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## Editorial

### **Maximising individualisation of sports injury risk reduction approach to reach success**

**Running heading:** Individualisation for sports injury reduction

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**Key words:** End-user; implementation; individualisation; individual subject; injury risk reduction; sports injury prevention.

Highlights:

-To individualise injury risk reduction measures could help to better match athlete's individual characteristics and should thus improve their effectiveness.

-To individualise injury risk reduction measures could help to improve athlete adherence into such measures and consequently their effectiveness.

-This maximised individualised approach is proposed to be used whatever the sport (i.e., individual and teams sports) in both scientific studies and real-world settings, with an end-user centred approach (especially athlete-centred approach) and a co-construction of the injury risk reduction measures with all stakeholders.

**Supplementary material:** A supplementary file presenting an example based on Figure 1 to concretely describe the conceptual strategy of the maximised individualisation approach.

We now have a high level of scientific evidence suggesting the efficacy of injury risk reduction measures (IRRM) (e.g., neuromuscular exercises, psychological interventions) to reduce sports injuries.<sup>1,2</sup> Randomised controlled trials and meta-analyses have shown that, at the group level, athletes in intervention groups (i.e., supposed to perform IRRM) present lower injury risks than athletes in control groups (i.e., supposed not to do IRRM).<sup>1,2</sup> However, compliance with IRRM has been reported to be low in the context of scientific studies<sup>3</sup> as well as adherence to IRRM in applied practice.<sup>4</sup> If the targeted end-users do not adopt, implement and maintain IRRM in applied sport settings, the potential to reduce sports injuries may not be accomplished.<sup>5</sup>

One promising strategy to improve both IRRM effectiveness and athlete' adherence is through individualisation of IRRM and its implementation. Through this Editorial, we aim *i)* to discuss the interest of individualisation of IRRM and its implementation and *ii)* to propose practical suggestions to maximise individualisation in scientific studies and in real-world settings illustrated by the metaphor of the Trojan horse approach.

### **Individualise IRRM to better match athlete's characteristics**

Although IRRM has shown evidence for effectiveness at the group level,<sup>1,2</sup> this may vary at the individual level. Each athlete differs in their physical, psychological, and sociological characteristics. It is therefore reasonable to hypothesise that they are likely affected differently by IRRM. Some athletes could be “non-responders” showing no reduction in injury risk. This is supported by evidence reported in primary<sup>3</sup> and secondary prevention context.<sup>6</sup> Consequently, IRRM should be adapted to the athlete's characteristics in every dimensions (i.e. multifactorial: physical, psychological, and sociological, to match the sports injury's nature and reality), especially targeting the individual athlete's risk factors and deficiencies/deficits to better meet the athlete's individual needs.<sup>7</sup>

## **Individualise IRRM implementation to improve athlete ‘buy-in’**

Improvement of athlete’s adherence is a part of the success of IRRM implementation.<sup>4</sup> After individualisation of IRRM, the next step is to act on the behaviour to help the athlete accepting, adopting, and implementing the IRRM. Knowledge from both *i*) behaviour-change theories regarding motivation, beliefs, and intentions (i.e., determinants) to adopt IRRM, and *ii*) context, environmental, social, and delivery factors (e.g., culture, other end-users behavior, resources, time) that may facilitate or hinder successful outcomes, are crucial to success adherence in a sport setting.<sup>2,5</sup> These parameters may differ at the individual level.<sup>8</sup> Therefore, the method of presenting the measure to the athlete and the levers to favour the changes in their habits should also be individualised. In practice, the promotion of IRRM can be based on behaviour change determinants and principles (i.e., techniques) to be more effectively adopted.<sup>8</sup>

## **Practical suggestions to maximise individualisation**

This approach is considered person-centred, especially end-user centred. It mainly means that the *athlete* is at the center of the individualisation (athlete-centred approach), but it may also be considered for other individual levels, such as the coach or health professional. In practice, IRRM individualisation could be done through individual screening in different domains (e.g., physical, psychological, social) to determine individual deficiencies/deficits, which could differ from the mean group-level.<sup>6</sup> It should also target the known and valid injury risk and protective factors for a sport or a pathology. Such approach could help to better target appropriate needs for IRRM.<sup>6,7</sup> Individualisation of IRRM implementation could be achieved through individual screening of the socio-cognitive determinants of behaviours, by identifying adherence’s barriers and facilitators, considering programme-related (e.g., intervention components), socio-cognitive (e.g., behaviour change determinants such as intention and self-

efficacy), social (e.g., socioeconomic status), and organisational (e.g., club structures) factors.<sup>5</sup> This screening process may be performed regularly to adapt to the potential variations over time in an athlete's characteristics.<sup>9</sup> The content of the screening and their regularity should be of course adapted to the practical aspects (e.g., material, human resources, athlete's age and level), their scientific evidence, as well as the variations of the measured parameters.

The development of the overall approach requires a co-construction with multidisciplinary teamwork, including researchers, clinicians, end-users (e.g., coach, player, healthcare provider) and members of the target community, meaning a public involvement.<sup>5</sup> The athlete should be at the centre of the project. It also implies education of end-users, especially the athlete. Although increasing the knowledge on the health determinants or the preventative effect will not automatically translate into changed behaviour, each individual's learning process and experiences, as part of their routine and culture, can play a role in the adoption and implementation of the IRRM program.<sup>10</sup> An example of such approach is proposed in the Supplementary material.

### **Illustration of the maximised individualisation approach by the metaphor of the Trojan horse**

We believe that maximising the individualisation of the overall injury risk reduction approach by individualising both the content (i.e., IRRM) and the form (i.e., IRRM implementation) should improve the chances of injury risk reduction. To help understanding, we illustrate this conceptual strategy by the metaphore of the Trojan horse approach (**Figure 1**). We are aware that the Trojan horse was a wicked strategy to destroy the Trojans by inviting the foe without knowing it. In our approach, the IRRM-user should be aware about the strategy and be involved in the process, and it is not about doing the IRRM without knowing it. The

present proposed approach here strives to optimize the likelihood to have a total matching between the strategy and the user, at two levels: the IRRM and the implementation.

In this illustration (**Figure 1**), the Trojan horse symbolises a method of presenting IRRM (i.e., IRRM implementation) to an athlete (i.e., the village), and the soldiers on the Trojan horse represents IRRM. We suggest that the horse itself (i.e., represented by the colour) should meet the individual athlete's preventive behaviour change determinants (i.e., represented by the villages' colour) to improve the village's probability of acceptance. Also, the soldiers (i.e., IRRM) on the horse should be adapted to the villagers' weakness and strength (i.e., athlete's risk and protective factors) to provide benefits at the individual level for injury risk reduction.

### **Perspectives**

This maximised individualised approach is proposed to be used whatever the sport (i.e., individual and teams sports) in both scientific studies and real-world settings. We aware about the complexity and probably the difficulty to implement this approach in both settings. However, this challenge seems as high as the goal of injury risk reduction, and it is likely the price to pay to reach success. We believe that promoting IRRM based on individual characteristics and enhancing IRRM adoption of athletes and their staff, this global individualised approach, can help to improve both adherence and in turn effectiveness of IRRM. Although its efficacy should of course be evaluated, we believe that such an approach can have direct benefits for athletes and their entourage to optimise the chances of injury risk reduction.

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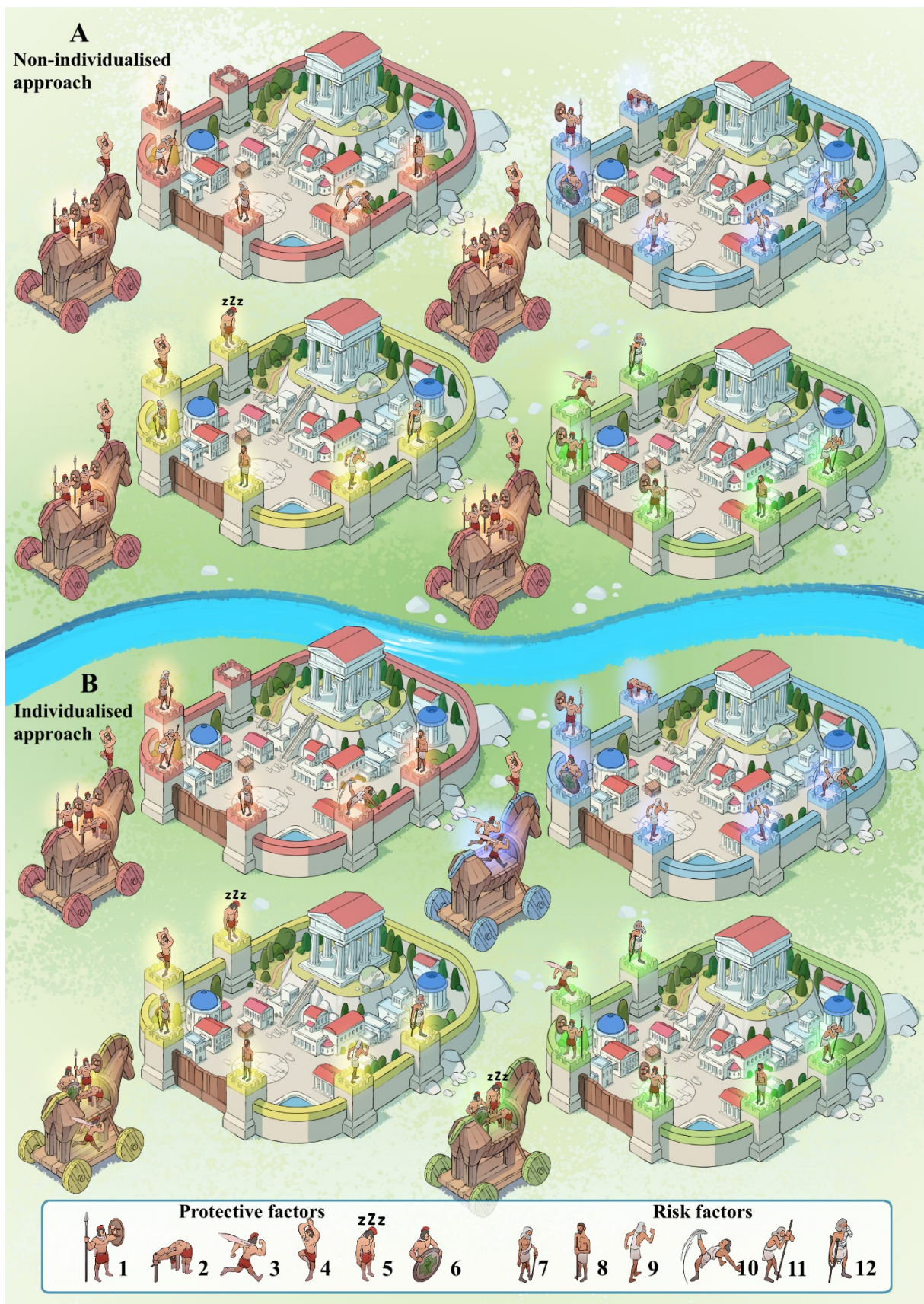
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## Figure legend



**Figure 1** Illustration of this conceptual strategy by the metaphor of the Trojan horse

approach.

The Trojan horse represents the method of presenting IRRM to the athlete (i.e., IRRM implementation) and different colours represent different IRRM implementation approaches. The Trojan horse soldiers represent the characteristics of the IRRM. The different soldiers (numbers 1 to 6) represent, as an example and illustration, potential specific measures that can be proposed to the athlete to improve his/her weakness and risk factors. The village represents the athlete, and the different colours represent different behaviour change determinants. The villagers represent the strengths / protective factors (soldiers with numbers 1 to 6) and weaknesses / risk factors (weak villagers with numbers 7 to 12) of the athlete; the characteristics presented in the Figure are examples and do not exhaustively present all existing strengths / protective and weaknesses / risk factors.

The soldiers with numbers 1 to 6 illustrate, as an example, different IRRM when they are on the horse and strengths when they are in the village. The soldiers illustrate physical IRRM or strengths: strengthening or strength (1), stretching or flexibility (2), sprint mechanics training or sprint performance (3), sensorimotor control training or sensorimotor control (4), recovery (5), and injury management (6); or psycho-behavioural IRRM or strengths: self-determination (1), psychological flexibility (2), perseverance (3), stress management (4), relaxation (5), and adaptive coping strategies (6). The weak villagers represent, as an example, the weakness or injury risk factors that an athlete should improve to reduce the risk of injuries. The weak villagers illustrate physical weakness/risk factors: strength deficient or imbalance (7), lack of flexibility (8), sprint mechanics weakness (9), lack of sensorimotor control or core stability (10), physical fatigue (11), and poor previous injury management (12); or psycho-behavioural weakness/risk factors: lack of self-determination (7), automatic pilot (8), impulsivity (9), anxiety and stress (10), mental fatigue (11), and non-adaptative coping strategies (12). These

different characteristics for soldiers and villagers are only example to illustrate the concept; they should not be considered as evidence-based IRRM in the present illustrative example.

The upper part of the illustration (A) represents an injury risk reduction approach without individualisation: the injury risk reduction measures (IRRM) implementation and the IRRM are the same for all athletes, illustrated by the fact that the Trojan horses have all the same colour, including the same soldiers inside whatever the village that they address. The lower part of the illustration (B) represents an individualised injury risk reduction approach: the IRRM implementation and the IRRM are adapted to each athlete, illustrated by the fact that each Trojan horse has a colour adapted to the colour of the village that it addresses, and the soldiers on the horse are adapted to the addressed villagers. The Trojan horse is open, the soldiers (i.e., IRRM) are visible for the village (i.e., athlete) since the IRRM should have been co-constructed with the athlete.

## Supplementary material

### **Maximising individualisation of sports injury risk reduction approach to reach success**

We propose here an example based on Figure 1 of the present editorial to describe the conceptual strategy of the maximised individualisation approach.

The upper part of Figure 1 (A) represents an injury risk reduction approach without individualisation. A standardised injury risk reduction programme (symbolised by the horse and soldiers) is proposed to all athletes (symbolised by the villages). It includes the same IRRM (symbolised by the soldiers) for all athletes; note that it is advised to base IRRM on the higher level of scientific evidence. In the present example, it is composed of 50% strengthening / self-determination exercises, 25% sensori-motor control / stress management exercises, and 25% stretching / psychological flexibility exercises (this is an example to illustrate the proposal of strategy). The programme uses the same method to be presented to all athletes (i.e. same horse's colour). In the present example, a health professional says to the athlete "these are relevant IRRM, it is important for you to do it". The red village is likely to accept the red horse, i.e. the red athlete is likely to accept the IRRM, because the health message matches the determinants of IRRM adoption of this athlete: in this case, the athlete already presents a self-determined motivation and good planning skills regarding the IRRM. However, there is a high risk that the other athletes (blue, yellow, and green) will not be compliant with the IRRM as their determinants of IRRM adoption do not match with the health message (examples of the determinants below) symbolised by different colours of the villages than the proposed red horse. In addition, the standardised IRRM programme is not appropriate for all athletes. The

current programme matches the deficiencies of the red athlete and only partially for other athletes (1 out of 6 of the deficiencies for the blue and green athletes, and 2 out of 6 for the yellow athlete), which reduces for them the chances of the IRRM being beneficial at the individual level.

The lower part of the illustration (B) represents an individualised injury risk reduction approach. In order to develop such individualised IRRM programme, we suggest an individual screening of the athlete's risk and protective factors in addition to an evaluation of the socio-cognitive determinants of IRRM adoption. In the present example, the four athletes were screened at the start of the sporting season for their risk and protective factors for strength (1), flexibility (2), sprint performance (3), sensori-motor control (4), sleep quantity (5), previous injuries (6), self-determination (1), psychological flexibility (2), perseverance (3), stress management (4), relaxation (5), and adaptive coping strategies (6), using appropriate, objective, reliable, and valid methods. Additionally, they were also screened for their motivation, beliefs (attitudes, subjective norms, perceived control), intentions, and planning skills to perform an IRRM (i.e. socio-cognitive determinants). Based on this screening, four individualised IRRM programmes were co-constructed by a multidisciplinary team including the athlete, researchers, clinicians, end-users and members of the target community. In addition, an education of all actors should be performed to explain the interest of the overall injury risk reduction approach and IRRM programme development.

These IRRM programmes are proposed with four different health messages. Since the methods of IRRM presentation to the athletes matches its IRRM adoption determinants (i.e. each horse's colour matches the addressed village's colour), there is a high chance that the IRRM programme will be accepted and performed by the athletes. If the athletes are compliant with the IRRM, there is a higher chance of reaching success. As mentioned above, the red athlete is already



likely to perform the IRRM program with a simple invitation to do it “because it is important”. For the blue athlete, who for example presents no motivation to perform IRRM, because he/she doesn’t perceive it as potentially beneficial for him/her, a first motivational phase will be necessary in order to implement an intention to perform the recommended programme. The yellow athlete has for example the intention to perform the IRRM programme, however he/she doesn’t succeed in finding the time to do the exercises. With this athlete, an intervention to help him/her plan the action of performing an IRRM programme despite his/her perceived barriers. For the green athlete, who thinks for example that an IRRM programme may be beneficial but does not perceive the health professional as a competent individual, showing him/her that other athletes perform the IRRM programme may increase his/her compliance to the programme, because subjective norms seem to be the determinant for him/her.

In addition, for each of the four athletes, the IRRM match the athlete’ risk factor / athlete’ weakness: the IRRM proposed in the IRRM programme are appropriate to the weakness / risk factors of the athlete detected through the screening procedures (i.e. soldiers on the horse match weak villagers). For example, the red athlete presents deficiencies in strength, flexibility, neuro-muscular control, self-determination, psychological flexibility, and stress management. The red horse thus proposes IRRM targeting these deficiencies. On the contrary, the blue athlete presents deficiencies in sprint performance, neuro-muscular control, perseverance and stress management, and the proposed IRRM are appropriated to these deficiencies. The two athletes (red and blue) do not need the same IRRM to try to reduce injury risk. An individualised IRRM seems more appropriate than a standardised one (Figure 1 A) to reach success.

The development of the IRRM programme should be performed or adapted regularly, to match with potential changes of athlete’s characteristics with time. Such individualised approach should increase the chance of efficacy of the IRRM at the individual level. Indeed, the

individual IRRM will facilitate the improvements of the weaknesses of the athlete, and thus reduce the individual risk factor and in turn reduce the risk of injury at the individual level.