ARCHIVES OF BUDO
Journal of Innovative Agonology

e-ISSN: 1643-8698

Section: ***COMPLEMENTARY RESEARCH METHODOLOGY*** *Original Paper*

Complementary research methodology versus paradoxes of evaluating the effectiveness of hand-to-hand combat systems

Michał Kruszewski[A-D]

[1] Jozef Pilsudski University of Physical Education in Warsaw, Poland;

***Corresponding author:** Michał Kruszewski, University of Physical Education in Warsaw, Poland; michal.kruszewski@awf.edu.pl

Authors' Contribution:

A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

Received: 22.10.2025
Accepted: 28.12.2025
Published 30.12.2025

Abstract:

Background and Study Aim: In every hand-to-hand combat training system, offensive and defensive actions are key elements, and only simultaneous attack is possible, but not simultaneous defence (of course, during one-on-one combat). Perhaps one of the greatest paradoxes is the fact that even in many scientific and educational publications, aikido is classified as a martial art, although it is clearly a self-defence art. A paradox of a similar scale is the necessary exposure to sophisticated forms of attack from a partner during training, but aikido does not include the teaching of offensive actions in its programme. The cognitive goal of this work is the innovative application of complementary research methodology in determining the effectiveness profiles and motor and somatic potential of those military cadets who have twice fought testing fights (first in a vertical posture, second in horizontal posture) with four randomly selected peers, regardless of body weight difference.

Material and Methods: The author imitatively analyses unique, unpublished research findings from Mariusz Kisiel's master thesis on testing fights in a vertical posture (TFVP) of military cadets (n = 31). The profiles concern 11 who stood out in the observed group due to their unique body weight (Exclusive Group). Exclusion criterion: who at the observed stage of Andrzej Chodała's experiment did not participate in test fights (TF) with cadets of the Exclusive Group). Criteria for identifying empirical variables in relation to the effectiveness of hand-to-hand combat without weapons F-Index (sum results of combat in vertical and horizontal posture: TFVP & TFHP): motor potential (FITNESS, i.e. the sum of points International Physical Fitness Test); somatic potential (body mass and BMI); workload (arbitrary units, calculated based on HR and TFs time). The unification of indicators is based on the ratio of the result to the highest value of the variable among the persons with whom the cadet covered by the profile fought. The exception to the determination of the ratio indicator is HR calculated within the 'workload' variable. A correlation coefficient was calculated between the empirical variables and the dependent variable F-Index.

Results: Due to the body mass criterion, the observed military cadets constitute 19 factions (described by codes C1 to C19). The greatest variation in proportion indices occurs in the F-Index (100%). Occasional statistically significant correlations between the independent variable indicators and the dependent variable F-Index provide empirical evidence that both versions of the TFs primarily measure predispositions to hand-to-hand combat. Dividing the set of cadets included in the statistical calculations into those who either won or lost all TFs (F-Index 0 or 100%) and the remaining 20 individuals (F-Index from 25% to 62.5%) further validates the TFs.

Conclusions: A significant interpretative limitation is the absence in these secondary analysis results of the S-Index (proportion of scuffles won), which provides more accurate information on 'dispositional feasibility' within the framework of evaluating 'possibility of action'. However,

Dictionary:

Scuffle – a short, confused fight or struggle at close quarters (in TFVP fights in the vertical posture based on the simplest forms of pressure on the opponent's body); differently than encounter (conflict, dash) in praxeology: the fight destructive during the impact phase at each of two warring parties (both sides attacking either one attacking and the other counterattacking [5, p. 231].

INNOAGON (Innovative Agonology) – is an applied science dedicated to promotion, prevention, and therapy related to all dimensions of health and the optimization of activities that increase the ability to survive (from micro to macro scales) [39].

social acceptance of the escalation of bloody spectacles shows that fighting without weapons can pose a deadly threat, especially in the absence of any external control. Therefore, the key practical issues are, on the one hand, the necessary work on clarifying the legal criteria for necessary defence and, on the other hand, improving methods of compensating for the shortcomings of self-defence education based on hand-to-hand combat systems. In situations of extreme danger, the use of verbal-motor self-defence support measures would prevent possible abuse.

Keywords: aikido, INNOAGON, possibility of action, preventive medicine, self-defence, sumo, verbal-motor self-defence

Poomse (kata in karate) – it is traditionally understood as the style of conduct which expresses directly or indirectly mental and physical refinements as well as the principles of offense and defence resulting from cultivation of taekwondo spirit and techniques. Nowadays, poomse is involved in competition in the taekwondo technique modality.

1. Introduction

This paper continues the theme of my original and co-authored publications concerning the empirical findings of research into human effectiveness in hand-to-hand combat, exclusively in the context of -defence [1-4]. These publications analyse only the results of observations using a basic methodological approach – testing fight in vertical posture (TFVP) [5, 6]. This is understandable, as homo erectus most often faces the necessity of defending against physical aggression by an individual or a group of people whilst in a vertical posture. The word 'faces', together with the phrase 'necessity of defence', are key elements of the reasoning in this paper. It is easy to cite historical facts or numerous examples of everyday occurrences where people, when physically attacked or when their lives are threatened by perpetrators of this form of violence who are not necessarily armed, do not take any countermeasures. It is as if the right to self-defence, to which every human being is entitled, for some reason becomes 'dead'.

There is good reason to hypothesise that responsibility for the passivity of potential victims towards perpetrators of violence and physical aggression should be attributed to those who, by virtue of their authority and duties, fail to provide adequate education in all types of schools. In a re-analysis of the results of Szajerski's experiment from 20 years ago [7, 4], I concluded that 'The student with the code P-14 should be classified as being at very high risk of helplessness in a situation of physical aggression directed at her. The school, however, is the most appropriate place to make such a diagnosis and, together with the parents (legal guardians), to take appropriate preventive and, in many cases, therapeutic measures' [4, p. 318]. This observation concerns an 11-year-old pupil at a Polish primary school who was unable to win a single one of the 15 TFVPs contested against 15 classmates (the TFVPs were scheduled according to a specific timetable for PE lessons over the course of a single term). In this code, the number 14 corresponds to the last ranking position (RP) of the empirical variable F-Index (i.e. the proportion of TFVPs won, which in this pupil's case is zero). It is not the number 16 because two pupils each won 7 TFVPs, and two others each won 3 TFVPs.

The pupil with the code P-14 was ranked 13th out of 15 in the motor potential (muscle strength) ranking, 14th out of 16 in the BMI ranking, and 12th out of 14 in the body mass ranking. She therefore also lost the TFVP to the following peers: one whom she surpassed in BMI and body mass, but to whom she was clearly inferior in muscle strength; a pupil who won 80% of TFVPs yet did not match P-14 in terms of muscle strength; a peer who was clearly inferior to her in muscle strength, but who surpassed P-14 by only 1 kg in body mass and by just under 8% in BMI.

Unfortunately, the issue of providing compulsory self-defence education for young people as part of the school curriculum in Poland remains unresolved. This is one of

the most significant indicators of the crisis in education, given that since 1991 numerous recommendations have been published in Poland (including those concerning the hand-to-hand combat skills of soldiers, police officers, etc.), which have been comprehensively verified by competent scientists and research teams [8-24]. Meanwhile, the unique experiences of Polish scientists and practitioners of various forms of hand-to-hand combat, amongst other things, proved to be an inspiration for Zdenko Reguli and his co-researchers to introduce a highly popular and socially valued 'self-defence' faculty at the University [25-28].

In view of the methodological aspects highlighted in this paper, I would like to emphasise two key points. Firstly, the valid combination of the motor and mental effects of training in combat sports and particularly certain Far Eastern hand-to-hand combat systems (hapkido, kung fu, etc.) with self-defence skills leads to their classification also on the basis of dominant body posture and permissible means of action. For example, boxing, karate and taekwondo belong exclusively to the category of strikes based on a vertical posture. Judo, wrestling, etc. belong to the category of both vertical and horizontal posture. However, whilst Brazilian ju-jitsu does indeed begin in a vertical posture, the dominant part of the fight takes place in a horizontal posture. Secondly, in every hand-to-hand combat training system, offensive and defensive actions are key elements, and only simultaneous attack is possible, but not simultaneous defence (of course, during one-on-one combat). Perhaps one of the greatest paradoxes is the fact that even in many scientific and educational publications, aikido is classified as a martial art, although it is clearly a self-defence art [29, 30]. A paradox of a similar scale is the necessary exposure to sophisticated forms of attack from a partner during training, but aikido does not include the teaching of offensive actions in its programme.

The cognitive goal of this work is the innovative application of complementary research methodology in determining the effectiveness profiles and motor and somatic potential of those military cadets who have twice fought testing fights (first in a vertical posture, second in horizontal posture) with four randomly selected peers, regardless of body weight difference.

2. Materials and Methods

I conducted a secondary analysis of the results from Mariusz Kisiel's master's thesis [31], published 24 years ago, based on the methodological principles of the review of omitted implications method [32]. The key premise, however, was that Kisiel's thesis is the only available source of results from a testing fight in vertical posture (TFVP) experiment repeated among the same adults in a testing fight in horizontal posture (TFHP) format. Unfortunately, the author does not document the results precisely, but I obtained some important information from the author of this experiment (from 21 August 2000 to 22 June 2001), Andrzej Chodała [12]. During the course of his research for his doctoral thesis, Chodała was assisted at a certain stage by Mariusz Kisiel, who in this way obtained data for his master's thesis. Both candidates for academic promotion carried out their work under the supervision of the same supervisor and obtained the approval of the local bioethics committee.

Participants

Of the 31 observed military cades, they form 19 factions due to their body weight. The Ranking position (RP) of each faction is monitored by numbers from 1 to 19 immediately after the letter 'C', which is the first part of the code of each military cadet

analysed. Of these, 11 are a collection of those with unique body masses, while the remaining factions consist of two to four individuals (Table 1 in section 'results'). The code $C1_{96}$ indicates that this cadet has the highest body mass, while $C19_{58}$ indicates that this military cadet has the lowest body mass (as indicated by the subscript). The lowercase letters next to the monitored RP military cadets outside the Exclusive Group (with whom they fought test matches) indicate that there are more individuals with the same body mass ('a' or 'b' indicating that there are at least two such individuals, etc.).

Study design

This was part of Chodala's experiment, in which military cadets from two competitive subgroups (n = 18 and n = 15) during first year at the Military University of Technology (WAT) engaged in test sparring matches in a 'round-robin' format (17 and 14 matches respectively) according to the following principle: the first semester in a vertical posture; the second semester in a horizontal posture. In both cases, during each PE session, each cadets took part in 2 or 3 test fights, with those of extreme body mass fighting last. For some reason, Kisiel analysed the results of 31 military cadets (rather than 33), which is not surprising, as Chodała ultimately included the results of 24 cadets from these two experimental subgroups and 24 from control group in the final analysis [12]. Kisiel's analysis [31] shows that this was not yet the final stage of the first semester's observations. At that time, $C1_{96}$'s opponent with the lowest body mass was a $C14_{67}$ cadet (range body mass 29 kg). Conversely, the heaviest opponent of $C19_{58}$ was an $C6b_{76}$ cadet (range body mass 18 kg). Meanwhile, the actual range of extreme body weights of the cadets was 38 kg.

The consequence of the random selection (during the first semester, which had not yet ended) for individual analyses after 4 TF was the inclusion of the results of fights fought in the second semester against the same opponents, but this time in the testing fight in horizontal posture (TFHP) format. Unfortunately, Kisiel does not articulate these circumstances clearly. However, he correctly states that the analysis covers a total of 8 test fights by individual military cadets against the same four opponents at intervals of approximately one month [31].

Measurement of test fight effectiveness in the vertical posture (TFVP)

The result of TFVP (type non-apparatus test) is conventional criterion of talent for combat sports and self-defence (generally: hand-to-hand combat). Each TFVP ends with one of the participants winning 4 scuffles based on a simplified sumo formula (the possible result is in the proportions of won scuffle from 4:0 to 4:3) [5, 6].

Measurement of test fight effectiveness in the horizontal posture (TFHP)

I refer to the description of the method, which is available in only one publication [17]. The contests were conducted according to judo formula in the each-to-each system until 3 scuffles won. The contests were performed on judo mats without delimiting the field.

The 'parterre' (in combat sports jargon or judo terminology *ne waza*) advantage in every scuffle was counted according to judo criteria: lever (*kwansetsu waza*), choking (*shime waza*) or holding (*katame waza*) for 20 s. Before starting each scuffle, the contestants were sitting back-to-back (backs touching) on the mat. At the instructor's command 'ready', the opponents touched the ground with their fists, and at the next command – 'go', started the fight in horizontal posture (position), i.e. no upright

position was allowed at any moment of the fight, but one-leg kneeling was admissible. After the fight has been concluded by victory or a no contest (e.g. mutual blocking of movements for about 5 s), the fight was resumed like before. The winner of TFHP was the one who was the first to succeed in three scuffles. The possible TFHP result is in the following ratios: 3:0, 3:1, 3:2.

Criteria for assessing hand-to-hand combat skills

According to Kisiel's findings, the main criterion for assessing competence based on two types of test fights classified as hand-to-hand combat against four randomly selected opponents is the F-Index (the proportion of fights won, calculated as a percentage). However, the author does not monitor the results of TFVP and TFHP separately. Therefore, only an F-Index of 100 is definitive proof that a person has won the required number of 28 scuffles, summing up all the fights won against each of the four opponents. There is, however, no information regarding the proportion of scuffles won by the opponents. And yet it is entirely possible that the outcome of these fights, measured by the S-Index (the ratio of won scuffles) of 7:0 (i.e. 100%) versus 7:5 (58.33%). Therefore, for the sake of clarity in interpreting the results, I use the conventional F-Index as the ultimate criterion for measuring hand-to-hand combat competence (in fact, it is the proportion of TFs won to eight TFs fought without distinguishing their specificity). An F-Index score of 50 could result from a calculation based on defeating each of the 4 opponents during TFVP and losing to each of them during TFHP. However, this score could also stem from many other combinations. And this is precisely one of the fundamental paradoxes of evaluating the effectiveness of hand-to-hand combat systems, if the authors of the research do not clearly inform about the motor circumstances of the fight.

Measurement of somatic potential

Somatic potential is based on three indicators: body height ('cm'), body mass ('kg'), 'BMI'.

Measurement of general physical fitness

The International Physical Fitness Test [33] was used. I adopted the average score of the eight trials (points) as a general indicator of the motor potential estimated in this way. In the tables and graphical models of cadets, I will refer to this indicator as 'FITNESS'. However, when monitoring the results of individual trials (in points), I use the terms employed in the key publication [33] or abbreviations.

Measurement of workload during testing fights

The key data in Kisiel's study [31] are the monitored average durations (in seconds) of the test fights conducted by military cadets and the average exercise heart rate (HR), recorded by palpation immediately after each test fight and documented in beats per minute (bpm). After converting seconds to minutes (by first multiplying the average TF result by 8), further calculations are very simple [34, 35]. For example, 8 bouts with an average duration of 62 seconds (variable 'TF time', identified in tables by the letter 't' with the second symbol in parentheses) means that the cumulative effort lasted 8 minutes and 16 seconds. If the average HR was determined to be 186 bpm, then dividing this result by 60 seconds equals 3.1 bpm. These HR 186 multiplied by 8 minutes equals 1488 and after multiplying 16 s by 3.1 bpm (which after rounding is 50), and then adding both numbers, the result 1538 means conventional 'load' units. However, the fights did not take place one after the other, so this cumulative result is

purely symbolic and is merely a conventional indicator of the energy cost of the test fights spread out over a period of up to several days. HR is therefore a partial (purely physiological) indicator, but one with sufficient informative power, as most of the observed test fights did not exceed 1 minute.

Regardless of these obvious reservations, it is difficult to question the usefulness of the method from the perspective of ensuring the energetic safety of the trained individuals. Knowing the resting HR of the individual, it is easy to determine the difference in bpm over the same period, but in circumstances when the body is not under physical load. In the analysis of the energy cost of military cadets, I assumed a safe HR = 192 bpm, based on the formula by Tanaka et al. [35]: HRmax = 208 − (0.7 × age). Age was determined within safe limits for the oldest cadet, as the difference in months between the youngest (19 years) and the oldest (21 years) could exceed the formal range of 2 years. Furthermore, in the mathematical calculations, I assume the exercise intensity zones for adults recommended by Pollock et al. [36].

Statistical analysis

The key statistical data consist of ratio indices expressed as percentages, the results of the eight IPFT trials measured on the T-scale, and the average 'FITNESS' index. Obviously, the primary indicator based on the ratio formula is the F-Index, but also the somatic potential indicators of individual military cadets compared to those of their opponents. However, prior to this, the raw results are decomposed according to the following rule: if the highest value of the index pertains to the cadet being analysed, this fact is represented by the number 100 in their profile. But if, for example, the heaviest of $C1_{96}$ competitors (who weighs 96 kg) is $C12_{67}$ with a body mass of 67 kg, then in $C12_{67}$ cadet profile (which fought with it) this variable is described by the indicator 69.79 (implicitly a percentage).

A similar breakdown of the raw results of two partial indicators of the 'workload' variable ('TF time' and 'load' follow exactly the same rules. HR decomposition is related to the established safe value of 192 bpm. Given that the paper by Tanaka et al. [35] was published in 2001, the same year Kisiel defended his own master's thesis [31], this further supports the validity of applying elements of the omitted implications method [32] in this reanalysed study of Kisiel's observations. A correlation coefficient was calculated between the empirical variables and the dependent variable F-Index.

3. Results

Groups of military cadets under observation

Based on body weight, the military cadets under observation form 19 groups (designated by codes C1 to C19). However, when individuals with extreme, unique body masses are grouped together, 10 groups emerge. At one end of the spectrum are four cadets with codes from $C1_{96}$ to $C4_{82}$ (with the highest body mass), and at the opposite end are 6 cadets with the lowest body mass (coded from $C14_{67}$ to $C19_{58}$). The two cadets weighing 75 kg did not engage in TF with cadets from conventional Exclusive Group. Therefore, Table 1 does not include the characteristics of these individuals.

Table 1. The distribution of ranking positions (RP) among the cadets observed (n = 29), based on the number of individuals within each body mass category and the raw values of the empirical variables (the shaded rows refer to cadets in the conventional Exclusive Group).

Code RP & kg	F-Index	Body composition			General physical fitness#									Workload		
	TF-VH	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull-up	sit-ups	FITNESS	HR	t (s)	load
4 cadets with the highest body mass (range 14 kg)																
C1$_{96}$	**100**	96	189	**26.87**	59	49	50	61	47	62	48	60	**54.50**	172	38	**871**
C2$_{85}$	**100**	85	185	**24.84**	60	60	55	60	56	55	62	55	**57.88**	155	59	**1219**
C3$_{84}$	**75**	84	186	**24.28**	34	61	50	64	58	62	62	67	**57.25**	155	60	**1240**
C4$_{82}$	**62.5**	82	188	**23.20**	48	44	46	49	41	43	41	45	**44.63**	187	55	**1445**
2 cadets RP 5 (80 kg)																
C5a$_{80}$	**37.5**	80	185	**23.37**	73	52	51	64	59	80	46	60	**60.63**	172	61	**1399**
C5b$_{80}$	**100**	80	183	**23.89**	60	52	51	63	51	51	48	60	**54.5**	172	38	**871**
4 cadets RP 6 (76 kg)																
C6a$_{76}$	**37.5**	76	182	**22.94**	60	56	55	48	53	47	61	65	**55.63**	169	46	**1288**
C6b$_{76}$	**100**	76	180	**23.46**	42	60	54	60	57	53	53	55	**54.25**	159	55	**1219**
C6c$_{76}$	**100**	76	180	**23.46**	60	66	60	51	46	64	63	65	**59.38**	142	43	**814**
C6d$_{76}$	**37.5**	76	177	**24.26**	68	55	58	62	46	51	53	46	**54.88**	156	47	**978**
3 cadets RP 7 (74 kg) /two 75 kg cadets did not fight against individuals from the Exclusive Group/																
C8a$_{74}$	**50**	74	184	**21.86**	60	52	46	51	42	51	44	44	**48.75**	172	56	**1284**
C8b$_{74}$	**37.5**	74	176	**23.89**	57	59	55	43	57	41	44	46	**50.25**	144	94	**1805**
C8c$_{74}$	**25**	74	175	**24.16**	49	61	45	61	51	53	50	72	**54**	163	87	**1891**
2 cadets RP 9 (72 kg)																
C9a$_{72}$	**50**	72	182	**21.74**	56	52	57	72	65	61	53	52	**58.5**	180	61	**1464**
C9b$_{72}$	**75**	72	175	**23.51**	61	62	58	63	57	54	46	67	**58.5**	186	60	**1488**
2 cadets RP 10 (71 kg)																
C10a$_{71}$	**37.5**	71	179	**22.16**	57	59	61	45	47	41	44	55	**51.13**	168	55	**1288**
C10b$_{71}$	**25**	71	172	**24**	61	51	51	44	53	54	63	55	**54**	148	62	**1223**
2 cadets RP 11 (70 kg)																
C11a$_{70}$	**25**	70	181	**21.37**	52	51	55	56	60	52	0	60	**48.25**	179	57	**1360**
C11b$_{70}$	37.5	70	180	**21.6**	57	59	53	40	50	47	0	60	**47**	171	57	**1300**
1 cadet RP 12 (69 kg)																
C12$_{69}$	**25**	69	173	**23.05**	44	65	52	48	56	62	48	49	**53.00**	170	52	**1178**
3 cadets RP 13 (68 kg)																
C13a$_{68}$	**25**	68	181	**20.76**	50	55	59	55	55	52	46	53	**53.13**	168	57	**1277**
C13b$_{68}$	**0**	68	180	**20.99**	24	50	58	54	49	61	53	53	**50.25**	163	56	**1217**
C13c$_{68}$	**100**	68	165	**24.98**	57	56	52	69	59	67	63	100	**63.38**	156	75	**1560**
6 cadets with the lowest body mass (range 9 kg)																
C14$_{67}$	**25**	67	188	**18.96**	75	36	50	59	41	48	46	45	**50.00**	171	62	**1414**
C15$_{66}$	**0**	66	171	**22.57**	48	55	37	40	38	54	56	47	**46.88**	174	41	**951**
C16$_{65}$	**0**	65	172	**21.97**	39	53	54	60	53	57	62	49	**53.38**	144	57	**1094**

$C17_{64}$	**62.5**	64	173	**21.38**	50	52	49	56	56	62	62	60	**55.88**	162	68	**1469**
$C18_{59}$	**62.5**	59	172	**19.94**	42	55	58	61	55	59	48	69	**55.88**	174	58	**1376**
$C19_{58}$	**37.5**	58	169	**20.31**	**66**	**64**	**60**	**60**	**59**	**59**	**56**	**53**	**59.63**	174	56	**1299**

#the bolded general physical fitness scores for cadet $C19_{58}$ indicate that his individual scores are ordinal variables in the tables and graphical models (the highest 'FITNESS' \score among cadets from the Exclusive Group).

At this stage of the experiment, three cadets from the Exclusive Group (classified in the lowest body mass category: $C16_{65}$, $C17_{64}$, $C18_{59}$) ach fought two TFs against one another, and this is the only instance where three individuals could be analysed within the 'round robin' framework. In total, they fought 12 TFs against one another. Meanwhile, four other cadets from the Exclusive Group fought twice in two pairs: $C1_{96}$ with $C14_{67}$ and $C2_{85}$ with $C3_{84}$. Furthermore, cadet $C1_{96}$ fought two opponents of identical body weight (each 70 kg) and similarly, cadet $C19_{58}$ faced opponents weighing 72 kg. Of the 18 cadets outside the Exclusive Group, three ($C5b_{80}$, $C10a_{71}$, $C13c_{68}$) faced three opponents each who were qualified for this designated Group. In contrast, the opponents of the four cadets from the Exclusive Group ($C4_{82}$, $C12_{69}$, $C15_{66}$, $C19_{58}$) were exclusively the other participants in the experiment (Table 2).

Table 2. The number of matches played against Exclusive Group cadets by each participant in this stage of the experiment.

Code	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**The biggest difference kg**
RP & kg	**96**	**85**	**84**	**82**	**80**	**76**	**75**	**74**	**72**	**71**	**70**	**69**	**68**	**67**	**66**	**65**	**64**	**59**	**58**	
Total ►	1	1	1	1	2	4	2	3	2	2	2	1	3	1	1	1	1	1	1	
$C1_{96}$								a			a;b			**x**						29
$C2_{85}$			**x**		a						a		a							17
$C3_{84}$		**x**			a	a				a										13
$C4_{82}$						d		b		b			a							11
$C12_{69}$					b	c				a			c							12
$C14_{67}$	**x**				b			c			b									29
$C15_{66}$					b				b	b			c							14
$C16_{65}$						b		c									**x**	**x**		11
$C17_{64}$								a		a						**x**		**x**		10
$C18_{59}$								c					c			**x**	**x**			15
$C19_{58}$						b			a;b				b							18
total fights fought with Exclusive Group cadets (including between cadets from this Group)																				
	2	**2**	**2**		4 a 6 b	2 a 4 b		4 a 4 b	2 a 4 b	6 a 4 b	4 a 4 b		4 a 2 b	**2**		**4**	**4**	**4**		
						2 c		4 c					6 c							
						2d														

Results of the test fights of the military cadets from the Exclusive Group

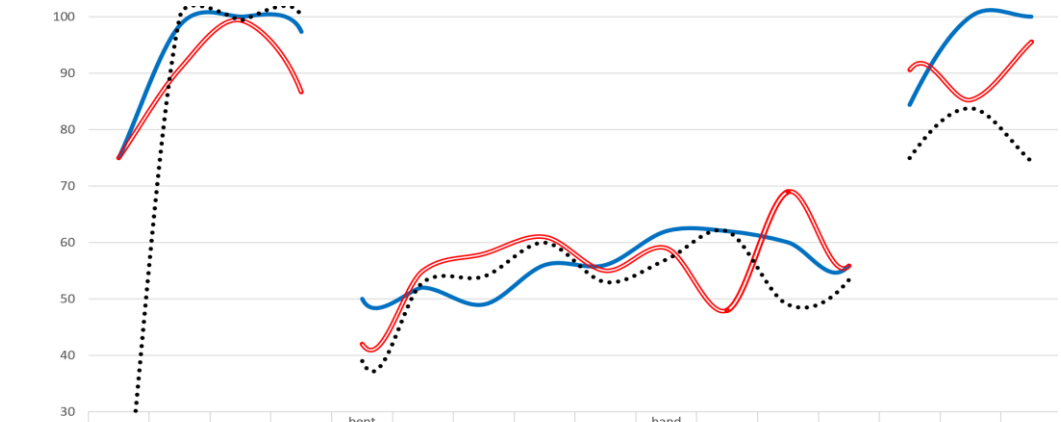
Cadet $C16_{65}$ lost all his fights (Table 1), including against two opponents from the Exclusive Group, whom he surpassed in terms of body mass and BMI, but lagged behind in general physical fitness (Table 3, Figure 1). His opponents, when fighting each other, won one fight and lost one (hence their identical F-Index of 75%). Unfortunately, based on the available documentation, it is impossible to determine which of them won the TFVP and, conversely, lost the TVHP. F-Index of 62.5% for both cadet $C17_{64}$ and cadet $C19_{58}$, taking into account all TFs fought (Table 1), is evidence that they performed similarly against opponents heavier than themselves. It was possible to establish that cadet $C17_{64}$ won both bouts against cadet $C8a_{74}$, who was 10 kg heavier, and lost two to opponent $C10a_{70}$. In a sense, the pattern of results is similar (albeit with different opponents) for cadet $C18_{59}$ – he won both bouts against cadet $C8c_{74}$, who was 15 kg heavier, whilst losing both to the cadet $C13c_{68}$, who was 9 kg heavier but also the fittest of all those observed (his 'FITNESS' score = 63.38 points). Cadet $C18_{59}$ did not dominate in terms of any of the analysed empirical variables (Figure 1).

Table 3. Raw indicators for military cadets from the Exclusive Group who have fought TFs against each other (the F-Index takes into account only the results of TFs fought between them).

Code RP & kg	F-Index	Body composition			General physical fitness									Workload		
	TF-VH	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull-up	sit-ups	FITNESS	HR	t (s)	load ##
three cadets 'round robin' four TFs each (range of body mass 6 kg)																
$C17_{64}$	**75**	64	173	**21.38**	50	52	49	56	56	62	62	60	**55.88**	162	68	**735**
$C18_{59}$	**75**	59	172	**19.94**	42	55	58	61	55	59	48	69	**55.88**	174	58	**688**
$C16_{65}$	**0**	65	172	**21.97**	39	53	54	60	53	57	62	49	**53.38**	144	57	**547**
weight difference 29 kg																
$C1_{96}$	**100**	96	189	**26.87**	59	49	50	61	47	62	48	60	**54.50**	172	38	**218**
$C14_{67}$	**0**	67	188	**18.96**	75	36	50	59	41	48	46	45	**50.00**	171	62	**354**
weight difference 1 kg																
$C2_{85}$	**100**	85	185	**24.84**	60	60	55	60	56	55	62	55	**57.88**	155	59	**305**
$C3_{84}$	**0**	84	186	**24.28**	34	61	50	64	58	62	62	67	**57.25**	155	60	**310**

indicators adjusted for TF four and two respectively.

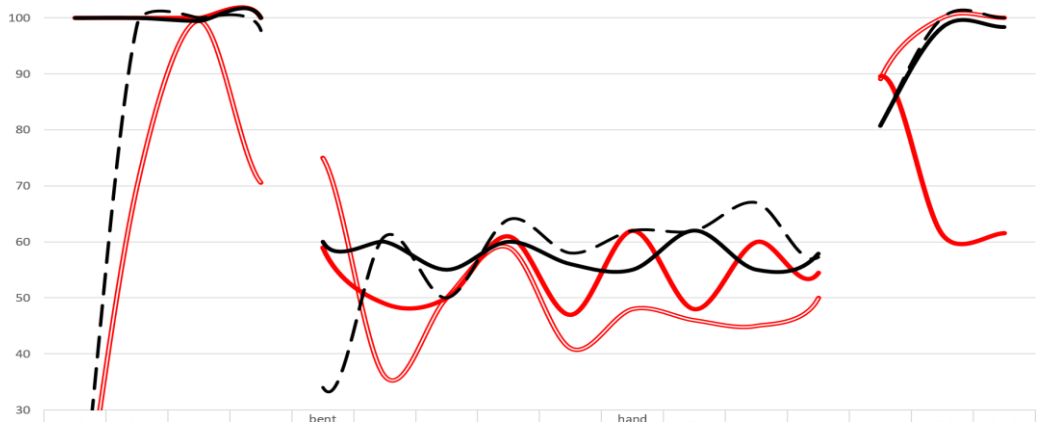
Profile of cadet $C17_{64}$, which provides information on overall motor ability, is the most stable (Figure 1).



	F-Index	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull-up	sit-ups	FITNESS	%HRmax	t (s)	load
C17/64	75	98.46	100	97.31	50	52	49	56	56	62	62	60	55.88	84.37	100	100
C18/59	75	90.76	99.42	86.7	42	55	58	61	55	59	48	69	55.88	90.62	85.29	95.6
C16/65	0	100	99.42	100	39	53	54	60	53	57	62	49	53.38	75	83.82	74.42

Figure 1. Profiles of three cadets from the Exclusive Group (from the lowest body mass category) who competed against each other in two round-robin training sessions – following the breakdown of raw body composition and workload data into percentage ratios.

The 29 kg difference in body weight between cadets $C1_{96}$ and $C14_{67}$, coupled with a 4.5-point difference in the 'FITNESS', does not yet conclusively explain why cadet $C14_{67}$ lost both fights. Admittedly, he won only two of the eight TFs fought, despite being lighter than all his opponents and, in the case of the heaviest, also inferior in terms of general physical fitness (Table 1). However, he won both fights against cadet $C8c_{74}$, who was 7 kg heavier and had slightly higher motor potential. Given the similarity in the motor potentials of cadets $C2_{85}$ versus $C3_{84}$, it would be difficult to attribute the 1 kg difference in body weight to the winner's advantage. Both demonstrated a high aptitude for hand-to-hand combat. Both won all their TFs against their opponents at that stage of the experiment. The profile model of the four cadets analysed, based on data following the decomposition of raw results, is further evidence that the distribution of general physical fitness for cadet $C2_{85}$ is the most balanced (Figure 2).



	F-Index	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull-up	sit-ups	FITNESS	%HRmax	t (s)	load
C1/96	100	100	100	100	59	49	50	61	47	62	48	60	54.50	89.58	61.29	61.58
C14/67	0	69.79	99.47	70.56	75	36	50	59	41	48	46	45	50.00	89.06	100	100
C2/85	100	100	99.46	100	60	60	55	60	56	55	62	55	57.88	80.72	98.33	98.38
C3/84	0	98.82	100	97.74	34	61	50	64	58	62	62	67	57.25	80.72	100	100

Figure 2. Profiles (following the breakdown of raw body composition and workload data into percentage ratios) of four cadets from the Exclusive Group who each competed in two TFs against one another: results for individuals differing by 29 kg in body weight are marked in red; those differing by 1 kg are marked in black.

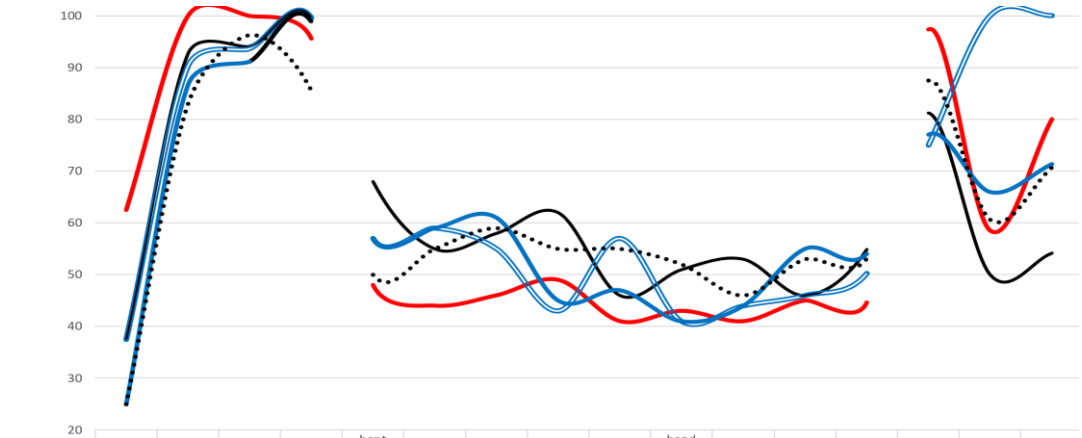
Results of test fights of military cadets from the Exclusive Group who did not fight each other

Cadet $C4_{82}$ emerged as the leader, though he did not win all the TFs. Whilst it dominated its opponents in terms of body mass, it was clearly outclassed by each of them in terms of overall motor potential (Table 4). He won two fights against cadet $C13a_{68}$, and one against each of the others. A profile model of cadet $C4_{82}$ and the four opponents against whom he fought two TFs each, based on data following the decomposition of raw results, shows that despite having the lowest motor potential, the distribution of his general physical fitness is the most balanced (Figure 3).

Table 4. Raw indices of the empirical variables for military cadets (shaded rows) and their opponents from outside the Exclusive Group – the ordinal variable F-Index (with body weight held constant).

Code RP & kg	F-Index	Body composition			General physical fitness#									Workload		
	TF-VH	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull -up	sit-ups	FITNESS	HR	t (s)	load
body weight difference from $C4_{82}$: min 6 kg; max 14 kg																
$C4_{82}$	**62.5**	82	188	**23.20**	48	44	46	49	41	43	41	45	**44.63**	187	55	**1445**
$C6d_{76}$	**37.5**	76	177	**24.26**	68	55	58	62	46	51	53	46	**54.88**	156	47	**978**
$C8b_{74}$	**37.5**	74	176	**23.89**	57	59	55	43	57	41	44	46	**50.25**	144	94	**1805**
$C10b_{71}$	**25**	71	172	**24**	61	51	51	44	53	54	63	55	**54**	148	62	**1288**
$C13a_{68}$	**25**	68	181	**20.76**	50	55	59	55	55	52	46	53	**53.13**	168	57	**1277**
body weight difference from $C12_{69}$: min 1 kg; max 11 kg																
$C5b_{80}$	**100**	80	183	**23.89**	60	52	51	63	51	51	48	60	**54.5**	172	38	**871**
$C6c_{76}$	**100**	76	180	**23.46**	60	66	60	51	46	64	63	65	**59.38**	142	43	**814**
$C13c_{68}$	**100**	68	165	**24.98**	57	56	52	69	59	67	63	100	**63.38**	156	75	**1560**
$C10a_{71}$	**37.5**	71	179	**23.16**	57	59	61	45	47	41	44	55	**51.13**	168	55	**1288**
$C12_{69}$	**25**	69	173	**23.05**	44	65	52	48	56	62	48	49	**53.00**	170	52	**1178**
body weight difference from $C15_{66}$: min 2 kg; max 14 kg																
$C5b_{80}$	**100**	80	183	**23.89**	60	52	51	63	51	51	48	60	**54.5**	172	38	**871**
$C13c_{68}$	**100**	68	165	**24.98**	57	56	52	69	59	67	63	100	**63.38**	156	75	**1560**
$C9b_{72}$	**75**	72	175	**23.51**	61	62	58	63	57	54	46	67	**58.5**	186	60	**1488**
$C10b_{71}$	**37.5**	71	179	**22.16**	57	59	61	45	47	41	44	55	**51.13**	168	55	**1288**
$C15_{66}$	**0**	66	171	**22.57**	48	55	37	40	38	54	56	47	**46.88**	174	41	**951**
body weight difference from $C19_{58}$: min 10 kg; max 18 kg																
$C6b_{76}$	**100**	76	180	**23.46**	42	60	54	60	57	53	53	55	**54.25**	159	55	**1219**
$C9b_{72}$	**75**	72	175	**23.51**	61	62	58	63	57	54	46	67	**58.5**	186	60	**1488**
$C9a_{72}$	**50**	72	182	**21.74**	56	52	57	72	65	61	53	52	**58.5**	180	61	**1464**
$C19_{58}$	**37.5**	58	169	**20.31**	**66**	**64**	**60**	**60**	**59**	**59**	**56**	**53**	**59.63**	174	56	**1299**
$C13b_{68}$	**0**	68	180	**20.99**	24	50	58	54	49	61	53	53	**50.25**	163	56	**1217**

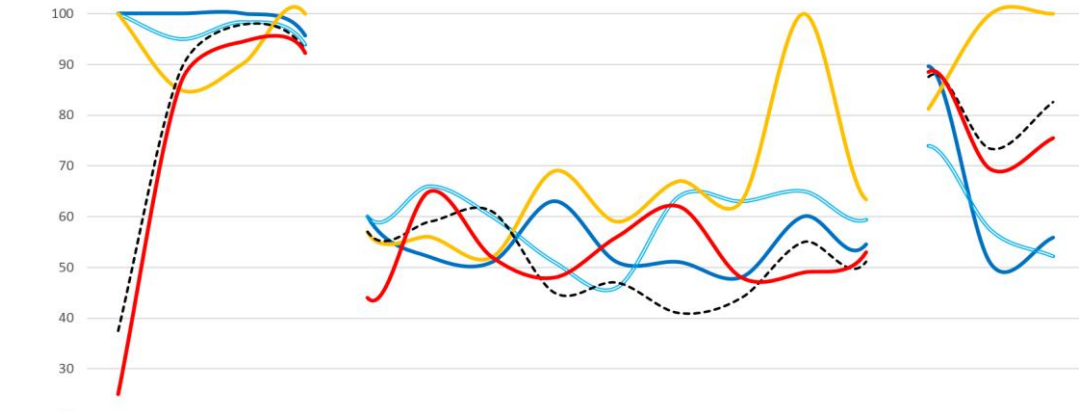
#the bolded general physical fitness for cadet $C19_{58}$ indicate that his sub-scores are ordinal variables in the tables and graphical models (the highest 'FITNESS' score among the Exclusive Group cadets).



	F-Index	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull-up	sit-ups	FITNESS	%HRmax	t (s)	load
C4/82	62.5	100	100	95.63	48	44	46	49	41	43	41	45	44.62	97.39	58.51	80.05
C6d76	37.5	92.68	94.14	100	68	55	58	62	46	51	53	46	54.88	81.25	50	54.18
C8b74	37.5	90.24	93.61	99.55	57	59	55	43	57	41	44	46	50.25	75	100	100
C10b71	25	86.58	91.14	98.92	57	59	61	45	47	41	44	55	54	77.03	65.95	71.35
C13a68	25	82.92	96.27	85.57	50	55	59	55	55	52	46	53	53.13	87.5	60.63	70.74

Figure 3. Profiles (following the breakdown of the raw body composition and workload results into percentage ratios) for cadet $C4_{82}$ and four cadets from outside the Exclusive Group, with whom he undertook two TFs each at this stage of the experiment.

Cadet $C12_{69}$ won two TFs against the cadet $C10a_{71}$, who was 2 kg heavier, but lost all the others to opponents with exceptional aptitude for hand-to-hand combat (each with an F-Index of 100%). This is also proof that, at this stage of the experiment, they had not yet fought each other. The profile model of cadet $C12_{69}$ and the four with whom he fought two TFs each, based on data following the decomposition of raw results, reveals, among other things, the disparities of cadet $C13c_{68}$ in terms of abdominal muscle strength compared to the others. His score of 100 points in the 'sit-ups' trial is not only the only one recorded in this experiment, but also the only one among all trials (Figure 5 and Table 1).

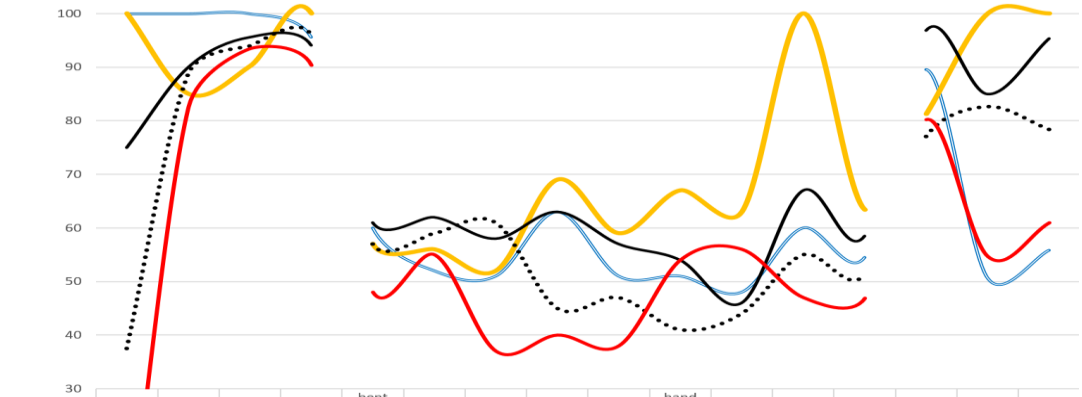


	F-Index	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull-up	sit-ups	FITNESS	%HRmax	t (s)	load
C5b80	100	100	100	95.63	60	52	51	63	51	51	48	60	54.5	89.58	50.66	55.83
C6c76	100	95	98.36	93.91	60	66	60	51	46	64	63	65	59.38	73.95	57.33	52.17
C13c68	100	85	90.16	100	57	56	52	69	59	67	63	100	63.38	81.25	100	100
C10a71	37.5	88.75	97.81	92.71	57	59	61	45	47	41	44	55	51.13	87.5	73.33	82.56
C12/69	25	86.25	94.53	92.27	44	65	52	48	56	62	48	49	53	88.54	69.33	75.51

Figure 4. Profiles (following the breakdown of the raw body composition and workload results into percentage ratios) for cadet $C12_{69}$ and four individuals from outside the Exclusive Group with whom he engaged in two TFs each during the experiment.

The profiles of cadets $C13a_{68}$ and $C5a_{80}$ reappear among those who all outperformed cadet $C14_{66}$ in both TFs (his F-Index = 0). In this comparison, these two cadets lead all

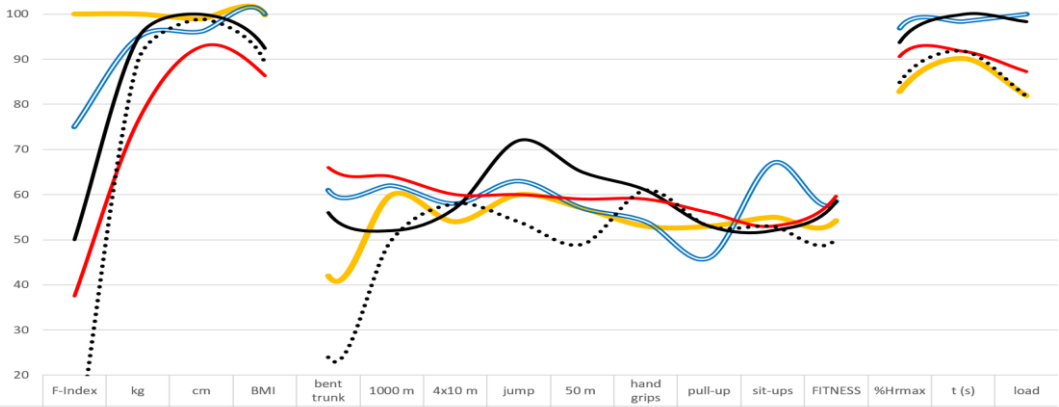
decomposable indicators, with cadet C13a$_{68}$ dominating the BMI indicator, the 100-point 'sit-ups' trial as well as having the longest-lasting TF in which he participated, and incurring the highest energy cost in hand-to-hand combat – the 'load' indicator. Cadet C14$_{66}$ differs least from his randomly selected opponents in terms of height. He is just under 7% shorter than the tallest among them, C5b$_{80}$. Furthermore, he trails cadet C9b$_{72}$ by a similar 7% in the 1000 m run, but outperforms cadet C5b$_{80}$ by 3% in this trial. His exercise heart rate was the lowest and similar to that observed in cadet C13a$_{68}$, whilst it was just under 17% lower than that of the cadet C9b$_{72}$ (Figure 5).



	F-Index	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull-up	sit-ups	FITNESS	%HRmax	t (s)	load
C5b80	100	100	100	95.63	60	52	51	63	51	51	48	60	54.5	89.58	50.66	55.83
C13c68	100	85	90.16	100	57	56	52	69	59	67	63	100	63.38	81.25	100	100
C9b72	75	90	95.62	94.11	61	62	58	63	57	54	46	67	58.5	96.88	85	95.38
C10b71	37.5	88.75	93.98	96.07	57	59	61	45	47	41	44	55	51.13	77.08	82.66	78.39
C15/66	0	82.5	93.44	90.35	48	55	37	40	38	54	56	47	46.88	80.2	54.66	60.96

Figure 5. Profiles (following the breakdown of raw body composition and workload data into percentage ratios) for cadet C14$_{66}$ and four individuals from outside the Exclusive Group with whom he undertook two TFs each during the experiment.

Cadet C19$_{58}$, the one with the lowest body weight, won two bouts against cadet C15$_{66}$ and one against C10b$_{71}$, despite facing opponents who were heavier than him (unfortunately, it is not possible to determine his form). At the same time, his general physical fitness characterized by decreasing values of trials results from 65 points for bent trunk to 53 points for sit-ups (Figure 6).



	F-Index	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull-up	sit-ups	FITNESS	%Hrmax	t (s)	load
C6b76	100	100	98.9	99.78	42	60	54	60	57	53	53	55	54.25	82.81	90.16	81.92
C9b72	75	94.73	96.15	100	61	62	58	63	57	54	46	67	58.5	96.87	98.36	100
C9a72	50	94.71	100	92.47	56	52	57	72	65	61	53	52	58.5	93.75	100	98.38
C19/58	37.5	76.31	92.85	86.38	66	64	60	60	59	59	56	53	59.63	90.62	91.8	87.29
C13b68	0	89.47	98.9	89.28	24	50	58	54	49	61	53	53	50.25	84.89	91.8	81.78

Figure 6. Profiles (following the breakdown of raw body composition and workload data into percentage ratios) for cadet C19$_{58}$ and four individuals from outside the Exclusive Group with whom he undertook two TFs each during the experiment.

Energy cost of test fights

None of the cadets observed exceeded the maximum exercise intensity zone during the TFs. The highest average heart rate was 187 bpm (97% of HRmax for the average age of the subjects) for cadet C4$_{82}$, who was fourth in the body mass ranking. He also represents the seven who exceeded 90% HRmax and is the heaviest among them. In this homogeneous group in terms of very high exercise intensity, the body mass range is 24 kg. The lightest is cadet C19$_{58}$ who brings up the rear in the body mass ranking (which is also the main criterion for identifying participants in the observed experiment). In this homogeneous group, due to the criterion of very high exercise intensity during TFs, there is no individual who won all fights, but cadet C15$_{66}$ lost all of them (Table 5). Thus, the F-Index = 0 for cadet C15$_{66}$, combined with the short duration of the fights in which he participated (an average of 41 seconds), is more indicative of a lack of aptitude for hand-to-hand combat than a lack of motivation for these forms of direct competition. Furthermore, only cadet C4$_{82}$ (44.63 points) has a lower 'FITNESS' score than his 46.88 points, yet cadet C4$_{82}$ cadet won 6 out of 8 TFs.

Table 5. Raw results for cadets (n = 7) who undertook test sparring sessions at a very high intensity – an ordinal variable based on the highest F-Index value; where the index is equal, higher body mass).

Code	F-Index	Body composition			General physical fitness									Workload		
RP & kg	TF-VH	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull -up	sit-ups	FITNESS	HR	t (s)	load ##
C9b$_{72}$	**75**	72	175	**23.51**	61	62	58	63	57	54	46	67	**58.5**	186	60	**1488**
C4$_{82}$	**62.5**	82	188	**23.2**	48	44	46	49	41	43	41	45	**44.63**	187	55	**1445**
C18$_{59}$	**62.5**	59	172	**19.94**	42	55	58	61	55	59	48	69	**55.88**	174	58	**1376**
C9a$_{72}$	**50**	72	182	**21.74**	56	52	57	72	65	61	53	55	**58.5**	180	61	**1464**
C19$_{58}$	**37.5**	58	169	**20.31**	66	64	60	60	59	59	56	53	**59.63**	174	56	**1299**
C11a$_{70}$	**25**	70	181	**21.37**	52	51	55	56	60	52	0	60	**48.25**	179	57	**1360**
C15$_{66}$	**0**	66	171	**22.57**	48	55	37	40	38	54	56	47	**46.88**	174	41	**951**

Of the four cadets who had the same exercise heart rate (172 bpm), C1$_{96}$ and C5b$_{80}$ completed all TFs in an average of 38 seconds. Their energy expenditure was therefore identical, whereas the average exercise time for the other two increased in inverse proportion to the efficiency of the TFs (Table 6).

Table 6. Raw results for cadets (n= 4) who took part in test matches at an intensity level on the borderline between the high and very high zones – an ordinal variable ranked by the highest F-Index value, where the index is equal, higher body mass).

Code	F-Index	Body composition			General physical fitness									Workload		
RP & kg	TF-VH	kg	cm	BMI	bent trunk	1000 m	4x10 m	jump	50 m	hand grips	pull -up	sit-ups	FITNESS	HR	t (s)	load ##
C1$_{96}$	**100**	96	189	**26.87**	59	49	50	61	47	62	48	60	**54.50**	172	38	**871**
C5b$_{80}$	**100**	80	183	**23.89**	60	52	51	63	51	51	48	60	**54.5**	172	38	**871**
C8a$_{74}$	**50**	74	184	**21.86**	60	52	46	51	42	51	44	44	**48.75**	172	56	**1284**
C5a$_{80}$	**37.5**	80	185	**23.37**	73	52	51	64	59	80	46	60	**60.63**	172	61	**1399**

Correlations between independent variables and the dependent F-Index variable for military cadets differing in their exercise intensity zone during TF

Statistically significant correlations between energy expenditure (workload) indices and the F-Index were found only in two groups of participants selected on the basis of exercise intensity during TFs. Although three cadets with identical exercise HR (174 bpm, which corresponds exactly to 90.62% of HRmax) differed in their average TF duration, which was shorter almost in proportion to decreasing efficiency: $C18_{59}$ F-Index = 62.5% and t = 58 seconds and accordingly $C19_{58}$ 37.5% & 56 s; $C15_{66}$ 0% & 41, which in turn modifies the 'load' indicators (Table 5). The higher the efficiency, the greater the energy cost. Among the remaining cadets in this group, the HR range is 8 bpm and falls between 179 bpm and 187 bpm in raw results. Converted (without rounding) to %HRmax, it ranges from 93.22% to 97.9%. The 'load' shows the strongest statistically significant correlation with the F-Index ($r = 0.873$, $p<0.02$). The strength of this relationship is weaker for exercise duration ($r = 0.784$, $p<0.05$). There is also a high correlation between HR and the F-Index ($r = 0.609$), but this relationship is not statistically significant. In this group of individuals, which is relatively homogeneous in terms of the very high intensity of this specific exercise, none of the other independent variables correlates statistically significantly with the F-Index (Table 7).

This isolated pattern is even more clearly evident in the case of cadets with identical exercise heart rates (Table 6). There is a negative linear relationship between the exercise time and 'load' indices and the F-Index, whereas identical heart rates preclude the calculation of the r index (Table 7).

In the group of the remaining 18 cadets, whose exercise intensity during TFs falls within the high zone (individually ranging from HR = 142 bpm to 171 bpm, corresponding to from 73.95 to 86 %HRmax), and with even greater variability in body composition and general physical fitness, statistically significant correlations with the F-Index were found for four of them. There is a very high correlation with 'FITNESS' ($r = 0.702$, $p<0.01$) a high correlation with body mass, BMI and the result of sit-ups trial (Table 7).

Table 7. Correlations between the raw scores of the independent variables and the dependent F-Index variable for military cadets differing in their exercise intensity zone during test fights [the required critical value of r, given the degrees of freedom (df) is shown in square brackets].

Body composition			**General physical fitness**									**Workload**		
kg	**cm**	**BMI**	**bent trunk**	**1000 m**	**4x10 m**	**jump**	**50 m**	**hand grips**	**pull-up**	**sit-ups**	FITNESS	**HR**	**t (s)**	**load**
HR >90%max: n = 7 [0.754]														
0.274	0.296	0.132	0.096	0.014	0.584	0.592	0.316	0.121	0.200	0.474	0.423	0.609	**0.784***	**0.873^**
HR = 90%max: n = 4 [0.950]														
0.625	0.301	0.706	−0.721	−0.570	0.346	0.292	−0.269	−0.509	0.827	0.444	−0.178		**−1.000**	**−1.000**
HR 70 to 89%max: n =18 [0.468]														
0.534*	0.064	**0.519***	0.166	0.421	0.025	0.352	0.350	0.344	0.276	**0.501***	**0.702****	−0.265	−0.053	−0.122

***p<0.05, ****p<0.01

Correlations between independent variables and the dependent F-Index variable for selected military cadets from the Exclusive Group

Only in one isolated instance of a random selection of three cadets (all from the Exclusive Group) who were pitted against each other in two forms of hand-to-hand combat did each cadet fight two bouts in a 'round robin' system. There is a linear relationship between the F-Index and 'FITNESS' (Table 8). Both cadets who won the TF against cadet $C16_{65}$ are characterised by an identical overall physical fitness index (55.88 points – compared to 53.38 points for $C16_{65}$). The results of the 50 m run trial also show a close, statistically significant correlation (r = 0.945). Similarly, 'load' (r = 0.971) and exercise HR (r = 0.918). These details are clearly visible in the model of their individual profiles (Figure 1).

Table 8. Correlations between the indicators and the dependent F-Index variable for three cadets from the Exclusive Group, who each fought two TFs using the 'round robin' system (required critical value r = 0.997).

Body composition			**General physical fitness**									**Workload**		
kg	**cm**	**BMI**	**bent trunk**	**1000 m**	**4x10 m**	**jump**	**50 m**	**hand grips**	**pull-up**	**sit-ups**	**FITNESS**	**HR**	**t (s)**	**load**
three cadets from the Exclusive Group 'round robin'														
0.621	0.500	−0.724	0.711	0.189	−0.064	−0.327	0.945	0.803	−0.500	0.893	**1.000**	0.918	0.569	0.971

Two indicators among the independent variables are statistically significantly correlated with the F-Index. These are the body mass of cadet $C4_{82}$ and his opponents (r = 0.961, p<0.01), and the trial jump results (r = 0.974, p<0.01) of $C14_{66}$ cadet and his competitors. Negative correlation coefficients close to statistical significance for 'FITNESS' (r = −0.874) and some trials with F-Index variable are, moreover, important empirical evidence that both types of test fights (TFVP and TFHP) primarily measure aptitude for hand-to-hand combat (Table 9).

Table 9. Correlations between the indicators and the dependent F-Index variable for four cadets from the Exclusive Group who each competed in two TFs against four randomly selected participants in the experiment (required critical value r = 0.878).

Body composition			**General physical fitness**									**Workload**		
kg	**cm**	**BMI**	**bent trunk**	**1000 m**	**4x10 m**	**jump**	**50 m**	**hand grips**	**pull-up**	**sit-ups**	**FITNESS**	**HR**	**t (s)**	**load**
$C4_{82}$ with: $C6a_{76}$; $C8b_{74}$; $C10b_{71}$; $C13a_{68}$														
0.961**	0.770	0.256	−0.520	−0.635	−0.043	−0.747	−0.848	−0.730	−0.539	−0.455	−0.874	0.677	−0.100	0.336
$C12_{69}$ with: $C5b_{80}$; $C6c_{76}$; $C10a_{71}$; $C13c_{68}$														
0.517	0.035	0.705	0.775	−0.408	−0.166	0.753	−0.018	0.382	0.700	0.637	0.747	−0.539	−0.049	−0.253
$C14_{66}$ with: $C5b_{80}$; $C9b_{72}$; $C10b_{71}$; $C13c_{68}$														
0.569	0.222	0.715	0.580	0.210	0.702	**0.974****	0.749	0.350	−0.298	0.715	0.804	0.105	0.281	351
$C19_{58}$ with: $C6b_{76}$; $C9a_{72}$; $C9b_{72}$; $C13b_{68}$														
0.585	0.060	0.832	0.380	0.561	−0.655	0.354	0.426	−0.870	−0.361	0.436	0.360	0.070	0.073	0.219

******p<0.01

Correlations between the independent variables and the dependent F-Index variable in general terms

A seemingly absurd procedure of correlating fourteen independent variables with the dependent F-Index variable for all observed military cadets (n = 29) during the initial phase of Chodała's experiment revealed two patterns. Furthermore, the correlation of these indicators was analysed after separating the group into those classified as part of the conventional Exclusive Group (n = 11) and the remainder, who had engaged in test fights with at least one cadet from that Group (n = 18). Firstly, with such compilations of results, none of the partial workload indicators (energy cost of the fights) correlates with the F-Index. Secondly, the smaller the group following the separation, the fewer statistically significant r coefficients there are among body composition and general physical fitness (Table 10).

Table 10. Correlations between the raw results and the dependent variable F-Index within the identified subgroups [the required critical value of r in square brackets, given the degrees of freedom (df)].

Body composition			**General physical fitness**									**Workload**		
kg	**cm**	**BMI**	**bent trunk**	**1000 m**	**4x10 m**	**jump**	**50 m**	**hand grips**	**pull-up**	**sit-ups**	FITNESS	**HR**	**t (s)**	**load**
all observed military cadets: n = 29 [0.374]														
0.525**	0.230	**0.516****	0.170	0.206	0.114	**0.412***	0.173	0.180	0.200	**0.455^**	**0.483****	−0.054	−0.150	−0.175
military cadets of the Exclusive Group: n =11 [0.602]														
0.693^	0.592	0.570	0.092	0.045	0.257	0.501	0.289	0.187	−0.005	0.593	0.407	0.038	0.052	0.083
who have had test fights with at least one military cadet from the Exclusive Group: n =18 [0.468]														
0.370	−0.171	**0.495***	0.238	0.432	−0.005	0.375	0.079	0.287	0.289	0.428	**0.538***	−0.116	−0.245	−0.308

*p<0.05, **p<0.01, ^p<0.02

Moreover, dividing the set of cadets included in the statistical calculations into those who either won or lost all TFs (F-Index 0 or 100%) and the remaining 20 (F-Index from 25% to 62.5%) further ensures that TFs measure predispositions to hand-to-hand combat (Table 11). This is particularly noteworthy given that, among those competing against cadet $C12_{69}$, the F-Index was 100% in three cases; yet this index did not correlate statistically significantly with either body mass or BMI. Similarly, among the competitors of cadet $C12_{66}$, out of five calculated results, the F-Index = 100% in two cases, and 0 in one case (Table 9).

Table 11. Correlations between the independent variables and the dependent F-Index variable after outlier removal [the required critical value of r in square brackets, given the degrees of freedom (df)].

Body composition			**General physical fitness**									**Workload**		
kg	**cm**	**BMI**	**bent trunk**	**1000 m**	**4x10 m**	**jump**	**50 m**	**hand grips**	**pull-up**	**sit-ups**	FITNESS	**HR**	**t (s)**	**load**
either they won or lost all TFs: n = 9 [0.666]														
0.673*	0.396	**0.779^**	**0.760^**	0.409	0.304	0.561	0.459	0.121	−0.066	0.510	**0.733***	−0.042	0.000	0.010
neither won nor lost all TFs: n =20 [0.444]														
0.191	0.094	0.114	−0.371	0.088	−0.053	0.327	0.090	0.151	0.239	0.276	0.233	0.256	−0.076	0.035

*p<0.05, ^p<0.02

4. Discussion

In my view, the most compelling argument from a methodological perspective for conducting a secondary analysis of the results of the testing fight (in two forms of hand-to-hand combat) involving military cadets – which, in a different social context, was carried out by Andrzej Chodała [12] in a unique experiment a quarter of a century ago, is the emergence of new tools for the scientific analysis of the intensity of physical exertion. In exactly the same year (2001), when Mariusz Kisiel defended his master's thesis based on observations of testing fight military cadets during the initial phase of Chodała's experiment, three researchers – Tanaka, Monahan and Seals [36] – published a method for determining maximal heart rate in adults. Since Kisiel recorded the testing fight duration and HR after the end of each bout, it is possible both to classify these exertions into the intensity zones established by Pollock et al. [37] – before the publication by Tanaka et al. [36], and to estimate the physiological load using such measures – the simplest indicator being the product of intensity and duration (in minutes) of the exercise [34, 35]. It is therefore certain that the forms of TFs used did not place a physiological load on the body exceeding the safe intensity threshold (measured by HR). Since TFs are specific INNOAGON measures [38–40], it has become possible to make quantitative and qualitative comparisons of measures relating to various aspects of personal safety and health prevention (self-defence, safe fall, etc. [41, 1, 42-44]).

Bartłomiej Gąsienica-Walczak used these criteria for estimating exertion when summarising the results of teaching the safe fall technique to physiotherapy students during two courses spanning two semesters [41]. Meanwhile, Andrzej Chodała [12], in a concise summary of the main methods employed during an experiment based on various forms of hand-to-hand combat in relation to other methods of influencing military cadets during their annual training in the first two semesters of study at a military university, applied training load assessment criteria relating to the so-called information layer [45]. This is hardly surprising, as experts in other forms of military training (drill, marksmanship, tactics – in the sense of specific motor activities on a simulated battlefield, etc.) are unfamiliar with the methods of evaluating physical effort used by experts in sport science and sport medicine.

However, in a sense, the crux of the paradoxes surrounding the assessment of people's hand-to-hand combat (not only those of soldiers, police officers, etc.) lies in the rather ill-advised transfer of models from the field of combat sports, particularly those of Asian origin (kata, poomse, etc.) or hand-to-hand combat systems that do not meet the criteria of a discipline based on direct combat. Demonstrating a set range of so-called attack and defence techniques, with or without the use of weapons or various accessories, has many entertainment values that meet the criteria for sporting competition (similar to gymnastics, particularly artistic gymnastics). However, in general, many motor demonstrations have low predictive value in terms of self-defence that does not carry the risk of exceeding the legal criteria for necessary defence, should many of the attractive motor responses to a simulated attack be transferred to the reality of interpersonal conflicts. Furthermore, in sporting competitions based on the demonstration of hand-to-hand combat weight categories modelled on those in combat sports are implemented, amongst other things. The essence of self-defence is survival, regardless of any differences in physical and motor capabilities in favour of the aggressor.

An example of a unique, albeit spontaneous, challenge to these stereotypes is the report [2] detailing the results of TFVP matches between girls and boys. The results were selected from a study examining 997 boys and girls in age 7 to 13 years across the Poland (from 39 leading judo clubs) which began judo training in 2006 [46]. However, in that example, the principles of similarity or identical body weight and age among the competing children were observed. In the experiments by Kisiel [31] and Szajerski [7], the principle of identical gender was applied, but body weight was unrestricted. The results of both these experiments provide evidence that aptitude for hand-to-hand combat is not clearly correlated with either body weight or general physical fitness. The example of an 11-year-old schoolgirl who had a weight advantage over her classmates (she defeated each of them in the TFVP), yet was inferior to most of them in terms of muscle strength, is difficult to explain other than by her optimal aptitude for hand-to-hand combat. In the secondary analysis of Kisiel's study [31] carried out in this paper, there is data which most convincingly supports the estimation of aptitude for hand-to-hand combat based primarily on the results of testing fights that were not limited by either the participants' body weight or their general physical fitness – see Table 9. Only in the case of military cadet $C4_{82}$ does body weight correlate positively with the F-Index, however, this is not the case for the other body composition indicators (both his own and those of his competitors). Conversely, there is no significant correlation between the F-index and FITNESS in any of the four examples.

Authors of publications on mathematical statistics emphasise the need to first establish whether there are logical grounds for the emergence of significant relationships between pairs of empirical variables. In this discussion, I focus more on the opposite phenomenon – avoiding hasty conclusions about statistically significant correlations that have been identified, unless the set of results has first been divided into subsets that are relevant on the basis of criteria, particularly qualitative ones. It is precisely the results in Tables 10 and 11 that provide methodological arguments for the need to use the correlation coefficient with caution. When the results for all observed military cadets are correlated, statistically significant relationships emerge between the F-Index and FITNESS, as well as with some of the body composition indicators. Grouping the results into relevant subsets based primarily on qualitative criteria mitigates some of these correlations.

There is another important methodological aspect in the context of using various forms of TFs (particularly by distinguishing between combat in a vertical posture and horizontal posture, which Kisiel [31] failed to do) from the perspective of predicting aptitude for hand-to-hand combat. Andrzej Chodała [17], having access to a complete set of results from these military cadets who competed in a 'round robin' system during the first semester in TFVP and during the second semester in TFHP in two groups (14 and 17 participants) found a very high correlation ($r = 0.892$) between the number of wins in TFVP and TFHP. Niedomagała [46], on the other hand, confirmed the hypothesis regarding the predictive value of TFVP results for success in judo tournament from the club to international level tournament fighting (he analysed the results of 363 boys over a three-year period). However, there is no methodological basis for drawing similar conclusions based on positive correlations between the TFVP F-Index and the results of hand-to-hand combat tests (military, police or those dedicated exclusively to self-defence) [12, 15, 19] based on demonstrating motor responses to predetermined forms (techniques) of physical attack.

This most general synthesis of the TFs applied in research into hand-to-hand combat in various practical contexts (sport, military or police intervention skills, self-defence

for all, etc.) may be contested in accordance with the paradigm of physical activity and/or sports theory, which distinguishes between three categories of preparation for sports competitions: general, targeted, special [45, 47]. However, guided by the INNOAGON criteria, particularly in the context of the links between this new applied science and preventive medicine, it is appropriate to refer to praxeological criteria (and the language of praxeology takes precedence over INNOAGON [48]). Therefore, based on the sports theory terminology preferred by some authors [45, 47], the TFVP results associated by Niedomagała with the effectiveness of competitive judo matches [46] qualify for special measures. In contrast, the results of trials The International Physical Fitness Test qualify for general measures. In the case of the experiments by Chodała [12] (including, to some extent, those by Kisiel [31]), Bukowiecka [15] and Tomczak [14], the primary frame of reference is effectiveness during hypothetical military or police interventions. Consequently, the results of TFs, in the language of sports theory qualify for special measures. However, Tomczak [14] assessed these competencies within the framework of the 'survival multidisciplinary competition', one of the three parts (competitions) of which was TFVP. Thus, the outcome of these fights was one of the main objectives of the inter-agency (military-police) combat sport. If the 'survival multidisciplinary competition' as a whole is regarded as one of the methods of preparation for intervention operations, then special measures should include (in accordance with the cited sports theory [45, 37]) not only TFVP but also paintball battle. However, in the case of target measures 800 m run ending with shooting – the target at the shooting range does not simulate an opponent during a paintball battle [14, 49]. Meanwhile, in the experiments by Syska [19] and Szajerski [7], the primary frame of reference for TFVP results is effectiveness during a hypothetical counteraction to interpersonal physical aggression; that is, there are no closer links to the terminology of sports theory. Nevertheless, classifying TFVP as a special measure is justified if the analysis of self-defence training is based on the sports theory terminology cited in this paper [45, 47].

The universal language of praxeology (the science of effectively achieving the goals of all mental and physical work) makes a clear distinction between 'possibility of action' – the strength, intellectual or manipulative prowess, knowledge (skill) and willingness sufficient to perform a given action [50]. The methodological criteria for measuring this phenomenon relate to 'dispositional feasibility'. It is difficult to assign either the result of any single TFVP or that of several or even a dozen or so to any of the components of the definition of 'possibility of action'. Rather, each form of TFs is, in a sense, a synthetic criterion of 'possibility of action', which only appears to relate to predicting success in actions associated with hand-to-hand combat. The findings of Niedomagała's [46] long-term observations confirm this conclusion, which at first glance appears to be the only valid one. Meanwhile, the findings of Stanisław Dadeła's research [51, p. 78] on the professional competencies of security personnel, based on a complementary approach, provide evidence that only the TFVP scores correlate statistically significantly with each of the other six generalised factors of these competencies (theoretical and practical preparation, professional activity, morphological characteristics, physical fitness, psychological characteristics, and supervisor's assessment). The implications regarding the predictive value of TFs extend beyond both the physical activity paradigm and interpretations based on the language of sports theory – that is, associating TFs results exclusively with some form of hand-to-hand combat (particularly a specific combat sport or self-defence).

From a praxeological perspective, 'dispositional feasibility' is verified by 'situational actionability', and such methodological criteria should encourage flexible interpretations of phenomena related to the measurement of 'dispositional feasibility' and those that are either also correlated with 'situational actionability', or account for a significant proportion of the unexplained variance. Since Dadeła's observations revealed a correlation between TFVP results and the other groups of factors determining the professional competence of security staff [51, p. 78], then, in my view, it is precisely the hand-to-hand combat score evaluated on the basis of simple measures of performance that encapsulates a component which subtly permeates each of the (analytically) identified elements intersubjectively recognised as key to this profession. This conclusion regarding the professional competences of security personnel, in a sense, ties in with the interpretation offered by the authors of a study which analyses, amongst other things, the results of Chodała's experiment using the TFVP and TFHP. They cite the example of the successful repulsion of an assailant's attack during the assassination attempt on US President Ronald Reagan in 1981. The assailant managed to fire six shots from a revolver within 2.8 seconds, after which he was easily knocked to the ground and subdued by the President's bodyguards, who pinned him to the ground [17]. This incident (assuming that the professional competence of the US President's bodyguards meets the highest standards of 'dispositional feasibility') is an example of the fulfilment of the criteria of 'situational actionability' and, at the same time, evidence of the complete (dispositional feasibility and situational actionability) possibility of action [50].

It is not only in the light of this incident that the controversy surrounding the interdependence between the effectiveness of TFs and the general physical fitness seems naive. However, from a methodological perspective, the problem concerns the indicators on which the assessment of general physical fitness. Therefore, the standardisation of criteria for measuring this phenomenon [52] – not least with a view to predicting success in self-defence – is of crucial importance in research into human motor potential within the broader context of the possibility of action.

5. Conclusions

A significant interpretative limitation is the absence in these secondary analysis results of the S-Index (proportion of scuffles won), which provides more accurate information on 'dispositional feasibility' within the framework of evaluating 'possibility of action'. However, social acceptance of the escalation of bloody spectacles shows that fighting without weapons can pose a deadly threat, especially in the absence of any external control. Therefore, the key practical issues are, on the one hand, the necessary work on clarifying the legal criteria for necessary defence and, on the other hand, improving methods of compensating for the shortcomings of self-defence education based on hand-to-hand combat systems. In situations of extreme danger, the use of verbal-motor self-defence support measures would prevent possible abuse.

Acknowledgements

I would like to thank the experts Andrzej Chodała and Roman M. Kalina for their valuable comments during the editing of this paper.

Data Availability Statement: not applicable

Source of support: not applicable

Conflicts of Interest: The author declares no conflicts of interest.

References

1. Kruszewski M, Kruszewski A, Niedomagała W. Innovative method for predicting the chances of effective self-defence against physical aggression among children and adolescents based on the results of testing fights in a vertical posture. Arch Budo J Inn Agon 2024, 20: 270-286
2. Kruszewski M, Niedomagała W, Klimczak J et al. Methodological and mental distance to the dissemination of vertical test fights between girls and boys – the perspective of rational preparation of children and adolescents to counteract physical interpersonal aggression. Human Factors in Design, Engineering, and Computing, Vol. 159, 2024, 1460-1470
3. Kruszewski A, Kruszewski M. The Potential Hand to Hand Combat Focus on Attractiveness, Health, Education for Peace, and Personal Security. Human Factors in Sports, Preventive Medicine and Innovative Agonology, Vol. 188, 2025, 52-59 https://doi.org/10.54941/ahfe1006482
4. Kruszewski M. Testing fights in a vertical posture of 11-year-old schoolgirls in round robin system as an example of complementary health and survival education in a modern school. Arch Budo J Inn Agon 2025, 21: 305-325
5. Kalina RM, Jagiełło W, Chodała A. The result of "testing fights in a vertical posture" as a criterion of talent for combat sports and self-defence – secondary validation (part I: the reliability). Arch Budo Sci Martial Art Extreme Sport 2015; 11: 229-238
6. Kalina RM, Jagiełło W, Chodała A. The result of "testing fights in a vertical posture" as a criterion of talent for combat sports and self-defence – secondary validation (part II: the accuracy). Arch Budo Sci Martial Art Extreme Sport 2016; 12; 163-180
7. Szajerski J. Związek efektywności walki w starciu bezpośrednim z rozwojem somatycznym i sprawnością fizyczną dziewcząt w wieku 11 lat. Płock: Bachelor Thesis. Wyższa Szkoła im. P. Włodkowica; 2016. Polish
8. Kalina RM, Ząbek L. Modyfikacja systemu oceny walki wręcz. Przegląd Wojsk Lądowych 1991; 8: 77-81. Polish
9. Kalina RM. Defence biathlon in the utility and sport aspect. In: Kalina RM, Kaczmarek A, editors. Ukierunkowane przygotowanie obronne. Warszawa: PTNKF. Tom 3. 1997: 134-140. Polish
10. Kalina RM. Sporty walki i trening samoobrony w edukacji obronnej młodzieży. Warszawa: Polskie Towarzystwo Naukowe Kultury Fizycznej. Tom 2; 1997. Polish, summary English
11. Sterkowicz S, Chwała W, Ambroży T. Zdolności motoryczne warunkujące rezultaty w teście podstawowej umiejętności samoobrony. In: Korzeniowski L, editor. Kształcenie pracowników ochrony: założenia programowe. Kraków: Liport LFK; 2001: 154-169. Polish
12. Chodała A. Porównanie efektywności dwóch metod treningu fizycznego żołnierzy przygotowywanych do misji „operacje inne niż wojna". Warszawa: PhD thesis. Akademia Wychowania Fizycznego Józefa Piłsudskiego; 2003. Polish
13. Kalina RM, Kruszewski A, Jagiełło W et al. Combat sports propedeutics – basics of judo. Warszawa: Akademia Wychowania Fizycznego; 2003
14. Tomczak A. Ocena przygotowania żołnierzy do działań w warunkach odosobnienia. Wrocław: PhD thesis. Akademia Wychowania Fizycznego we Wrocławiu; 2004. Polish
15. Bukowiecka D. System diagnozowania sprawności fizycznej funkcjonariuszy policji. PhD thesis. Warszawa: Akademia Wychowania Fizycznego Józefa Piłsudskiego; 2005. Polish
16. Chodała A, Kalina RM. Wynik walk według formuły sumo jako prosty sposób weryfikowania trafności testów służących ocenie przygotowania żołnierzy do walki w starciu bezpośrednim. In: Kalina RM, Jagiełło W, editors. Wychowawcze i utylitarne aspekty sportów walki. Warszawa: Akademia Wychowania Fizycznego Józefa Piłsudskiego; 2005: 48-52. Polish

17. Kalina RM, Chodała A, Dadeło S et al. Empirical basis for predicting success in combat sports and selfdefence. Kinesiology 2005; 37(1): 64-73

18. Przybycień R, Sterkowicz-Przybycie K. Program wychowania fizycznego dla klas IV-VI szkoły podstawowej. Sztuka walki Hapkido alternatywa¸ dla tradycyjnego wychowania fizycznego i sportu szkolnego / The curriculum of physical education for grades 4 to 6 of the primary school. Hapkido martial art as an alternative for conventional physical education and sport in schools. Wrocław: BK Wydawnictwo i Księgarnie S. J.; 2005

19. Syska JR. Psychomotoryczne efekty uprawiania przez kobiety nowoczesnych form gimnastyczno-tanecznych z elementami samoobrony. PhD thesis. Warszawa: Akademia Wychowania Fizycznego Józefa Piłsudskiego; 2005. Polish

20. Bukowiecka D, Bukowiecki I, Kalina RM. Metody oceny kompetencji psychomotorycznych policjantów z zakresu działań interwencyjnych. Szczytno: WSPol; 2006

21. Harasymowicz J, Kalina RM. Honourable selfdefence – the theoretical and methodological basis of training. Płock: Wydawnictwo Novum; 2006

22. Kalina RM, Jagiełło W, Wiktorek P. Motor competence in self-defence of students of a detectives' school during their course of studies. Arch Budo 2007; 3(3): 1-6

23. Tomczak A. The "survival multidisciplinary competition" psychomotor competence test as a synthetic tool for modern defence education. Arch Budo Sci Martial Art Extreme Sport 2022; 18: 51-59

24. Klimczak J, Chodała A. The effectiveness of hand-to-hand combat is not determined by the need for a high level of aggressiveness. Arch Budo 2023; 19: 205-212

25. Bugala M, Reguli Z, Cihounkova J. Educational background of security bodies identification in self-defence: study programme Special Education of Security Bodies. In: Kalina RM, editor. Proceedings of the 1st World Congress on Health and Martial Arts in Interdisciplinary Approach; 2015 Sep 17-19; Czestochowa, Poland. Warsaw: Archives of Budo; 2015; 79-84

26. Reguli Z, Bugala M, Vit M. Educational Background of Security Bodies Identification in the Study Programme of Applied Sport Education of Security Bodies. Zvonar M, Sajdlova Z, editors. Proceedings of the 10th International Conference on Kinanthropology: Sport and Quality of Life; 2016: 498-505

27. Vit M, Reguli Z, Sebera M et al. Predictors of children's successful defence against adult attacker. Arch Budo 2016; 12: 141-150

28. Reguli Z. Evolution of approaches in self-defence: from belief through experience to evidence-based self-defence training. Arch Budo 2018; 14: 345-350

29. Shishida F. Counter techniques against Judo: the process of forming Aikido in 1930s. Arch Budo 2008; 4(4): 4-8 40

30. Shishida F. Why can a little lady throw down a strong man using only a finger? The mechanism of soft atemi-waza. In: Kalina RM (ed.) Proceedings of the 1st World Congress on Health and Martial Arts in Interdisciplinary Approach, HMA 2015, 17–19 September 2015,Czestochowa, Poland. Warsaw: Archives of Budo; 2015: 49–58

31. Kisiel M. Związek między wszechstronną i specjalną sprawnością fizyczną studentów szkoły wojskowej. Warszawa: Master thesis. Akademia Wychowania Fizycznego Józefa Piłsudskiego; 2001. Polish

32. Kalina RM. Premises in the methodology of complementary research – innovative reviews: residuals and omitted implications. Arch Budo J Inn Agon 2025, 21:

33. Pilicz S, Przewęda R, Dobosz J et al. Physical Fitness Score Tables of Polish Youth. Criteria for Measuring Aerobic Capacity by the Cooper Test. Warszawa: Studia i Monografie AWF; 2002

34. Jaskólski E, Kalina R: Method of measuring the training load. Fizjoterapia, 2003; 11(3): 57-61

35. Kalina RM. Methodology of measurement, documentation and programming of optimal continuous workload with variable intensity – applications in sports medicine, physiotherapy, geriatrics, health-related training and sport for all. Arch Budo 2012; 8(4): 235-24

36. Tanaka H, Monahan KD, Seals DR. Age predicted maximal heart rate revisited. Journal of the American College of Cardiology 2001; 37(1): 153-56

37. Pollock ML, Gaesser GA, Butcher JD et al: The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. Med Sci Sports Exerc, 1998; 30: 975-991

38. Kalina RM. Innovative Agonology – its Definition, Detailed Theories, General Rule of Struggle, and Laws. Proceedings of the 14th International Conference on Applied Human Factors and Ergonomics (AHFE 2023) and the Affiliated Conferences; 2023 Jul 20-24; San Francisco, USA. Healthcare and Medical Devices. 2023; 79: 272-279; https://doi.org/10.54941/ahfe1003497

39. Kalina RM, Kruszewski A. INNOAGON is an acronym "innovative agonology," but is not synonymous with "science of martial arts". Arch Budo 2023; 19: 193-204

40. Kalina RM. BUDO & INNOAGON – historical complexity but similar missions. Arch Budo J Inn Agon 2024, 20: 1-15

41. Gąsienica Walczak B. Motoryczne, metodyczne i mentalne kwalifikacje studentów fizjoterapii z zakresu bezpiecznego upadania – perspektywa prewencji upadków osób z wadami wzroku, z unieruchomioną lub amputowaną kończyną [PhD dissertation]. Rzeszów: Uniwersytet Rzeszowski, Wydział Medyczny; 2017. Polish

42. Waszkiewicz E. Multidimensional Educational Models Recommended by Innovative Agonology – Examples of Physical Education and Music Education. In: Healthcare and Medical Devices, Vol. 79: Proceedings of the 14th International Conference on Applied Human Factors and Ergonomics (AHFE 2023) and the Affiliated Conferences; 2023 Jul 20-24; San Francisco Marriott Marquis, San Francisco, California, USA. 2023; p. 290-298; https://doi.org/10.54941/ahfe1003499

43. Kruszewski A, Cherkashin I, Kruszewski M et al. Interpretation of Chinese Hand-to-Hand Fighting Systems and Therapeutic Exercises from the Perspective of the INNOAGON Methodology. Human Factors in Sports, Performance and Wellness. 2024; 150: 74-83. https://doi.org/10.54941/ahfe1005292

44. Waszkiewicz E, Kruszewski A, Measurement of Motivation and Qualitative Effects of Physical Effort During Two Motor Learning Sessions With Multifaceted Variation of Goals, Methods, Measures and Tools– Example of Violin Playing and Safe Fall. Human Factors in Design, Engineering, and Computing, Vol. 159, 2024, 1471-1482

45. Sozański H, Śledziewski D (edit.). Obciążenia treningowe: dokumentowanie i opracowywanie danych. Warszawa: RCMSKFiS; 1995. Polish

46. Niedomagała W. The result of "testing fights in a vertical posture" as a selection criterion for professional training of judo sport – prognostic value TFVP. Arch Budo Sci Martial Art Extreme Sport 2016; 12: 181-190

47. Płatonow WN. Obszczaja tieorija podgotowki sportsmienow w olmpijskom sportie. Kijew: Olimpijska Literatura; 1997. Russian

48. Kalina RM, Bagińska J. Language of Innovative Agonology: a Guide in Combining Micro and Macro Scales of Preventive, Therapeutic and Defensive Actions. In: Healthcare and Medical Devices, Vol. 79: Proceedings of the 14th International Conference on Applied Human Factors and Ergonomics (AHFE 2023) and the Affiliated Conferences; 2023 Jul 20-24; San Francisco Marriott Marquis, San Francisco, California, USA. 2023; p. 307-315 https://doi.org/10.54941/ahfe1003501

49. Tomczak A. The "survival multidisciplinary competition" psychomotor competence test as a synthetic tool for modern defence education. Arch Budo Sci Martial Art Extreme Sport 2022; 18: 51-59

50. Kotarbinski T. Traktat o dobrej robocie. 7th ed. Wrocław: Zakład Narodowy im Ossolińskich; 1982. Polish, summary in English and in Russia

51. Dadelo S. Czynniki determinujące kom petencje pracowników ochrony na Litwie. Studia i Monografie. Warszawa: Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; 2005. Polish

52. Kalina A, Kalina RM, Kruszewski A et al. Universal test of possibility of action based on motor potential (UTPA-MP) – health and survival applications. Physical Education of Students 2024; 28(6): 346-361

Author:
Kruszewski Michał: https://orcid.org/0009-0008-6056-754X

Citation: Kruszewski M. Complementary research methodology versus paradoxes of evaluating the effectiveness of hand-to-hand combat systems. Arch Budo J Inn Agon 2025, 21: 326-349