Article original

Failure due to medical unfitness during Marine Commando Course 152

A retrospective study

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Les auteurs ne déclarent pas de conflit d'intérêt.

Les propos tenus dans cet article n'engagent que les auteurs et ne sauraient être considérés comme constituant la position officielle du Service de santé des armées.

Abstract:
The Elementary Marine Commando Course (EMMC) is one of the most challenging in the French military, both physically and mentally, with one of the highest attrition rates: nearly 80 to 90% of trainees are excluded. Among these exclusions, 50% were due to medical reasons according to a 2012 study. The main purpose of this work is to provide a comprehensive overview of the pathologies observed during EMMC 152 (2019) and the related medical unfitness.
Acute traumatic pathologies accounted for 54% of consultations and 64% of medical unfitness statements. Medical conditions accounted for 46% of consultations and 36% of pronounced medical unfitness. The number of medical unfitness cases was higher in 2019 (62%) compared to 2012 (42%) among all trainees. This study allows us to suggest, as a preventive measure, special attention to trainees with recent histories of osteoarticular injuries, as well as to older trainees. Finally, although CrossFit® appears to be good preparation according to our results, further analysis is still necessary before recommending it as appropriate training for the EMMC.

Keywords: CrossFit®. Marine commando course. Medical pathologies. Osteoarticular injuries history. Special forces. Traumatic pathologies. Military medicine.

Résumé :
ÉCHEC SUR INAPTITUDE MÉDICALE
AU COURS DU STAGE COMMANDO MARINE 152
Étude rétrospective
Le Stage commando marine (STAC) élémentaire est l'un des plus difficiles de l'Armée française, que ce soit sur le plan physique ou psychique, avec un taux d'attrition parmi les

plus importants : près de 80 à 90 % des stagiaires sont éliminés. Parmi ces derniers, 50 % l'ont été sur raison médicale en 2012.
L'objectif principal de ce travail est de dresser un tableau complet des pathologies retrouvées lors du STAC 152 pourvoyeuses d'inaptitudes, point de départ indispensable pour envisager une prévention.
Les pathologies traumatiques aiguës représentent 54 % des consultations et 64 % des inaptitudes médicales prononcées. Les pathologies médicales représentent 46 % des consultations et 36 % des inaptitudes médicales prononcées. Le nombre d'échecs pour inaptitude médicale est plus important en 2019 (62 %) qu'en 2012 (42%). Une attention particulière aux stagiaires présentant des antécédents récents de blessure ostéo-articulaire est à porter, ainsi qu'au plus âgés. Enfin, un recul est encore nécessaire pour préconiser le CrossFit® comme préparation à privilégier.

Mots-clés : CrossFit®. Stage commando marine. Pathologies médicales. Antécédents de lésions ostéo-articulaires. Forces spéciales. Pathologies traumatiques. Médecine d'armée.

Introduction

The Elementary Marine Commando Course (EMMC) is designed to select future operators for the French Navy's special forces. It is one of the most demanding courses in the French military, both physically and mentally, and one of the most selective. 80 to 90% of candidates do not complete the course due to insufficient scores, withdrawal, or medical reasons (1). The main reason for failure in the course is medical unfitness ; some cases seem preventable.

In 2012, 50% of eliminated trainees were disqualified due to injuries sustained during the course (1). Most of these injuries were minor, but some might have serious functional consequences and jeopardize the candidate's future in the Armed Forces.

The EMMC lasts 12 weeks. The first three weeks are purely dedicated to selection : candidates are challenged to their maximum physical and mental endurance.
Physically, most of the course takes place outdoors (including nights), with sleep duration ranging from zero to three hours per night, and all movements are conducted at a military jogging pace. The exercises include timed obstacle courses, timed marches and runs ranging from 4 to 30km, aggressivity tests, and waterborne activities in temperatures ranging from 8 to 18° C, depending on the season. The entire course is conducted in combat uniform and Rangers boots, except for the nautical activities. Additionally, no protective equipment is used, especially during the obstacle courses.

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Mentally, trainees are under important stress due to these imposed physical conditions, the constant pressure from instructors, and the uncertainty of the upcoming activities. No contact with the outside world is allowed.

Although few studies focus on the selection courses for special forces operators, the EMMC appears to be one of the courses with the highest attrition rates due to injury among military courses for which medical data has been published (2–7).

The main objective of our study is to comprehensively document the pathologies (nature, location, circumstances of occurrence) observed during EMMC 152 (2019) and the resulting unfitness. This study serves as a starting point for a preventive approach.

1 Materials and Methods

1.1 Study Population

The initial 67 trainees of EMMC 152, which took place from September to October 2019, were included in this retrospective study. This study was approved by the Clermont-Tonnerre Military Hospital local review board.

1.2 Data Gathering

Data was systematically gathered from the trainees' medical records (both electronic and paper) during the course period and from epidemiological monitoring forms systematically filled out by the medical team responsible for managing injuries during the EMMC.

Individual data collected included : age, height, weight, duration of service, and types of physical activities practiced in preparation for the EMMC.

Data related to each medical event were collected : diagnosis, location, and resulting medical unfitness. A distinction was made between acute traumatic pathologies (linked to a specific event) and medical pathologies (not linked to a specific event) at the time of data collection. In the case of acute trauma, the type of exercise or equipment, if it involved an obstacle course, was also recorded, as well as the ground condition (slippery or dry). Various medical events were classified according to table 1.

Tab. 1 : Classification of medical events

Acute traumatic conditions	Medical conditions
Osteoarticular injuries (sprains, fractures and dislocations)	Chronic wounds
Musculotendinous injuries	Microtraumatic pathologies
Contusions	Hypoglycemia
Acute wounds and burns	Hypothermia
Acute ENT (ear, nose, and throat) conditions	Chronic ENT conditions
	Other medical conditions
	Lower back pain

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1.3 Data Analysis

Data analysis was performed using Excel and JASP software (version 0.9.2, 2018).

Descriptive statistics were applied, with the incidence of each pathology calculated over the EMMC period (12 weeks).

For comparisons, relative risk was calculated with a 95% confidence interval.
The study of factors influencing the occurrence of traumatic and medical pathologies in the EMMC 152 (2019) trainee population was conducted using contingency tests (CHI2 or Fisher's test) for categorical variables and T-tests after normality and homogeneity tests for numerical variables.

2 Results

2.1 Description of the Study Population

The average age (standard deviation) of the candidates is 22.7 (±2.7) years.
The average height is 179 (±6.2) cm, average weight is 77 (±7.3) kg, and the average BMI is 24.1 (±1.8) kg/m².

Almost half of the trainees (46.3%) undergo the course for the second time.
The average length of service is 30.3 (±24.9) months.

2.2 Consultations and Outcomes

Out of 67 trainees, 13 (19%) were certified, 42 (62%) failed due to medical unfitness, 11 (17%) failed due to insufficient scores or inappropriate behavior, and one trainee (2%) could not continue for service reasons.

Sixty-two trainees (92%) consulted during the course, representing 91 consultations. Traumatic injuries accounted for 54.5% of consultations compared to 45.5% for medical conditions. The distribution of various types of injuries and the resulting medical unfitness are summarized in table 2.

Tab. 2 : Distribution of various medical injuries and resulting declared medical unfitness

	Number of consultations (% of total consultations)	Declared medical unfitness (% of total unfitness)
Total	91	42
Acute injuries	50 (54%)	27 (64%)
Osteoarticular	10 (11%)	10 (24%)
Musculotendinous	9 (10%)	7 (1%)
Contusions	16 (18%)	8 (19%)
Wounds	12 (13%)	1 (2%)
Acute ENT	3 (4%)	1 (2%)
Medical conditions	41 (46%)	15 (36%)
Chronic wounds	21 (23%)	4 (11%)
Microtrauma	14 (15%)	10 (23%)
Hypoglycemia	2 (2%)	0 (0%)
Hypothermia	1 (1%)	0 (0%)
Chronic ENT	1 (1%)	0 (0%)
Other medical conditions	2 (2%)	1 (2%)
Lower back pain	0 (0%)	0 (0%)

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2.3 Acute Traumatic Pathologies

These account for 54% of consultations and 64% of declared medical unfitness cases.

- Osteoarticular injuries include nine sprains and one shoulder dislocation, all resulting in medical unfitness. Eight out of nine sprains affected the lower limbs (five at the knee, three at the ankle, and one at the wrist). Three cases of prior sprains were noted in the year preceding the course. In nine out of ten cases, an obstacle course was involved. There was no significant difference between wet or dry ground conditions in the occurrence of sprains (p=0.180).
- Musculotendinous injuries led to nine consultations resulting in seven medical declarations of unfitness. They affected both lower and upper limbs equally (with one trainee consulting twice for the same injury). In five out of eight cases, an obstacle course was involved, and three injuries took place during a military march.
- Contusions led to sixteen consultations, resulting in eight medical declarations of unfitness. Eight cases affected the lower limbs, five affected the upper limbs, and two involved head injuries. Unfitness declarations included the two head injuries, five of the lower limb injuries, and one upper limb injury. In nine out of ten documented cases, an obstacle course was the cause.
- Acute Wounds led to 12 consultations for 17 wounds total. One resulted in medical unfitness. Six wounds affected the trunk, including four friction burns. Five affected the head, five the lower limbs, and one the upper limb (hand). For ten of the wounds, an obstacle course was the cause, with seven resulting from contact with an object causing acute burns.
- ENT conditions included one barotraumatic otitis (OBT) occurring during an aggressivity test ; one declaration of medical unfitness was pronounced. No OBTs occurred during water activities. Two dental fractures were observed, without affecting fitness—one occurred during an obstacle course and the other during a break, when the trainee fell asleep on the barrel of his submachine gun.

2.4 Medical conditions

These conditions represent 46% of consultations and 36% of declared medical unfitness.

- Chronic wounds were represented by 21 consultations, which led to four declarations of medical unfitness (two erysipelas and two tendon sheath infections). Twelve wounds affected the upper limb, including nine hand wounds. Eight affected the lower limb, including seven foot wounds.
- Microtraumatic pathologies were represented by 14 consultations, resulting in 10 declarations of medical unfitness. Thirteen of these cases affected the lower limbs. In 50% of cases, a prior related condition from the year before the course was identified.
- Two hypoglycemias were confirmed by capilar blood testing, but none led to medical unfitness.
- One hypothermia was diagnosed through rectal temperature, with no resulting unfitness.

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- ENT conditions were represented by one case of angina, with no unfitness declarations pronounced.
- Other medical conditionswere represented by one case of exertional malaise with no specific medical cause identified, resulting in a declaration medical unfitness, and by one case of occular trauma from a fall in the mud, with no medical unfitness declared.

2.5 Traumatic History in the Past Year and Outcomes

Out of 25 trainees with at least one history of injuries in the year preceding the course, 11 (44%) sustained an injury related to this previous episode, resulting in a statement of unfitness. This represents 26% of the total declarations of unfitness. For the remaining trainees, five (20%) turned out unfit for reasons unrelated to previous history, and nine (36%) showed absence of prior medical unfitness.

2.6 Factors Leading to Medical unfitness

We analysed the relationship between various factors (age, BMI, weight loss during the course, prior experience with the EMMC, length of service, sports practiced, ground conditions) and the occurrence of acute trauma, specifically sprains, as well as the occurrence of medical conditions, specifically microtraumatic pathologies, resulting in medical unfitness.

We considered trainees aged 28 and older and compared them with younger trainees, as was done in the 2012 study (1) to allow for comparison of results. We also separated trainees who were overweight (BMI > 25) from the others, trainees who lost more than 1 kg during the EMMC, and those undergoing EMMC for the first time. The results are summarized in table 3. Among these factors, two have a significant impact on medical unfitness : they are more frequent among trainees attempting the EMMC for the first time, and sprains are proportionally more likely to result in medical unfitness among trainees aged 28 or older.

Regarding length of service, there is no significant difference in the occurrence of unfit cases or outcomes between trainees with a length of service of 30 months or less (the average duration of the first contract) and those with a length of service exceeding 30 months.

We did not find a significant link between ground condition (wet or dry) and the incidence of unfitness.

Finally, regarding the type of physical activities undertaken by the trainees in preparation for EMMC, CrossFit® was significantly more practiced ($p<0,01$) by certified trainees (78%) than by those deemed unfit (40%) or eliminated (17%). There is no significant difference in outcome for trainees in other sports categories – endurance, strength sport, combat sport, nautical sports, or specific EMMC training – (see figure 1).

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Tab. 3 : Studied predictive unfitness factors for the course

Unfitness depending on age (n=67)	Age < 28 years *n*=63	Age ≥ 28 years *n*=4	*p*
Medical unfitness	39 (62%)	3 (75%)	0,6
For acute trauma	25 (40%)	2 (50%)	0,683
Including sprains	7 (11%)	2 (50%)	0,027
For medical conditions	14 (22%)	1 (25%)	0,897
Including microtrauma	10 (16%)	0 (0%)	0,560
Unfitness depending on BMI (n=67)	BMI <25 *n*=45	BMI≥25 *n*=22	*p*
Medical unfitness	28 (62%)	14 (64%)	0,911
For acute trauma	17 (38%)	10 (45%)	0,547
Including sprains	7 (15%)	2 (9%)	0,466
For medical conditions	11 (24%)	4 (18%)	0,564
Including microtrauma	8 (18%)	2 (9%)	0,349
Unfitness depending on weight loss (n=64)	Weight loss <1kg or no loss *n* =42	Weight loss ≥1kg *n*=22	*p*
Medical unfitness	30 (71%)	12 (55%)	0,293
For acute trauma	19 (45%)	8 (36%)	0,564
Including sprains	4 (10%)	5 (23%)	1,266
For medical conditions	11 (26%)	4 (18%)	0,161
Including microtrauma	8 (19%)	2 (9%)	0,656
Unfitness depending on previous EMMC experience (n=67)	1st try *n*=36	≥ 2 tries *n*=31	*p*
Medical unfitness	28 (78%)	14 (45%)	0,006
For acute trauma	17 (47%)	10 (32%)	0,213
Including sprains	6 (17%)	3 (10%)	0,906
For medical conditions	11 (31%)	4 (13%)	0,084
Including microtrauma	6 (17%)	4 (13%)	0,666

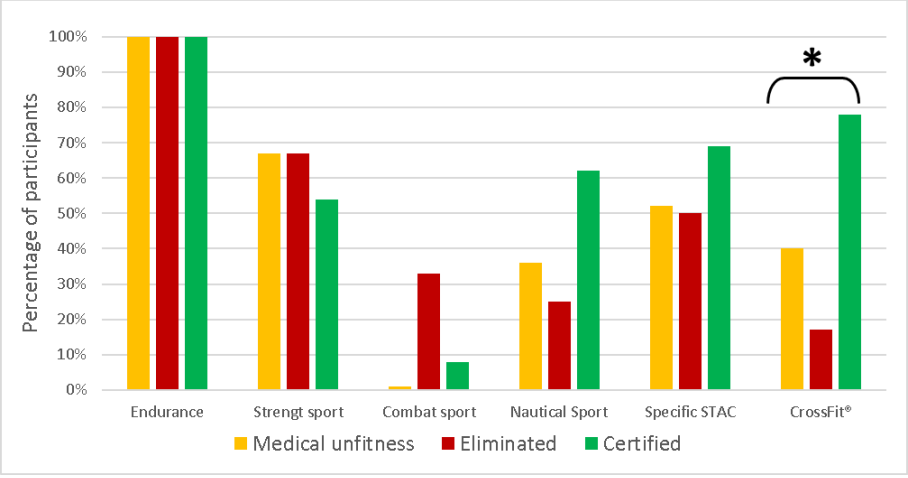


Fig. 1 : Undertaken physical activity before EMMC and outcome for the trainees
**significant difference, p< 0,05*

3 Discussion

The overall incidence of EMMC trainees consulting for medical condition or traumatic injury during the course period is higher in 2019 (92%) than in 2012 (77%). The number of medical unfitness is also higher in 2019 (62%) compared to 2012 (42%) (1). However, the distribution of injuries remains similar between 2012 and 2019, with 45.5% of medical conditions in our study compared to 48.6% in 2012, and 54.5% of traumatic injuries compared to 51.4% in 2012 (injury classification remains the same between 2012 and 2019).

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In France, a study (2) regarding trainees from the Centre national d'entraînement commando (CNEC), national commando training Center of the land Forces, which is comparable in some aspects to EMMC trainees, found a medical unfitness rate of 29% during consultations for acute traumatic pathologies, compared to 54% in our study and 48% in 2012. This difference may be explained by variations in the duration and content of the courses.

Abroad, for courses of equal duration in other armies (12 weeks), three studies—one Danish (3) and two American (4,5)—report injury incidence rates of 28%, 39.6%, and 46%, respectively, with the percentage of acute injuries among all injuries ranging from 22% to 35%. If we consider that the injuries in our study include acute injuries (44), chronic wounds (19), and microtraumatic pathologies (14), their incidence is much higher among EMMC trainees (77 injuries for 67 trainees, or 114 injuries per 100 trainees) than in these foreign studies. However, these three courses represent initial military training (for new recruits), unlike our course, which involves seasoned trainees. The greater difficulty of the course aimed at seasoned personnel, compared to new recruits, and their more intense engagement in the course could explain the higher occurrence of injuries.

For courses of equal intensity in other Armies, a study (6) among candidates for the U.S. Navy SEALs (Sea, Air, and Land), the special forces of the U.S. Navy, found an incidence of 61.4 pathologies per 100 recruits per month, divided into 31.7% medical conditions and 29.7% musculoskeletal injuries. In this 32-week course – the first 8 weeks being devoted solely to physical preparation – intended for seasoned fighters, the overall incidence of injuries is higher than those concerning mere recruits. This can be explained by the physical and mental intensity required of the candidates, similar to the EMMC in France, in order to select an elite group. The choice of pathologies collected is comparable to that of our study, but we cannot compare the incidence of pathologies encountered because the incidences in our study are calculated by course duration (12 weeks) and not by month, as injuries are not evenly distributed throughout the EMMC.

There is a significant disparity in the results between different studies regarding the incidence of injuries, with some courses showing a variation as much as twofold.
However, comparisons remain challenging due to differences in the definitions of the pathologies recorded, the "initial" nature of some courses, and varying durations for others. Moreover, comparison is even more complicated to make due to the limited number of studies addressing what occurs during the selection of special forces operators.

Nevertheless, the incidence of injuries seems to be correlated with the difficulty of the course despite the military experience of the trainees, as suggested by our study and the 2012 study on the EMMC, both of which report a particularly high incidence of injuries compared to other courses that have been studied and published.

Strains and microtraumatic injuries are of special concern.

Forty-four percent of trainees with prior traumatic injury proved unfit for medical reasons related to that injury.

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Among those candidates, 91% of declared unfitness were related to micro traumatic conditions or sprains. Efforts should therefore be made to prevent these injuries.

More specifically, 33% of sprains were related to an incident from the previous year (37.5% in 2012), as well as 50% of micro traumatic pathologies. Prior injuries are clearly identified as a risk factor for new injuries in several studies conducted in both military ad civilian context (8,9,10). In a study conducted in CNEC from 2002 to 2003 (10) evaluating the efficiency of an injury prevention program, Germain finds prior related injuries in 40% of failures, in keeping with our study.

Finally, it should be noted that for trainees aged 28 and older, there is an overrepresentation of certificates of unfitness due to sprains ($p<0.05$), however none of these candidates had a record of prior related injury.

Regarding the treatment of sprains, patient follow-up, rehabilitation and gradual physical reconditioning seem essential in order to lower the risk for new injuries.
A six-month minimum systematic certificate of unfitness to undergo the EMMC after a sprain could be suggested in the light of several arguments :

- The healing process of a ligament can last up to 8 weeks (11) ;
- Rehabilitation, the duration of which should be established depending on individual progress, a precise duration being therefore impossible to determine. However, a 2003 literature review finds an average duration of six to ten weeks for grade A studies (12). This finding was added in 2000 to the French Good Practice Recommendations (13), with the formulation of several criteria to be met to allow for a gradual return to usual physical activities. An indicative duration of 8 weeks was also suggested ;
- The duration of gradual reconditioning, which should be coordinated with instructors in Military and Sports Physical Training (MSPT), who are now trained in this type of recovery after injury (14) ;
- The duration of retraining, specific to the preparation for the EMMC, which should also be carried out with the MSPT instructors. This retraining should be a prerequisite for restoring fitness for the course.

Concerning microtraumatic pathologies, we also recommend systematic incapacity for four to six months in view of the elements previously cited and applied to tendinopathies.

Is CrossFit® recommended for EMMC preparation ?

In our study, a significant difference emerged regarding the practice of CrossFit® : 78% of those who were certified had practiced it at the EMMC, compared to 40% among those deemed unfit and 17% among those who were eliminated. CrossFit® is a relatively new sport, created in the 1970s in the United States, and has been experiencing one of the fastest expansions since the 2000s (15,16). This sport combines gymnastics, endurance, weightlifting, and powerlifting exercises (16) in short and intense sessions (one hour). It appears to be a well-rounded sport and, therefore, potentially a good method of preparation for the EMMC. Indeed, the activities and challenges of the EMMC require a variety of physical skills that are developed through CrossFit®.

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Several studies have gone over that subject. A consensus (17) produced by the American College of Sports Medicine in association with the Consortium for Health and Military Performance warned in 2011 about the potential emergence of a high injury risk for the then very recent CrossFit®. However, Poston (18), in 2016, concluded that the risk of injury was similar to or lower than that of traditional military sports activities, and that it was effective in improving the physical condition of military personnel while reducing the training volume of other sports. This reduction was also deemed beneficial as it decreased the risk of injuries by shortening the duration of sports sessions. More recently, a 2018 meta-analysis (15), aimed at analysing the results of scientific literature related to this recent sport, was unable to reach a consensus on the direction of injury risk, particularly musculoskeletal injuries. This is due to the lack of high-evidence-level studies with a low risk of bias available.

Further time appears necessary before CrossFit® can be recommended for preventing injuries during the EMMC.

There are some limitations in our study.

Our study was conducted within a small sample. Originally planned for two sessions, the March-May 2020 session was unfortunately cancelled due to the SARS-CoV2 epidemic. This results in a lack of statistical power. No previous data exists to date, except for the 2012 study (1).

Recruitment biases should be noted :

- Tolerance to pain or functional impairment varies among individuals. Some trainees may be reluctant to see a doctor out of fear of being excluded from the course. For these reasons, for the same injury, some trainees will seek medical advice, while others will not, leading to a bias in the incidence of reported pathologies, but not in the incidence of declared medical disqualifications.
- Some trainees may want to leave the EMMC and prefer a medical disqualification over requesting a voluntary withdrawal from the instructors. Thus, some consultations may be motivated by the desire to withdraw under the guise of a medical reason. Our study, therefore, only considers the pathologies for which the personnel sought medical consultation, at the time they consulted.

There is a measurement bias as trainees consulted multiple doctors, and the care provided was not standardized.

There is a selection bias in our study, which only focused on the September-October 2019 session (considered summer). The March-May 2020 session (considered winter) was cancelled, which may have led to an underestimation of the incidence of certain winter-dominant pathologies.

Conclusion

The Elementary Marine Commando Course (EMMC), which selects the future operators of the French Navy's special forces, is one of the most challenging courses in the French armed forces. Medical disqualifications appear to be more frequent than in other courses described in the cited studies.

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Our study identifies previous osteoarticular injuries as a key concern and emphasizes the importance of initial care, rehabilitation, reconditioning, and specific re-training for the EMMC—essential prerequisites to reduce the risk of recurrence during the course. Special attention should also be given to older trainees in this regard.

While more time is needed to recommend CrossFit® as the preferred preparation method, the results and the relatively recent emergence of this practice suggest that this avenue is worth exploring.

We have sought to identify elements to improve the selection and preparation of trainees. This selection and preparation should optimize success in the course, both from an institutional and individual perspective, without lowering the course's standards.

Finally, it would be beneficial to monitor this specific population of Marine Commando course trainees to track the evolution of encountered pathologies in relation to changes in the course content. A systematic data collection process could be proposed for this purpose, which would increase the statistical power in case of future studies and allow for the immediate proposal of preventive measures to the command.

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