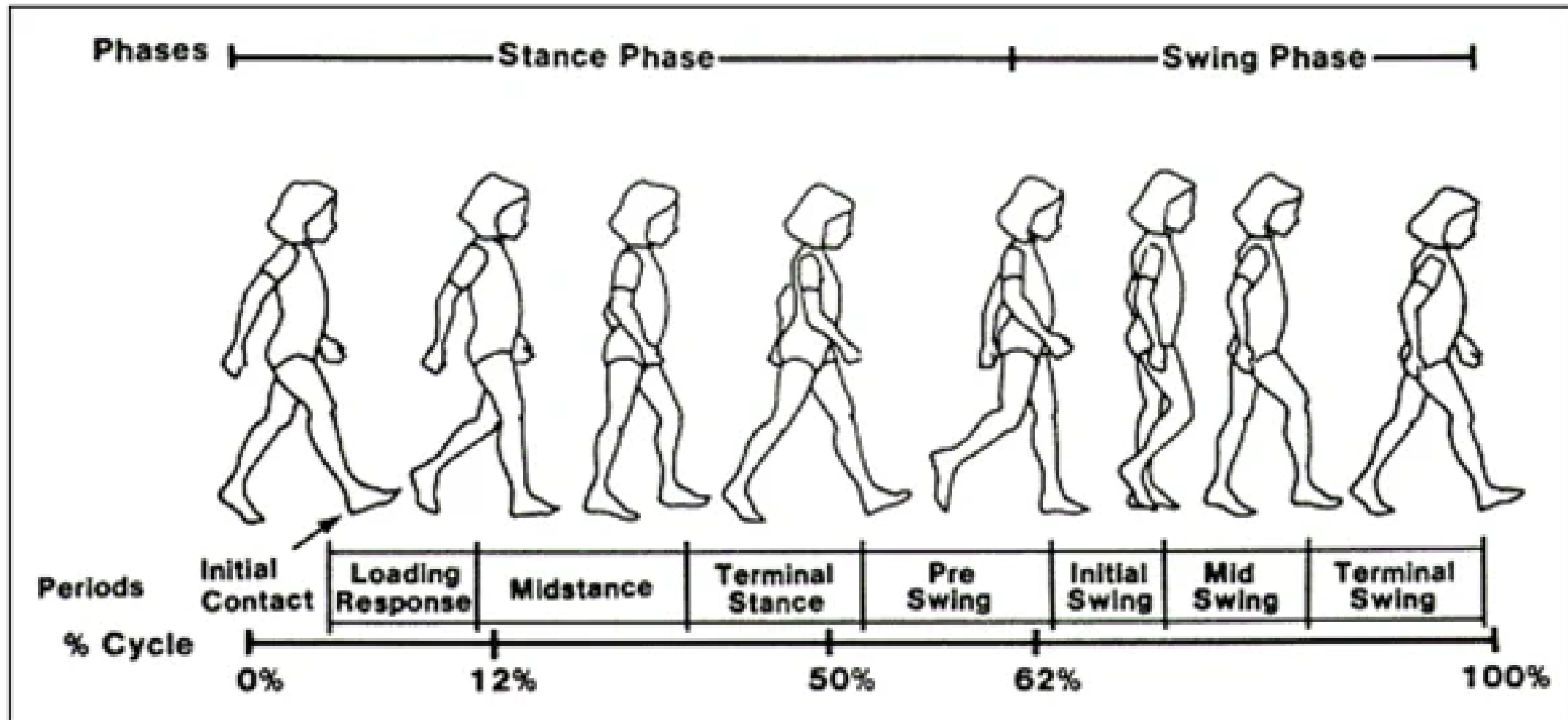


hamstrings

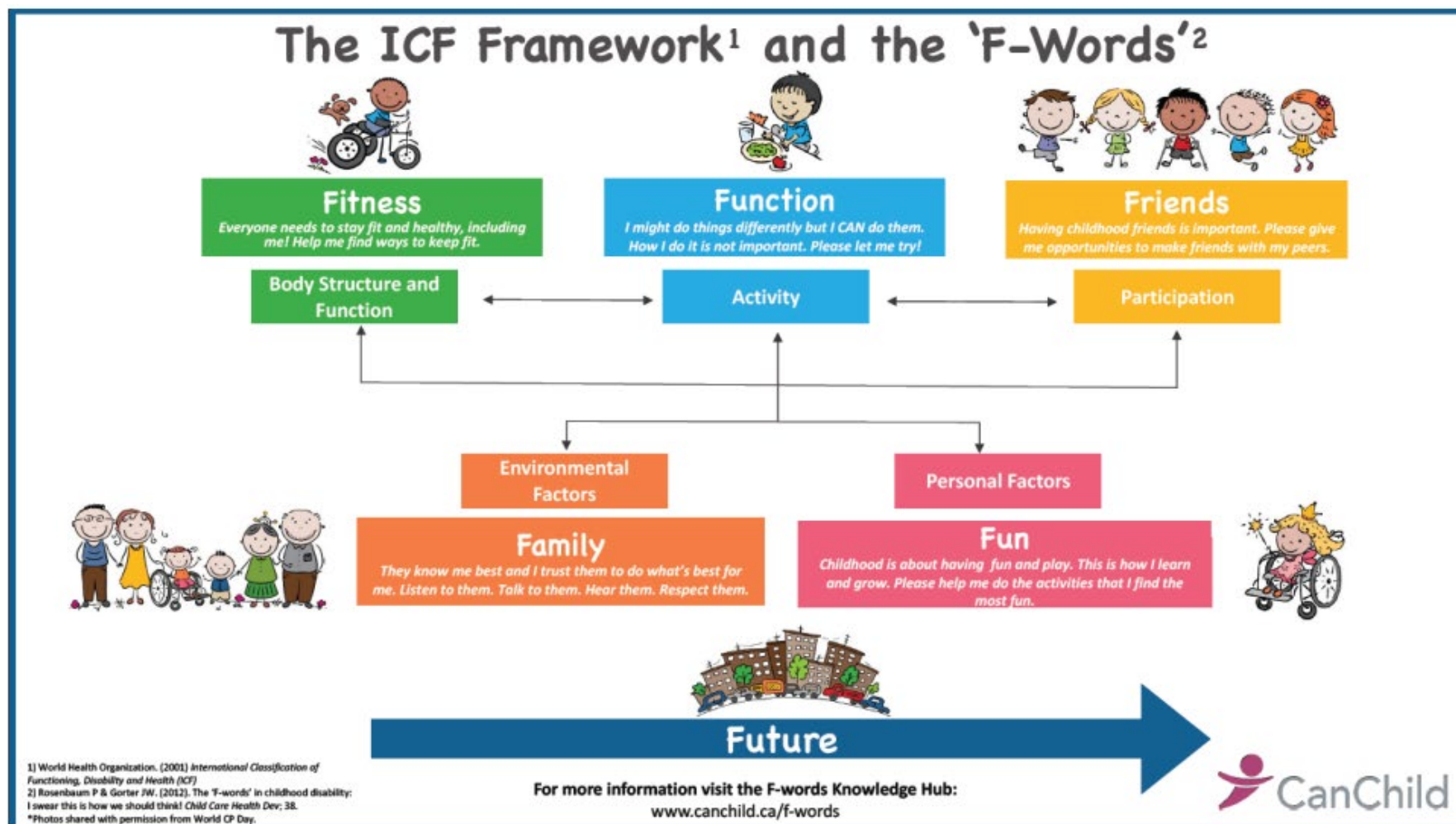


gluteal muscles

Muscle activity in gait.



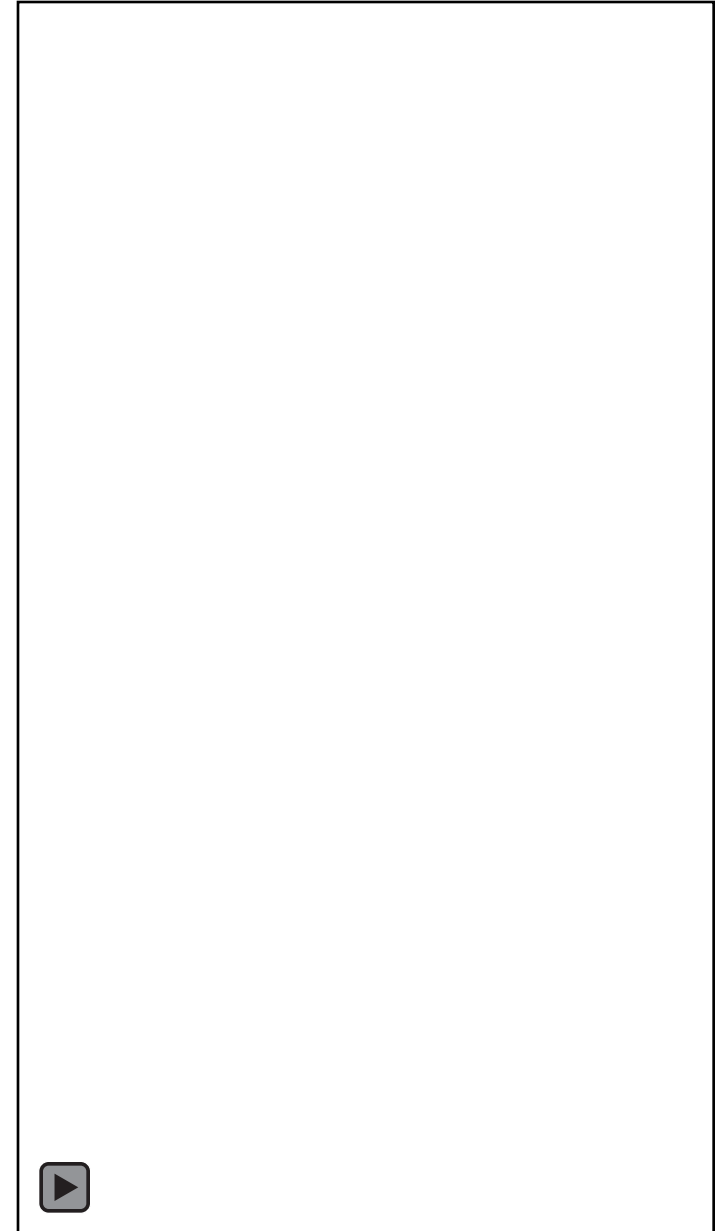
Cycling shows impact in all the ICF components.



Why our study?

Therapists' experiences show that cycling can also facilitate walking for children with movement impairments.

This is considered an especially interesting aspect because supporting gait training with cycling provides another opportunity to enhance and intensify therapy with joy and regular activities.



Our study.





Non-interventional study to investigate the change in gait pattern of children with disability participating in a cycling programme.



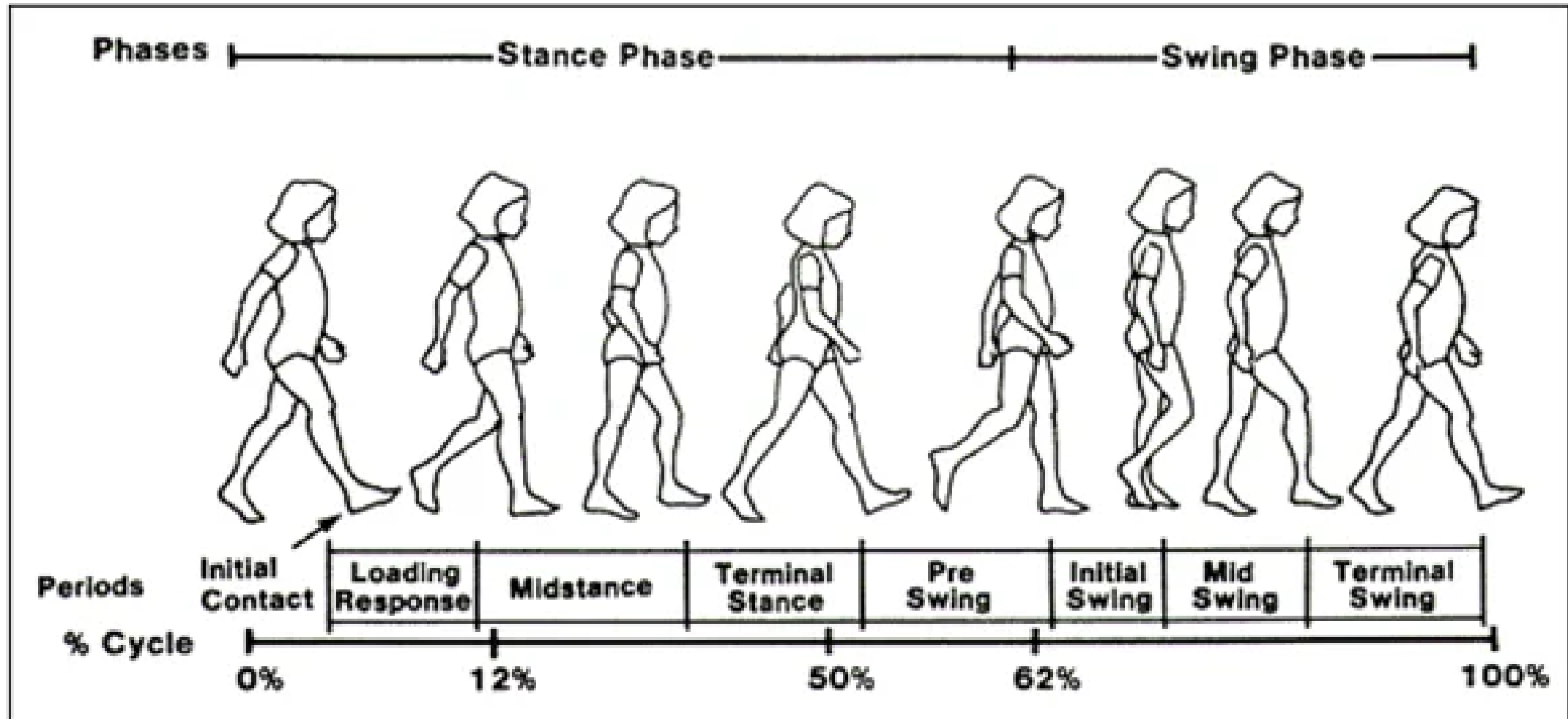
The goal.



The goal of this observational study was to collect data on the effect of tricycle training on walking in a structured and systematic manner. We hypothesized that regular tricycle riding has a positive effect on the gait pattern of ambulatory children with a disability.

M

uscle activity in gait.



Balance.



Muscle activity.



As the gastrocnemius is important for pace we thought it might be a good idea to measure pace.

Joints.



As the step length is important to measure the efficacy of gait /walking we thought it might be useful to measure ROM in hip and knee.

Methods.





Methods.



To answer the research question regarding a change in gait pattern, relevant gait parameters were recorded at the beginning and end of the 3-to-4-week observation phase, both before and after the cycling programme.



Set up.



- 
- We measured in two schools
 - Two PT Teams in two schools worked for us
 - Two student teams in two schools worked for us

Study parameters.



For the observation of the gait pattern, videos were recorded while the child walked on a straight path. The videos were recorded and processed using the OpenCap software (Uhlrich et al., 2022) with a 3-camera-setup. An additional camera was used to record the gait over a marked distance of five meters.

To analyse any relationships between patient characteristics and treatment success, age, height, diagnosis, and GMFCS level were recorded. Moreover, the participants were asked some questions about their experience with the cycling programme in a semi-structured interview during the post measurement, aiming at identifying any negative effects such as muscle soreness or saddle pain. Where available, the therapists' observations regarding treatment effects were recorded as well.

Set up for calibration.



Ambulant gait laboratory

- not expensive
- reliable data
- easy to transport
- ai – based

Data analysis

Spatiotemporal gait parameters: Time needed for walking 5 m and the initial contacts (IC) on that distance were determined based on the video data. Based on this, we calculated the walking speed in m/s, the average step length in m and the average cadence in steps/min as follows:

- *walking speed = $\frac{5m}{timeins}$*
- *average steplength = $\frac{5m}{ICcount}$*
- *average cadence = $\frac{ICcount}{timeins} \times 60s$*

Results.



Results.



To examine this effect more closely, we conducted a study in which the walking patterns of children with disabilities were recorded before and after an intensive cycling interval.

In total, 19 children and adolescents between the ages of six and 17 participated.

The medical conditions included cerebral palsy, ataxia, and global developmental disorders, among others.

All children and adolescents completed the three-week training period, averaging 13 sessions of 20 minutes on a tricycle, recumbent bike, therapy bike, or regular bicycle.

Results.

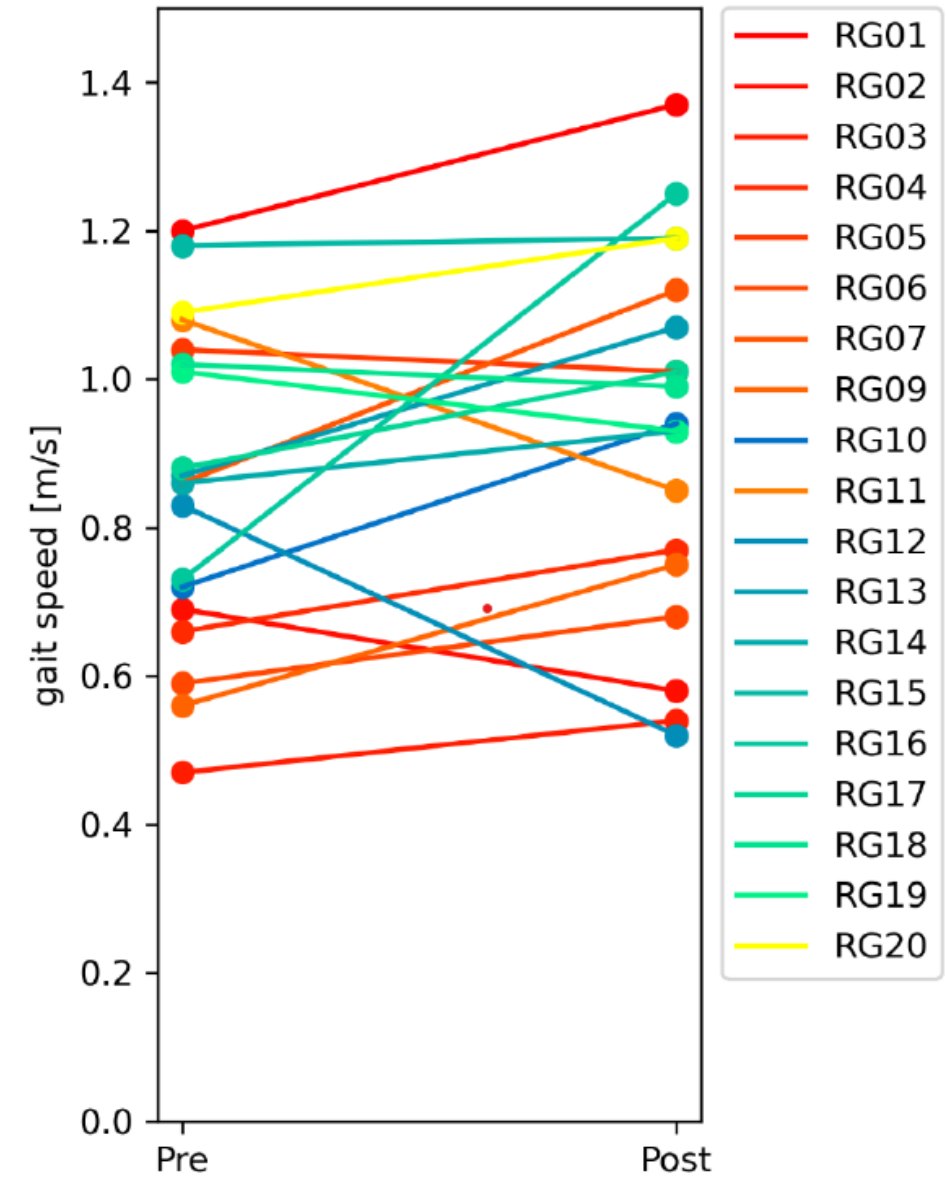
The majority of participants reported enjoying cycling and appreciating the group setting. Unpleasant effects, such as saddle discomfort or muscle soreness, were rare. Measurements with the mobile gait lab were also carried out with high motivation.



Results.

There were small individual changes in spatiotemporal gait parameters. Gait speed increased slightly in 13 of the participants.

(Table 2, Figure 1).



Results.



There were small increases in gait speed, step length and cadence in each of the means.

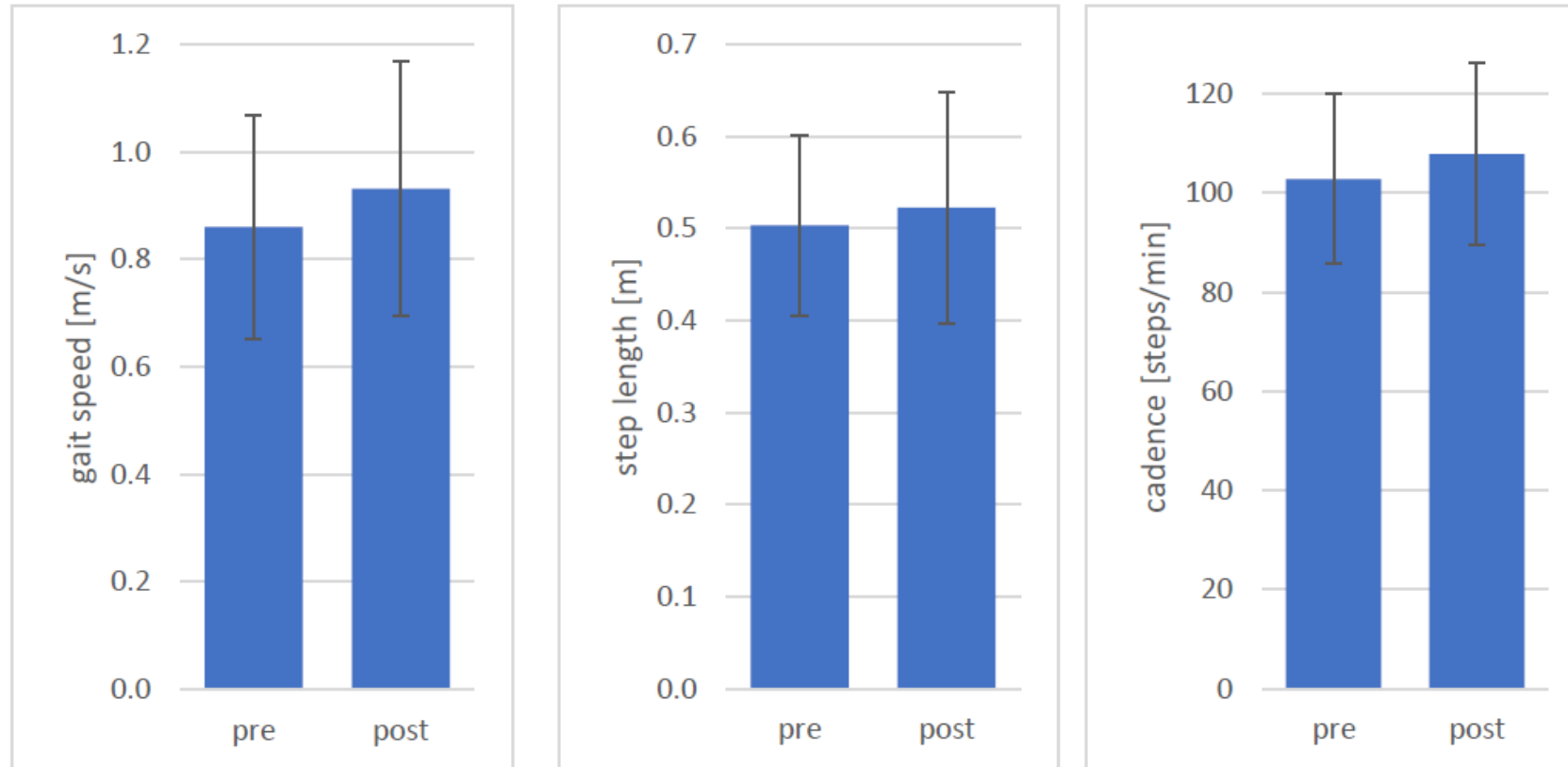


Figure 2: Means and standard deviations of the spatiotemporal parameters pre and post cycling programme.



Results.



The evaluation of gait analysis revealed that average walking speed, step length and step frequency were slightly increased after the cycling interval.

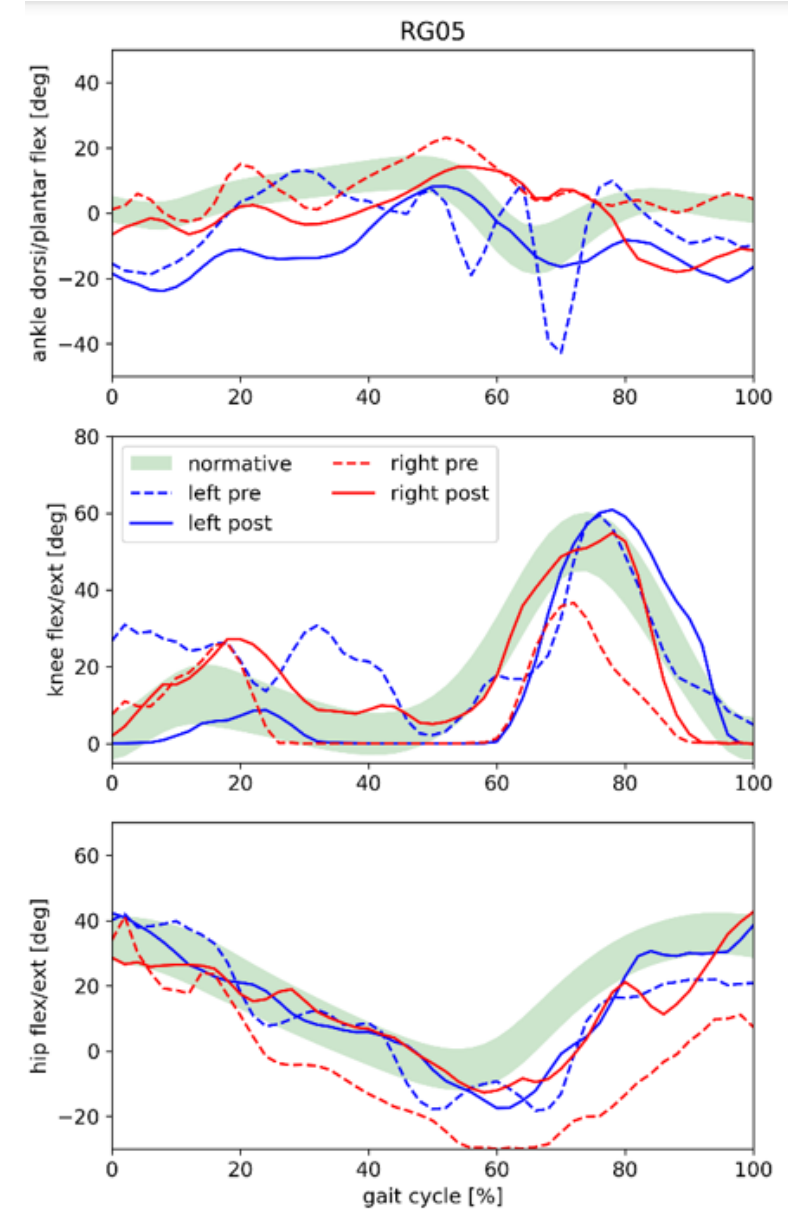
Regarding joint angles during walking, slight improvements were observed in individual participants.

Some subjects exhibited an increased range of motion in the knees.

Results.

Figure 1 shows two examples.

Participant RG05 had a reduced hyperextension of the right hip and right knee, as well as an improved right knee flexion during the swing phase after cycling training.



Results.



19 participants completed the cycling programme

4 sometimes experienced saddle pain.

4 participants reported sore muscles 'sometimes' and **1** 'most of the time'.

2 participants reported sometimes felt pain at the foot buckles.

Therapists reported **high motivation**. Even though cycling programmes were completed in winter, under unfavorable weather conditions, all children completed the activity.

2 participants sometimes had a lack of motivation, but still decided to complete

14 participants enjoyed cycling and **5** improved independence (2 switched from a bicycle with support wheels to a regular bicycle after some sessions).

1 participant progressed from being physically supported by a therapist, who took over the steering, and still falling over several times to being able to use a tricycle without any support.

Therapists noticed improvements in endurance, gross motor function, stair walking and (standing) balance in some children.

Results.



There are some limitations to the study design and setup which must be considered when interpreting the results. Spatiotemporal gait parameters were based on a single trial per condition and on a walking distance of 5 m.

To better evaluate effects of functional gait ability and endurance, one would have to perform several repetitions of a 5 m (or better 10 m) walking test and ideally also a 3-minute or 6-minute walking test.

Conclusion.



- **Intervall training is effective**
- **Group settings have a big motivational impact**
- **There are more effects than those we attended to measure (on ADL, self esteem, character, ...)**

The effects on walking in the participants confirm the importance of cycling in the context of medical treatment or disability compensation.



**The tricycles and
therapy bikes we used.**



momo tricycle.



momo. – ,in-betweenies' for teenies.



momo therapy bicycle.



momo motion.



mats. – the recumbend bike.





**Hands on –
let's give it a try**