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THE OPTIMISATION OF RUNNING TECHNIQUE: WHAT SHOULD RUNNERS CHANGE AND HOW SHOULD THEY ACCOMPLISH IT?

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ABSTRACT

Aim: (1) To gather knowledge about interventions (i.e., training programs, running technique methods) aimed to enhance or optimise the running technique in recreational runners by means of reviewing the scientific literature and (2) to identify the barriers and facilitators that are related to learning and applying a natural running technique. **Methods:** A systematic search of the scientific literature (Medline and SPORTDiscus) was conducted to identify relevant original studies. Subsequently, a qualitative research was conducted focusing on a specific and widely available natural running technique (Chi Running). Information was gathered from recreational runners who followed a Chi Running course by means of interviews and from Chi Running instructors participating in a focus group discussion. **Results:** Based on 7 original studies identified, step frequency, in combination with other running technique elements (step length and foot strike pattern), the Pose method, and visual feedback about tibial acceleration were found to have a positive effect on ground reaction force, contact time foot-ground, compartment pressures, mechanical power-consumption and self-reported pain. None of the retrieved studies investigated the sustainability of the learned technique aspects. From the interviews and focus group discussion, several barriers in learning and applying a new running technique emerged. The barriers were related to the individual runner (such as a lack of patience), the running technique method itself (such as being too extensive to learn), and the environment (such as adverse reactions from coaches). **Conclusion:** This study presents technique elements which could be beneficial for runners. Facilitators and barriers in learning and applying a running technique method were explored. This information is valuable in designing evidence-based interventions aimed at optimising running technique in recreational runners.

Keywords: military Chi Running; Review; Qualitative research;

INTRODUCTION

The number of recreational runners has been rising in many countries. Recent findings show that the total running population in the United States increased by 18% from 2007 to 2008, while the number of runners doubled within the decade in the Netherlands (Running-U.S.A. ; van Bottenburg 2009).

In contrast with the beneficial effects for physical health (Williams 2012; Williams 2012) and mental wellbeing (Thompson Coon et al. 2011), running activities may also lead to an increased risk of musculoskeletal injuries (Hespanhol Junior et al. 2011; Lopes et al. 2012). Known risk factors for running injuries are gender, high body mass index, history of previous running injuries, foot overpronation, muscle functions and weekly training distance and frequency (Van Middelkoop et al. 2008; Buist et al. 2010; Lopes et al. 2012; Moen et al. 2012). Also, Lieberman et al. (2010) found that modern running shoes with elevated and cushioned heels caused the runner to land on the heel and thereby increased the collision forces at the ground. Lieberman's suggestion that running barefoot might help to avoid injury has also been criticised, and examples of injuries associated with running barefoot have been published (Giuliani et al. 2011; Salzler et al. 2012). However, Lieberman and the barefoot running movement primarily hypothesise that many running injuries derive from poor running technique (Collier 2011; Lieberman 2012; Rixe et al. 2012).

Changing running technique and form has gained more attention over the years as a potentially effective strategy to reduce running-related injuries. Particularly, the 'natural running' techniques, such as barefoot running, Pose, and Chi Running, have been worldwide a topic of interest among both runners and sport scientists (Dreyer 2004; Fletcher et al. 2008; Collier 2011; Lieberman 2012; Rixe et al. 2012). The essence of these techniques is that the runner deliberately changes his or her technique and thereby strives to reduce the biomechanical load on tendons and joints as much as possible. For example, by learning Chi Running, runners aim at: improving their posture, using abdominal muscles to stabilize their pelvis, using gravity instead of muscle power to create a forward momentum, and running with a step frequency at around 180 steps/minute (Dreyer 2004).

However, Goss and Gross (2012) found in their review that there is scarce scientific evidence to substantiate the claims of injury prevention through natural running techniques, such as Chi Running. Results from a survey conducted among Chi Runners suggests that a change in the running technique and a transition to a more natural running style might be beneficial (Cucuzzella 2008; Cucuzzella 2011), but methodological weaknesses restrict the validity and generalisation of these results (Goss and Gross 2012). To our knowledge, there is no aggregated scientific evidence on the feasibility and effectiveness of alterations in running technique and form among recreational runners. Moreover, it should be verified whether learning a natural running technique leads to sustainable behavioural changes and mastering the technique in the long-term. It seems reasonable that runners might experience barriers in changing their running technique. The question should therefore not be restricted to "What is the effectiveness of adopting an alternate running style?" but should be complemented with "Are recreational runners able to learn and sustainably apply a natural running technique?". Exploring both the barriers and facilitators experienced by runners who transitioned to natural running is therefore a valuable step for both researchers and running

coaches who are interested in running technique.

Consequently, the aim of this study was twofold, namely (1) to gather knowledge about interventions (i.e., training programs, running technique methods) aimed to enhance or optimise the running technique in recreational runners by means of reviewing the scientific literature and (2) to identify the barriers and facilitators that are related to learning and applying a natural running technique.

METHODS

Interventions related to running technique

We conducted a systematic review of the recent scientific literature to gather knowledge about interventions, methods, and programs that focus primarily on the intrinsic enhancement or optimization of the running technique of recreational runners.

Search strategy

A systematic search strategy was performed to search the titles and abstracts of the electronic databases Medline (biomedical literature) via PubMed and SPORTDiscus (sports and sports medicine literature) via EBCOhost for the past 12 years (from January 2000 to July 2012). Two key words and synonyms were used, with a focus on using MeSH terms in Medline and with some search terms being truncated with a * symbol in Medline and a $ symbol in SPORTDiscus. In both databases, we used the Boolean commands OR/AND as follows: (technique OR physical education and training[Mesh] OR running style OR biomechanic[Mesh] OR biomechanic*$ OR kinematic*$ OR mechanic*$ OR natural OR pose OR barefoot OR chi OR Chi Running) AND (run*$ OR track and field[MeSH] OR jogg*$).

Inclusion and exclusion criteria

The inclusion and exclusion criteria were defined and used to ensure the capture of all relevant literature. We included original studies that (1) were published in a scientific journal from which full-text was available, (2) were written in English, Dutch or French, and (3) described an intervention or program that aimed primarily to enhance or intrinsically optimise the running behaviour (i.e., technique) of runners. We excluded studies that focused on the extrinsic enhancement or optimisation of the running technique in runners by the use of equipment such as footwear or orthotics or biomechanical studies that compared experimental conditions that were related to the running technique without any attention for behavioural change.

Study selection

After identifying and deleting all duplicates, both authors independently applied the inclusion criteria firstly to the titles of the studies and secondly to the abstracts. Studies were included for full text selection if they met the inclusion criteria or if the title and/or abstract did not provide sufficient information to determine whether the inclusion criteria were met. Then, the full articles of these studies were obtained, and the inclusion criteria were applied to the full text independently by both authors to identify the relevant articles. Any disagreements regarding the inclusion or exclusion of the full articles were resolved by consensus between both authors by discussing the inclusion/exclusion of the given study.

Data extraction

The data from the original articles were extracted with a standardised extraction form by one author and were independently checked by the other author. Within the extraction form, the following topics were included: (1) study information (author, year,

country and reference number), (2) name of the running technique intervention or program, (3) description of the running technique method or program studied, (4) characteristics of the study population, (5) main findings of the study, and (6) post-intervention strategy for sustainable behaviour.

Barriers and facilitators to learning and applying a running technique method

To identify the barriers and facilitators related to learning and applying a natural running technique, a qualitative study designed according to the Consolidated Criteria for Reporting Qualitative Research (COREQ) was conducted based on a cross-sectional design using semi-structured interviews and focus group discussions (Tong et al. 2007).

Participants

Among all popular natural running techniques, the Chi Running technique is the most widespread in the Netherlands and is the most standardised with regard to its instructions and instructors (ChiLiving). The method was founded in 1999 in the United States by Dreyer (Dreyer 2004). Since then, thousands of people learned Chi Running by using support products including books, DVD's, audio programs and technique-based distance training programs. Next to this, Dreyer, along with more than 135 Certified Instructors, have held clinics across the world. Consequently, recreational runners who had taken a course on Chi Running in the past were recruited for the semi-structured interviews, regardless of whether they were suffering from an injury. For the focus group, nine Dutch instructors (3 males and 6 females) specialised in Chi Running for at least 3 years were involved in the study.

Procedures

Prior to the interviews and focus group, a topic list relying on previous informal exchange with instructors and on the experience of the first auteur as Chi-Running instructor was formed to gather a broad perspective of the perceptions and opinions of all participants with regard to the barriers and facilitators for the application and implementation of technique intervention. The topic list based on open questions was formed in accordance to the aims of our study (facilitators and barriers) and divided into categories as suggested by a variant of the Ottawa model: characteristics of the (potential) adopters (i.e., runners), characteristics of the running environment, and characteristics of the innovation, i.e., intervention (Logant and Graham 1998).

After receiving written information about the aim and procedures of the study, the participants willing to be enrolled in the study were asked to contact the researchers to make an appointment for the interview or focus group. The interviews were conducted by phone by either of the two authors, who were randomly assigned to the participants. The participants were asked for consent to audiotape the interviews or focus group and were then given the opportunity to ask questions about the study. Both the interviews and the focus group were estimated to take 30 to 45 minutes. The finding of Guest et al. (2006) showed that data saturation in qualitative interviewing on a broad subject could be achieved in seven to 12 interviews. Consequently, it was decided to conduct at least 12 interviews on the assumption that data saturation would occur if more were performed.

Analysis

A directed content analysis approach was used for the analyses of the interviews and focus group (Hsieh and Shannon 2005). Audio tapes were attentively listened to so that, if necessary, the notes made on the topic

list during the interview or focus group could be completed. The transcribed topic list and the related notes were divided into important fragments, and these fragments were coded openly. The coded fragments were checked for their relevance, and the synonyms were combined. This step resulted in a schematic sorting of the content of the interviews and the focus group that was discussed by the authors.

RESULTS

Interventions related to running technique

Search strategy

A total of 5192 potentially relevant citations were retrieved from our literature searches of Medline and SPORTDiscus (August 2012). After checking for duplicates and applying the inclusion criteria to the titles, 254 potentially relevant original studies or reviews were identified. Then, inclusion criteria were applied to these 254 abstracts, resulting in only 16 primary studies for the full text review. From these full texts, 9 original studies were excluded mostly because these studies did not involve any intervention, method or training program that focused on the intrinsic enhancement or optimization of the running technique. Finally, 7 original studies were included.

Included studies

The step frequency (and related step length) as a focus of a running technique intervention was the topic of interest in 3 of the 7 included studies (Heiderscheit et al. 2011; Diebal et al. 2012; Hobara et al. 2012). In one of these studies, it was shown that a step frequency of approximately 185 steps per minute significantly decreased the peak vertical ground reaction force and the energy generated by the hip, knee and ankle joints (Heiderscheit et al. 2011). A second study found that a step frequency of 180 steps per minute, in combination with other running technique elements (step length and foot strike pattern), significantly decreased the ground reaction force, the foot-ground contact time, and the compartment pressures (Diebal et al. 2012). In addition, a step frequency of 180 steps per minute was also found to decrease self-reported pain (Diebal et al. 2012). In the third study, Hobara et al. (2012) found that the lower extremity loading was minimal at around +15% of preferred step frequency (Hobara et al. 2012).

The Pose method is the only 'natural running' technique intervention, i.e., method, that was retrieved from the scientific literature. The Pose method was involved in 2 of the 7 included studies (Dallam et al. 2005; Fletcher et al. 2008). The Pose method relies on the vertical alignment of the whole body on the ball of the supporting foot at impact with the ground, with the runner then moving from one leg to the other by falling forward (gravitational torque) and pulling the supported foot upwards vertically from the ground using the hamstring muscles. In both of the included studies, the Pose method was found to significantly increase the step frequency and to significantly decrease step length, vertical oscillation, stance time, and the distance of body's centre of mass to the foot impact (Dallam et al. 2005; Fletcher et al. 2008). The application of the Pose method did increase the oxygen consumption of the runners (Dallam et al. 2005; Fletcher et al. 2008).

In their study, Crowell and Davies (2011) explored the effect of visual feedback about tibial acceleration on the different outcome measures. Visual feedback was found to significantly decrease the peak positive tibia acceleration, vertical instantaneous and average loading rate, and vertical impact peak (Crowell and Davis 2011). The effect of pre-recorded verbal instructions in combination with auditory and visual feedback about vertical displacement,

step length, and mechanical power-consumption, was also studied by Eriksson et al. (2011) among well-trained runners. The authors found relevant adjustments in vertical displacement, in step length, and in mechanical power-consumption but these findings were not statistically significant (Eriksson et al. 2011).

None of the 7 included studies presented any information about post-intervention strategy meant to empower sustainably the behaviour of runners in the application of the running technique. The complete data extraction of the 7 included studies is presented in Table 1.

Barriers and facilitators to learning and applying a specific running technique method

Thirteen recreational runners who followed a Chi Running technique workshop or course in the past two years were interviewed. Among the participants, both runners who continued to apply the technique as well as runners who did not were recruited. Several facilitators and barriers were identified as related to learning and/or applying the Chi Running technique (Table 2). Six of the nine invited certified instructors participated in the focus group discussion. During the focus group discussion, the instructors reported on the facilitators and barriers that were also mentioned by the 13 interviewed recreational runners (Table 2).

Facilitators

The participants were facilitated in learning Chi Running when they had an eagerness to learn and intrinsic motivation to improve their technique. Secondarily, participants who were experienced with yoga and mindfulness found this of great help in learning the Chi Running principles. To apply the technique, the participants mentioned that patience and discipline are key elements. The participants with running-related injuries experienced a positive effect with regard to their running injuries as their complaints decreased or were even resolved. Some of the participants also reported that they experienced more ease during running, and that they could train longer or run faster with the same effort. With respect to the Chi Running method itself, the participants found the exercises and training tools (such as the book, DVD and metronome) helpful.

With regard to facilitators concerned with the individual runner, the instructors mentioned that those participants who were practising good posture throughout the day would benefit from this during their running. Furthermore, the participants who mastered the basic principles and experienced success (for example, no longer getting injured) are most likely to continue to apply the technique. However, the instructors mentioned several barriers, such as how some participants slow down their learning process by having negative thoughts about their own capacity to learn the technique or by trying too hard to get it right, which is counterproductive. Other barriers include: not being able to unlearn habits from years of running and not having adequate motor skills or being discouraged by their own technical shortcomings. Instructors also noted that some runners do not allow themselves enough time to go through the necessary learning phases, from unconscious and incompetent to conscious and competent.

Barriers

Chi Running was considered to be too much to learn, and too difficult as well as taking too much concentration to apply during running. After these barriers, some participants were afraid of getting injured when changing their technique so drastically. It was also mentioned that the optimistic tone of the founders of the Chi Running method does not fit the actual effort it takes to learn it,

which may lead to disappointment. Although opinions differ widely on whether the expenses for a course or workshop are high, some runners believed this to be a barrier. Furthermore, another obstructing factor is that there is no structured continuation after a course or workshop, in general. From the interviews, it appeared that the social environment can be a particular barrier in learning and applying Chi Running. Examples are negative reactions and the negative advice of medical experts, such as physical therapists and physicians. Furthermore, not all athletic trainers and coaches are familiar with the technique and will advise against learning it. Additionally, at some athletic clubs, another specific running technique is taught, that is not compatible with the Chi Running principles.

Instructors acknowledge the main barrier of Chi Running being an extensive method that requires someone to completely change his or her technique. Furthermore, some runners tend to prefer more 'easy' solutions to injuries, such as changing shoes, wearing orthotic insoles, taking medication, having a physical therapist to treat injuries or even not running at all.

DISCUSSION

The aim of this study was to gather knowledge about interventions (i.e., training programs or running technique methods) that are aimed to enhance or optimise the running technique in recreational runners and to identify the barriers and facilitators that are related to learning and applying a natural running technique. Seven original studies were found in our systematic literature search in which technical alterations in the running technique (namely, the step frequency, step length, foot strike pattern or a combination of alterations) were studied among recreational runners. The main findings of these studies showed relevant and beneficial effects, such as a decrease in the vertical ground reaction force and vertical excursion of the centre of mass. However, none of the studies explored whether the participating runners were able to sustain the alteration in their technique over time. Even more, none of the studies evaluated whether the running technique led to a reduction in running-related injuries. From interviews and focus group discussions among runners and running instructors involved in natural running (Chi Running), several barriers in learning and applying a new running technique emerged. The barriers were related to the individual runner (such as a lack of patience, self-discipline, motivation or concentration), the running technique method itself (such as being too extensive to learn and a lack of long-term feedback), and the environment (such as adverse reactions from professionals and coaches). The results of the present study therefore indicate that technical alterations in the running technique might have biomechanical benefits, but several barriers in learning and applying alterations in the running technique must be overcome by recreational runners.

Strengths and limitations

For many years, biomechanical studies have focussed on the effect of apparel on running gait and subsequent injury risk. In particular, shoes and orthoses have been recognised as useful for the prevention of running-related injuries. To our knowledge, our study is the first to systematically review studies in which the runner deliberately and intrinsically tried to change his or her running technique.

Furthermore, our study is the first to provide an in-depth view of the opinions of runners who were involved in a natural running technique training program. In addition, experienced instructors provided their opinion on how recreational runners learn and apply a natural running technique.

This approach might be criticised for being subjective, but in the present study, it provides relevant and sensible information for those involved in designing running technique training programs for both research and practice.

Implications for research and practice

While 'natural running' techniques claim to prevent running injuries, it seems peculiar that no prospective cohort study evaluating the effect of running posture and technique was retrieved from the scientific literature. Therefore, we recommend a prospective cohort study to study the causality between running technique and the occurrence of injuries. Furthermore, a substantial long-lasting follow-up period would allow for the monitoring of the learning process and sustainable technical changes related to a new running technique.

With respect to the development of an intervention in this field of health education and promotion, one of the structured processes being applied recently in several contexts is Intervention Mapping, which was initiated in 1999 by Bartholomew and was recently acknowledged for sport injury research by Verhagen and Van Mechelen (Bartholomew et al. 2001; Verhagen and Van Mechelen 2010). Despite the availability of such structured processes and the rising awareness that interventions in sport science and medicine should rely on evidence-based methods, our study emphasises the lack of any evidence-based intervention focusing on the intrinsically sustainable enhancement or optimisation of the running technique of recreational runners. The few original studies retrieved from the scientific literature, as well as the results of our qualitative study among recreational runners and instructors, emphasise that long-term strategies to achieve sustainable alterations in running technique are lacking. Considering the diffusion of innovation theory (Rogers 2003), it seems peculiar that worldwide popular natural running techniques seem to take into account to some extent the diffusion stage but not the adoption stage. Individual strategies for the long-term application of the natural running technique are lacking.

Whether learning and applying a natural running technique might be effective depends largely upon whether the intervention (i.e., running technique program) itself and the delivery of the intervention were optimal. Conducting a pilot implementation and evaluation of the process of this implementation might therefore be a fruitful approach in our opinion. Barriers that were mentioned by the participants in the present study should be tackled, and facilitators should be exploited.

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Table 1: Data extraction from included studies on running technique in recreational runners.

Author	Running technique intervention or program	Intervention or program description	Study population	Main findings
Crowell and Davis (2011) U.S.A.	**Retraining program**	Training (8 times over 2 weeks, from 15 to 30 min over 2 weeks) on treadmill with visual feedback displayed on a monitor about the tibial acceleration.	N = 10 recreational runners G = 4 males, 6 females A = 26.0 (SD = 7.0)	- Decrease (*) in peak positive acceleration of the tibia - Decrease (*) in vertical instantaneous loading rate - Decrease (*) in vertical average loading rate - Decrease (*) in vertical impact peak
Dallam et al. (2005) U.S.A.	**Pose method**	Theoretical and practical training (1 time per week for 60 min during 12 weeks) involving basic drills and sub-maximal short distance runs.	N = 16 experienced sub-elite triathletes G = 16 males A = 35.6 (SD = 5.1)	- Decrease (*) in step length - Decrease (*) in vertical oscillation - Increase (*) in oxygen cost
Diebal et al. (2012) U.S.A.	**Step frequency** **Step length** **Foot strike pattern**	Instruction (using a metronome for 3 steps per s), training (3 times per week for nearly 45 min during 6 weeks) and video feedback aiming to eliminate the initial hindfoot strike, and limiting pushing the foot off the ground by using the hamstrings muscle group.	N = 10 patients having suffered from chronic exertional compartment syndrome G = 8 males, 2 females A = 20.2 (SD = 1.5)	- Increase (*) in step rate - Decrease (**) in step length - Decrease (*) in ground reaction force - Decrease (*) in contact time - Decrease (**) in intracompartment pressures - Decrease (**) in self-reported pain - Increase (**) in lower leg condition
Eriksson et al. (2011)	**Vertical displacement** **Step length**	Visual (TV-monitor) and auditory (wireless headset) feedback about vertical displacement, step length,	N = 18 well-trained runners G = 11 males, 7	- Relevant adjustment in vertical displacement - Relevant adjustment in step length

Sweden	**Mechanical power-consumption**	and mechanical power-consumption, and pre-recorded verbal instructions on how to correct the technique (run higher/lower, too much/too little power, shorter/longer steps).	females A = 28.4 (SD = 6.4)	- Relevant adjustment in mechanical power-consumption (not tested for statistical significance)
Fletcher et al. (2008), Canada	**Pose method**	Theoretical and practical training (1 time per day for 60 min during 1 week) involving basic drills and sub-maximal short distance runs, using video feedback.	N = 8 recreational runners and triathletes free from musculoskeletal injuries G = 8 males A = 21.1 (SD = 1.7)	- Decrease (**) in stance time - Decrease (*) in distance of body's centre of mass to foot impact - Decrease (**) in average knee flexion angular velocity for stance from impact to maximum knee flexion - Increase (*) in average knee flexion angular velocity from terminal stance to maximum knee flexion during swing - Increase (**) in step frequency - Decrease (NS) in vertical oscillation - Increase (NS) in oxygen consumption
Heiderscheit et al. (2011), U.S.A.	**Step frequency**	Running for 15 s with visual feedback and digital audio metronome at different step frequencies: preferred, below (-5%), below (-10%) preferred, above (+5%) preferred, and above (+10%) preferred.	N = 45 healthy volunteers G = not reported A = 32.7 (SD = 15.5)	- Mean preferred step length: 100.8 cm - Mean preferred step frequency: 172.6 per min - Minimal step length at +10% of preferred step frequency - Minimal peak vertical ground reaction force at +10% of preferred step frequency

				- Minimal vertical excursion of center of mass at +10% of preferred step frequency - Decrease (**) in hip energy absorbed at +10% of preferred step frequency - Decrease (NS) in hip energy generated at +10% of preferred step frequency - Decrease (**) in knee energy absorbed at +10% of preferred step frequency - Decrease (**) in knee energy generated at +10% of preferred step frequency - Increase (NS) in ankle energy absorbed at +10% of preferred step frequency - Decrease (NS) in ankle energy generated at +10% of preferred step frequency
Hobara et al., 2012, Japan	**Step frequency**	Training (as long as needed, ranging from 3 to 4 min) with digital audio metronome at different step frequencies: preferred, below (-15%), below (-30%) preferred, above (+15%) preferred, and above (+30%) preferred.	N= 10 runners without neuromuscular disorders or functional limitations G = 10 males A = 28.8 (SD = 3.0)	- Mean preferred step frequency: 2.73 Hz - Minimal lower extremity loading at around +15% of preferred step frequency

N, number; G, gender; A, mean age in years; SD, standard deviation; s, second; min, minute; Hz, hertz; *p<.05; **, p<.01; NS, not significant; %, percentage

Table 2: Main facilitators and barriers in learning and applying a running technique (Chi Running) as perceived by course participants (P) and instructors (I) or both participants and instructors (all, except otherwise indicated).

Characteristics	Facilitators	Barriers
Runners	*Learning* – Eagerness and intrinsic motivation to learn natural running and improve technique – Frequent practice – Experience with yoga or mindfulness – Video-taping yourself and comparing to what extent your technique meets the criteria for ChiRunning – Beginning runner without ingrained running technique – Reading the ChiRunning book – Awareness of posture all day long (I)	*Learning:* – High degree of difficulty and effort to learn – Obstructive thoughts, such as 'I cannot learn this' (I) – Difficulties with unlearning habits from years of running – Difficulties with relaxing (which is needed in learning ChiRunning) – Not having good motor skills and body sensing abilities (I) – Forgetting of exercises, which might be useful – Afraid of getting injured as a result of changing running technique – Not taking enough time to go through each stage of learning proces (I) – Trying too hard, which is counterproductive and causes tension and sometimes injuries/complaints (I) – Too many 'shortcomings' in technique, which is discouraging (I)
	Continuing to apply: – Patience and discipline in practicing – Interest in mindfulness – Frequent and prolonged (4 to 5 months) practising of exercises (P) – Awareness of (beginning) injuries (I) – Being satisfied with the progress you make, even if that is small	*Continuing to apply:* – Takes too much concentration during running – Tired of practising after a few months (P) – Reluctant to constrict speed and/or distance and focus on technique first (I)
Innovation i.e,. program	*Learning and applying:* – Exercises before running (body looseners) and during running – Contact with instructor by email/social media	*Learning:* – ChiRunning has a reputation of being vague – The ChiRunning technique is too extensive to be learned in a full day or a course of approx. 6-8 hours (I)

Characteristics	Facilitators	Barriers
	– Video feedback by instructor – Using the metronome to increase step frequency – A training program for 5K, including a weekly training with an instructor	– Difficulties with completely changing running technique (I) – Courses/workshop/individual coaching is expensive – Courses/workshop/individual coaching is needed to really learn it, difficult to learn it by yourself (P) *Continuing to apply:* – No long-term strategy to continue to work on technique – The optimistic tone of the Chi Running-founders is not fitting the actual effort it takes for a runner to change his/her technique, which leads to disappointment (P) – Apparent contrast between the mindful approach and the often expressed ambitions, such as running a marathon or ultra marathon (P)
Social environment	*Continuing to apply:* – Having a training buddy who is also working on his/her technique and can give you feedback – Discussing your technique with other Chi Runners	*Learning:* – Negative reactions of medical experts (for example pysical therapists, who are "convinced that it is best to land on your heel". – Athletic trainers without knowledge about the technique and advise against learning and applying the technique – Other possibilities to get rid of a running injury (I)
		Continuing to apply: – Adherence to another running technique method (athletics club) – Some participants seek advice from everyone and follow up on every advise they are being given, even when it is a poor advice or counterproductive when a runner tries to apply Chi Running (I)

P, perceived only by participants; I, perceived only by instructor