ORIGINAL ARTICLE
INNOVATIONS IN RESEARCH METHODOLOGY

# Adaptive effects of long-term ignoring Cannon's "fight or flight" law in physical education and adapted physical activity

**Authors' Contribution:**
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

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## Abstract

**Background & Study Aim:** Estimating how many physical education (PE) and adapted physical activity (APA) practitioners uncritically accept warm-up guidelines composed by sports theorists and practitioners is difficult. The cognitive purpose of this study is justification (based on empirical evidence) for the statement that the effect of many years of repetition of warm-up in the form of running "single file" is to deprive PE or APA participants of the possibility of adequate motor response in situations of sudden threat – either external or internal (concerning the psychophysical state of human) of origin.

**Material & Methods:** The premises for conducting multiple experiments arose from the third author's fifty years of experience. They encompass: teaching academic subjects (theory and practice) related to PE, APA, and sports training; participation in competitions in various individual disciplines and combat sports, teams and military all-around events. Experimental observation (more than 300 classes with physical education or physiotherapy students and judo practitioners) had a simple structure of a fun form of exercise, „fast shopping". First, students were instructed to run in various directions but in such a way that they won't collide with each other (a crucial element of the task). After students started performing the exercise, the instructor stimulated them to do it correctly for over a dozen seconds. Then, he began pretending not to monitor them ("completing documentation", "tying shoelaces", etc.). He acted like that until all students spontaneously started running "single file". Experimental observations occurred in different locations (gym, sports ground or its section).

**Results:** The time interval length (from the onset of "no monitoring" to the moment when every student runs a "single file" was associated with the size of the surface (the smaller size, the shorter time). Surface size for the shortest (6 sec.) and the longest time interval (60 sec.) recorded were 8x5 m and 28x15 m (basketball court) and larger surface, respectively.

**Conclusions:** Running "single file" or "frontally – all in one direction" are fundamental elements of routine warm-up. As such, they make it counterproductive concerning its role in preparing people to perform an adequate motor response to hazardous situations, especially those related to personal security (collision with an object in motion, fall after overbalance or assault). Since that, an optimal warm-up should not only boost the physiological potential of an organism but also facilitate learning or cultivating unique motor competencies like avoiding collision with an object in motion, safe fall techniques and elements of self-defence.

**Key words:** avoiding a collision • counterproductive • safe fall • self-defence • warm-up



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## INTRODUCTION

Estimating how many physical education (PE) and adapted physical activity (APA) practitioners uncritically accept warm-up guidelines composed by sports theorists and practitioners is difficult. The paradigm of both PE and APA is oriented towards exercise safety (along the lines of sports training standards) – the gradual preparation of the body for increasing physical exertion. The motor activity practice of the emergency services, police, military etc., provides evidence that the aftermath of the declared alarm often requires immediate, intense motor activity. However, the warm-up paradigm within physical education in these formations is unchanged.

Meanwhile, Nature has equipped humans with an exquisite mechanism to achieve readiness for increased physical effort in situations of sudden danger, and this phenomenon is called "fight or flight", or more precisely, Cannon's law of "fight or flight" [1, 2]. Some of its implications constitute essential elements of a critique of the warm-up paradigm in PE and APA.

Walter Cannon, investigating the mechanisms of stress response, precisely described one aspect of the role of the autonomic nervous system in this response – a neurohormonal process he called "fight or flight". He discovered that the decisive organ involved in this reaction is the adrenal medulla, which gives it both a neurogenic (due to the involvement of the autonomic nervous system, especially its role in the initial phase of arousal) and a hormonal character. It is assumed that the initiation of the fight-or-flight response, as a functionally distinct psychophysiological axis, occurs in the dorsomedial part of the amygdala. From here, a stream of nerve impulses arrives at the lateral and posterior regions of the hypothalamus to successively – via the thoracic portion of the spinal cord and the visceral ganglia – reach the adrenal medulla, leading to the release of the adrenaline and noradrenaline into the bloodstream [3].

Unique results from a study of prison officers provide evidence that place in the standard intervention formation called "turtle array" (see glossary) during a clash with prison inmates (in the controlled experiment) very significantly differentiates the officers' body response (as measured by HR) to an identical motor effort.

The cognitive purpose of this study is justification (based on empirical evidence) for the statement that many years of repetition of warm-up in the form of running "single file" deprive PE or APA participants of the possibility of adequate motor response in situations of sudden threat – either external or internal (concerning the psychophysical state of human) origin.

## MATERIAL AND METHODS

### Own experimental research

The premises for conducting multiple experiments arose from the third author's fifty years of experience. They encompass: teaching academic subjects (theory and practice) related to PE, APA, and sports training; participation in sports competitions in various individual disciplines and combat sports, teams and military all-around events. Experimental observation (more than 300 classes with physical education or physiotherapy students and judo practitioners) had a simple structure of a fun form of exercise, „fast shopping". First, students were instructed to run in various directions but in such a way that they won't collide with each other (a crucial element of the task). After students started performing the exercise, the instructor stimulated them to do it correctly for over a dozen seconds. Then, he began pretending not to monitor them ("completing documentation", "tying shoelaces", etc.). He acted like that until all students spontaneously started running "single file". Experimental observations were conducted in different locations (gym, sports ground or its section).

**Testudo, acies testo (turtle array)** – a defensive array of Roman legions used to protect against enemy fire. Nowadays, a similar formation is sometimes used by police (also prison service) security forces, creating a shield from stones and firecrackers thrown by rioters.

**Warm up** – *verb* to prepare the body for exercise by stretching muscles and loosening joints [24].

**Warm-up** – *noun* an exercise or a period spent exercising before a contest or event [24].

**Counterproductive** – from praxeological perspective certain action can be: productive – non-productive – counterproductive – neutral. The action is **counterproductive** when a doer achieved goal opposite than intended [25, p. 220].

**Exercise intensity** – in order to improve physical fitness, exercise must be hard enough to require more effort than usual. The method of estimating appropriate training intensity levels varies with each fitness component. Cardiovascular fitness, for example, requires elevating the heart-rate above normal [26].

**Technique –** *noun* a way of performing an action [24].

**Training session** – *noun* a period of time during which an athlete trains, either alone, with a trainer or with their team [24].

**Abilities (motor abilities)** – stable, enduring traits that, for the most part, are genetically determined and that underlie a person's skill in a variety of tasks. People differ with respect to their patterns of strong and weak abilities, resulting in differences in their levels of skill [27].

### Narrative review

There are scant published studies related to this research project due to its innovative nature. Therefore, the authors, guided by the cognitive purpose of this publication, refer to only two papers [4, 5]

## RESULTS

### Own experimental research

We found a regularity that the smaller size of the venue where the fun form of exercise "fast shopping" is used, the faster the students start running "single file" (Table 1). We did not find that repeated "fast shopping" several times during the same training session (APA, judo) resulted in modification of students' behaviour (emotional and motor adaptation to virtual shopping in a virtual supermarket or marketplace).

### Narrative review

The result of the unique experiment by Rakowski et al. [4] provides evidence that identical physical exertion in a simulated legal team intervention situation results in differentiated body response (measured HR) in prison officers depending on the distance separating the officer and aggressive group. Although the authors of this experiment equate the measured HR with the so-called energy area (Table 2), in the body of the communication, they emphasise that "the heart rate value, in addition to physical exertion, was also influenced by emotional factors". Sticking

**Narrative reviews** – are a discussion of important topics on a theoretical point of view, and they are considered an important educational tool in continuing medical education. Narrative reviews take a less formal approach than systematic reviews in that narrative reviews do not require the presentation of the more rigorous aspects characteristic of a systematic review such as reporting methodology, search terms, databases used, and inclusion and exclusion criteria [28].

**Table 1.** Results of the observed fun form of exercise "fast shopping" experiments in places of different sizes.

| Exercise circumstances | | Time after which students run "single file" | |
|---|---|---|---|
| type of physical activity | location and size | number of observed | time (seconds) |
| APA | exercise room (12 x 6 m) | 120 | 6 to 10 |
| PA | 1/2 volleyball court (9 x 9 m) | 60 | 10 to 30 |
| judo training, PA, APA | judo mat (10 x 10 m) | 100 | 12 to 28 |
| PA, APA | basketball court (28 x 15 m) | 33 | 18 to 60 |
| PA, APA | a gymnasium (40 x 26 m) | 45 | 22 to 60 |
| PA | football field (of various sizes) | 12 | 30 to 60 |

**Table 2**. The prison officers' body response (5 in each series in "turtle array") during an experimental intervention (suppression of a prisoner's rebellion [4].

| Series in „turtle array": | Distribution of results in the energy area (%) | | | | HR (beats per minute) | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | M | max |
| first | 32.2 | 25.6 | 15 | 27.2 | 157.2 | 214 |
| second | 38.5 | 21 | 12.5 | 28 | 153.3 | 206 |
| third | 54.5 | 33.2 | 12.3 | - | 116.6 | 117 |
| | | | average values of indicators | | | |
| | **41.73** | **26.62** | **13.25** | **18.4** | **142.37** | **185.83** |

precisely to the physiological criterion of energy area would result in misinterpretation that the recorded value of HR max is evidence of the supramaximal intensity of physical exertion of some of the officers of the first and second series in "turtle array".

During PE type 1 lessons acquiring and developing skills – workloads of low intensity (32.4% to 39.4%) dominate. Meanwhile, during a training session based on safe fall exercises and fun forms of martial arts (FFMA), 40% of the effort is moderate-to-vigorous intensity and vigorous intensity (Figure 1).

## DISCUSSION

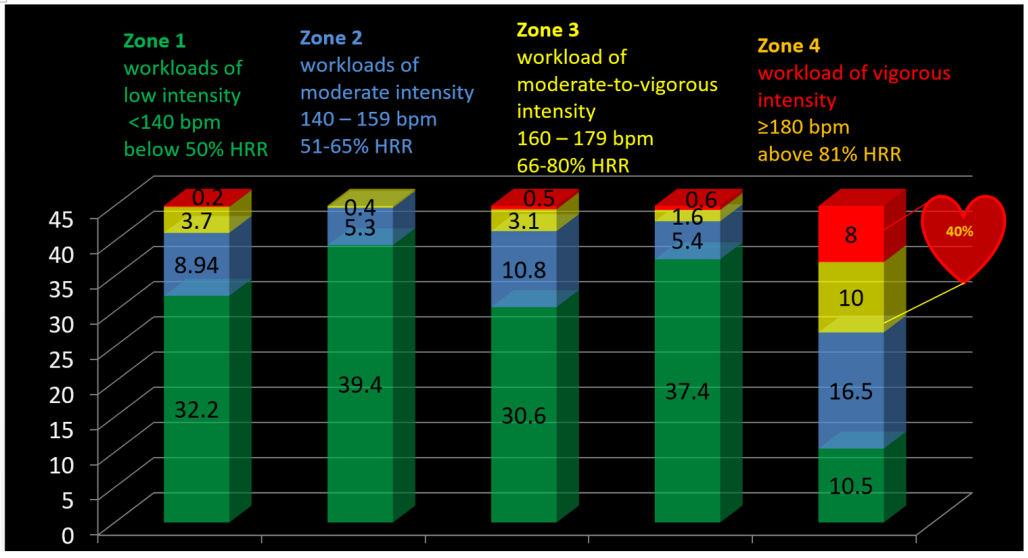
Although the empirical evidence authorising criticism of the primarily PE paradigm is modest, its quality is essential. One of the most controversial elements of the PE paradigm is the mode of selection of warm-up exercises, which is based on sports recommendations (preparing the body for increased effort). Criticism also applies to the content of the core curriculum of PE from different perspectives:

1. Since the creators of PE core curricula in Poland prioritise sports motor activities (techniques), basketball, volleyball, gymnastic and track & field, the consequences have a health and utilitarian dimension.

2. The lesson example given is evidence that most of the exercises with balls (their primary feature is that they vary in mass and girth) and part of the techniques track & field, in which specialised equipment (javelin, ball, discus) is used, are asymmetrical in nature.

3. The recommended techniques have little utilitarian value.

While the main empirical argument in this publication is the differences in exercise intensity during the four standard PE lessons (type 1 – acquiring and developing skills) compared to the training session recommended by innovative agonology [6, 7] based on safe fall exercises [8], avoiding collision exercises [9], fun forms of martial arts [10, 11], exercises reducing susceptibility to injury during a fall [12, 13], etc., it is by no means a problem to aptly demonstrate the underlying motor differences and their




| time (min) | basketball **HR 128.3** | volleyball **HR 127** | track & field **HR 121.5** | gymnastic **HR 116.6** | safe fall & FFMA **HR 143.4** |
|---|---|---|---|---|---|
| | type 1 lesson – acquiring and developing skills | | | | |

**Figure 1**. Mean values of exercising time (min) spent by girls aged 13 years (Poznań) in 4 intensity zones /type 1 lesson – acquiring and developing skills/ [5] and physiotherapy students aged 19 years.

survival adaptation values. Moreover, to formulate hypotheses indicating missed opportunities to strengthen health and survival from micro to macro scales simply because the coordinators responsible for education and public health need more courage or the knowledge to implement innovative recommendations that are scientifically well-founded and verified in practice.

Hypothesis I: If the separated activities of basketball, volleyball, etc., were to be merged into one subject block, "exercises with balls", then an opportunity would open up for, on the one hand, the realisation of such critical specific tasks related to motor safety as "avoiding collisions" and, on the other hand, e.g. playing basketball by changing the balls (to those used in other games) in a set rhythm (such exercises stimulate the ability to act precisely during increasing physical effort and changing other circumstances – this is complex motor ability is ignored in theoretical and empirical research)

Hypothesis II: if the safe fall programme repeatedly verified positively by the experts of the "Polish School of Safe Falling" were implemented at all levels of general education, both the number of people who annually suffer deaths caused by unintentional falls and the number of those who spend the rest of their lives in disability would be radically reduced.

Hypothesis III: Implementation of warm-up based on safe fall and avoiding collisions exercises, but also on alternating sequences of necessary self-defence (either in the form of FFMA or motor simulations) will drastically reduce stress, negative emotions and anxiety in extreme situations caused by sudden loss of balance, the threat of collision with a stationary or moving object, aggression by an individual or group, etc., and will increase the individual's readiness for an appropriate motor response in similar circumstances.

These hypotheses are strongly supported by the already available empirical data [14-18]. Furthermore, demonstrated higher intensity of lessons based on safe fall exercises, and FFMA mandates the implication that the evident health benefits also increase the attractiveness of these forms of physical activity in a physiological sense. Thus, the effect translates into both possible alternatives captured in Cannon's "fight or flight" law. This implication does not change the fact that an effective method of reducing emotions during real-life, necessary interventions is the repeated repetition of motor simulations of this nature (we refer to the findings of Rakowski et al. [4]). For the sake of methodological order, we emphasise that the term "energy area" used by Rakowski et al. [4] is not entirely precise, as, in addition to monitoring HR, it also takes into account the duration of effort in relation to the contractual zones I to V [19]. Thus, equating the HR summarised in Table 2 with the zones highlighted in Figure 1 will not be wrong.

We know that the expansive media promotion of neogladiatorship under the camouflaged name of "mixed martial arts" [20, 21] hinders the rational promotion of the health aspects of martial arts. Therefore, avoiding this generic name in scientific publications by referring to specific arts, e.g. *tai chi*, *taijiquan*, *khapsagai wrestling*, etc. [22, 23], can also be desirable, considering the seriousness of science and its social mission.

## CONCLUSIONS

Running "single file" or "frontally – all in one direction" are fundamental elements of routine warm-up. As such, they make it counterproductive concerning its role in preparing people to perform an adequate motor response to hazardous situations, especially those related to personal security (collision with an object in motion, fall after overbalance or assault). Since that, an optimal warm-up should not only boost the physiological potential of an organism but also facilitate learning or cultivating unique motor competencies like avoiding collision with an object in motion, safe fall techniques and elements of self-defence.

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