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RESEARCH ARTICLE (ORIGINAL)

Effectiveness of prehospital nursing interventions in stabilizing trauma victims

Eficácia da intervenção da enfermagem pré-hospitalar na estabilização das vítimas de trauma

Eficacia de la intervención de enfermería prehospitalaria en la estabilización de víctimas de traumatismos

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Abstract

Background: Trauma is a public health issue with a significant social and economic impact. However, national data on its characterization and the role of nursing in its management is still scarce.

Objective: To assess the effectiveness of prehospital nursing interventions in stabilizing trauma victims provided by nurses of Immediate Life Support Ambulances in Portugal.

Methodology: Observational, prospective, and descriptive-correlational study. Data were collected by nurses of the Immediate Life Support Ambulances in mainland Portugal, from 01/03/2019 to 30/04/2020, and the Azores, from 01/10/2019 to 30/04/2020. Trauma severity indices were assessed before and after the nursing interventions.

Results: This study included 606 cases (79.4% blunt trauma; 40.8% road accidents) reported by 171 nurses. Nurses performed mostly interventions for hemodynamic support (88.9%) and non-pharmacological pain control (90.6%) of trauma victims. The nursing interventions improved the Revised Trauma Score and the Shock Index (p<0.001).

Conclusion: Prehospital nursing interventions improve trauma victims' clinical status.

Keywords: wounds and injuries; trauma severity indices; health impact assessment; nursing care; Portugal

Resumo

Enquadramento: O trauma é um problema de saúde pública com considerável impacto social e económico. Contudo, a evidência nacional sobre a sua caracterização e o papel da enfermagem na sua gestão é ainda escassa.

Objetivos: Avaliar a eficácia da intervenção de enfermagem na estabilização da pessoa vítima de trauma, prestada pelos enfermeiros das Ambulâncias de Suporte Imediato de Vida em Portugal.

Metodologia: Estudo observacional, prospetivo e descritivo-correlacional. Dados colhidos pelos enfermeiros das Ambulâncias de Suporte Imediato de Vida de Portugal continental, de 01/03/2019 a 30/04/2020, e nos Açores, de 01/10/ 2019 a 30/04/2020. Avaliaram-se índices de gravidade do trauma antes e após as intervenções dos enfermeiros.

Resultados: Incluíram-se 606 casos (79,4% trauma fechado; 40,8% por acidentes rodoviários) reportados por 171 enfermeiros. Para gerir as vítimas de trauma, o enfermeiro realizou maioritariamente intervenções de suporte hemodinâmico (88,9%) e de controlo não-farmacológico da dor (90,6%). A intervenção dos enfermeiros melhorou os índices de gravidade RTS e SI (p < 0,001).

Conclusão: A intervenção pré-hospitalar dos enfermeiros melhora o quadro clínico das vítimas de trauma.

Palavras-chave: ferimentos e lesões; índices de gravidade do trauma; avaliação do impacto na saúde; cuidados de enfermagem; Portugal

Resumen

Marco contextual: Los traumatismos son un problema de salud pública con un considerable impacto social y económico. Sin embargo, los datos nacionales sobre su caracterización y el papel de la enfermería en su gestión son todavía escasos.

Objetivos: Evaluar la eficacia de la intervención de enfermería en la estabilización de la víctima de traumatismo, proporcionada por los enfermeros de las Ambulancias de Soporte Vital Inmediato en Portugal.

Metodología: Estudio observacional, prospectivo y descriptivo-correlacional. Datos recogidos por los enfermeros de las Ambulancias de Soporte Vital Inmediato de Portugal continental del 01/03/2019 al 30/04/2020, y en las Azores del 01/10/2019 al 30/04/2020. Se evaluaron los índices de gravedad de los traumatismos antes y después de las intervenciones de los enfermeros.

Resultados: Se incluyeron 606 casos (79,4% traumatismos cerrados; 40,8% por accidentes de tráfico) notificados por 171 enfermeros. Para tratar a las víctimas de traumatismos, el enfermero realizó principalmente intervenciones de soporte hemodinámico (88,9%) y de control no farmacológico del dolor (90,6%). La intervención de los enfermeros mejoró los índices de gravedad de RTS y SI (p < 0,001).

Conclusión: La intervención prehospitalaria de los enfermeros mejora el cuadro clínico de las víctimas de traumatismos.

Palabras clave: heridas y traumatismos; índices de gravedad del trauma; evaluación del impacto en la salud; atención de enfermería; Portugal

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Introduction

Trauma is a major public health issue, accounting for 5.8 million deaths globally (Mock et al., 2009). In Portugal, in 2018, more than 10% of emergency department (ED) visits were due to accident-related injuries, and 3,137 people died (Instituto Nacional da Estatística – Statistics Portugal [INE], 2020). Trauma-related injuries have a significant social and economic impact because, for each death, there are dozens of hospitalizations, hundreds of ED consultations, and thousands of medical consultations (Parreira et al., 2017). Trauma also causes substantial morbidity and a large number of sequelae.

Prehospital care teams provide rapid, high-quality emergency responses for which trained human resources are required (Alarhayem et al., 2016) to implement effective and efficient measures.

In 2007, as part of the Emergency Requalification Process, the Ministry of Health created a new prehospital care service: the Immediate Life Support Ambulances (ILSA). These ambulances are operated by a nurse, who is the team leader, and a prehospital emergency technician. Among other situations, these teams provide prehospital care to victims of accidents or sudden illness, differentiated support in ED care delivery, and inter-hospital transportation of critically ill patients through an equally differentiated response (Despacho n.º 5561, 2014).

As team members, nurses have become key pillars of prehospital emergency care. However, after more than ten years of existence, no study has been published on the effectiveness of these teams' interventions, which are also omitted in the official reports on the delivery of services by the National Health System.

In view of the above, this study aims to assess the effectiveness of prehospital nursing interventions by ILSA nurses in stabilizing trauma victims in Portugal.

Background

Trauma is the leading cause of death among people aged 1-44 years, with most deaths occurring in men (American College of Surgeons [ACS], 2012; INE, 2020). It can be understood as a disease that involves an exchange of energy between the environment and the body, resulting in injuries to body organs and systems (Parreira et al., 2017). Approximately 50% of trauma-related deaths result from hemorrhagic shock, which is potentially preventable (Brinck et al., 2016). The impairment of vital functions associated with trauma causes inadequate tissue oxygenation through the conventional aerobic metabolism (D'Alessandro et al., 2017; Johnson et al., 2017). The metabolic changes resulting from decreased oxygen perfusion contribute to physiological exhaustion that takes the victim into a vicious cycle called Lethal Triad: metabolic acidosis, hypothermia, and coagulopathy (Johnson et al., 2017).

Trauma mortality follows a trimodal distribution, that is, with three major peaks: the first peak occurs in the first seconds to minutes following trauma due to fatal injuries, and only prevention can reduce it; the second peak occurs minutes to several hours after trauma, resulting in potentially fatal injuries if there is no intensive care; the third peak occurs several days to weeks after trauma due to multiple organ complications. Healthcare plays a more significant role in avoiding the second and third peaks (Alvarez et al., 2016; ACS, 2012).

The international scientific literature on prehospital care highlights the interventions developed by professionals other than nurses, often because nurses are not those who provide this type of care in several countries. On the other hand, prehospital nursing itself also tends to direct its practices to the health/disease dichotomy and interdisciplinary actions (Mota, Cunha, Santos, Cunha, et al., 2019), ultimately contributing to the non-affirmation and differentiation of intervention fields valued by victims, families, and society.

It should be noted that, like Portugal, many countries such as Sweden, Finland, Belgium, England, Wales, Spain, or the Netherlands include nurses in prehospital emergency care services (Soren et al., 2015). Nurses who work in prehospital care play a key role in assessing the victims' illness and injury and treating them, seeking an optimal level of care, and creating conditions for the implementation of care based on individual patient needs (Soren et al., 2015). Prehospital nursing is a major part of emergency care in many health organizations worldwide, and nurses are responsible for providing first aid and treatments and accompanying the victims prior to hospital admission. Prehospital nurses are required throughout the care process, at the emergency site and in the ambulance, to monitor and assess the victims' overall status, as well as to provide appropriate nursing care and treatments (Soren et al., 2015; Mota, Cunha, Santos, Cunha, et al., 2019).

The assessment of the quality of prehospital care should, therefore, not focus exclusively on mortality or morbidity rates but rather operationalize plans for the adoption of other priorities such as managing pain, cold, adverse events, fear, family, and all variables that compromise health dimensions (Mota, Cunha, Santos, Cunha, et al., 2019). In Portugal, the practices and outcomes of prehospital nursing interventions to trauma victims are still understudied.

Research Questions

What are the characteristics of the trauma victims treated by ILSA nurses?

What is the impact of nursing interventions on improving the clinical status of trauma victims treated by ILSA nurses in a prehospital context?

Methodology

An observational, prospective, and descriptive-correlational study was carried out with a sample of trauma victims cared for in mainland Portugal between 1 March 2019 and 30 April 2020, and in the Azores Archipelago,

between 1 October 2019 and 30 April 2020. Inclusion criteria were being trauma victims aged over 18 years; treated by ILSA nurses, without direct interference from other professionals; victims of blunt or penetrating trauma. Exclusion criteria were being trauma victims who presented cardiorespiratory arrest at some point; victims of injuries caused by burns or poisoning.

Data were collected by the nurses who provide care in the ILSA of the North, Central, and South delegations of the National Institute of Medical Emergency (*Instituto Nacional de Emergência Médica*, INEM) and in the ILSA of the Regional Civil Protection and Firefighters Service of the Azores (*Serviço Regional de Proteção Civil e Bombeiros dos Açores*, SRPCBA). All nurses participated voluntarily and signed the informed consent form.

The participating nurses completed the Socioprofessional Questionnaire of the Prehospital Nurse (*Questionário Socioprofissional do Enfermeiro do Pré-Hospitalar*) and applied the Clinical Form of the Victim Receiving Prehospital Care (*Ficha Clínica da Vítima Socorrida no Pré-Hospitalar*). The main researcher provided specific training to the nurses to teach them how to fill out the clinical form to standardize data collection and, consequently, reduce the risk of bias.

The following variables were included to characterize the victims and their clinical status: age, gender, injury site, type of injury and injury mechanism, response and transport time, interventions administered, and trauma severity indices. These indices for assessing the severity of the victims were applied before and after the nurses' interventions. For this purpose, the Revised Trauma Score (RTS), the Shock Index (SI), and the Mechanism, Glasgow Coma Scale, Age, and Arterial Pressure (MGAP) score were applied. RTS is a physiologic-based score that provides a neurological evaluation, through the Glasgow Coma Scale, and a hemodynamic evaluation by systolic blood pressure and respiratory rate, ranging from 1 to 12. Higher scores indicate a higher likelihood of survival (Champion et al., 1989; Gabbe et al., 2003). SI is used for the early detection of severe hypovolemia. Higher scores indicate greater severity (Cannon et al., 2009; Mutschler et al., 2013). According to Mutschler et al. (2013), SI can be divided into four strata: I - *no shock* (SI <0.6); II - *mild shock* (SI ≥0.6 and <1.0); III - *moderate shock* (SI ≥1.0 and <1.4); and IV - *severe shock* (≥1.4). Finally, MGAP incorporates the Glasgow Coma Scale, systolic blood pressure, age, and injury mechanism, ranging from 3 to 29. Three severity levels are defined: *low-risk* (23-29 points), *moderate-risk* (18-22 points), and *high-risk* (<18 points; Sartorius et al., 2010).

The nursing interventions were divided into seven major groups: life support measures (airway aspiration, mandibular subluxation, head extension, oropharyngeal airway insertion, manual ventilation and oxygen therapy); hemodynamic support measures (intraosseous access, placement of one or more peripheral venous catheters, administration of fluid therapy); warm-up measures (active and passive); pharmacological (morphine, tramadol, midazolam, and paracetamol) and non-pharmacological (cryotherapy, heat therapy, distraction, immobilization, elevation of the injured extremities, and allow the presence of family or friends) pain relief measures; wound treatment; and immobilization techniques.

For the demographic and professional characterization of the nurses who helped the victims (and collected the data), the variables under study were age, gender, length of service, length of service as a prehospital nurse, and academic and professional qualifications.

The study is part of the project *Evidências para Não Arriscar Mais Vidas: do pré-hospitalar ao serviço de urgência e à alta* (MaisVidas; Evidence not to Risk More Lives: from the prehospital to the emergency department and discharge), reference: PROJ/UniCISE/2017/0001 and obtained a favorable opinion from the Health Ethics Committee of the Tondela-Viseu Hospital Center on 21 May 2018. It also received the assent of INEM on 25 January 2019 and the SRPCBA on 16 September 2019.

Data were processed using IBM SPSS Statistics software, version 23.0, and explored through descriptive (measures of central tendency) and inferential statistics. For inferential statistics, the *t*-test for paired samples was used to determine whether there was a difference in trauma victims' clinical status using the SI and RTS scales. The Wilcoxon nonparametric test for paired samples was used to determine whether there was a difference in the victims' level of shock using the stratified SI. Statistical significance was set at $p < 0.05$.

Results

The sample of this study included 606 trauma victims (Table 1), mostly male (66.3%; $n = 402$), with a mean age of 53.3 years (±19.6).

Regarding the type of injury, blunt trauma (79.4%; $n = 481$) predominated over penetrating trauma (15.7%; $n = 95$). Regarding the injury mechanism, road accidents were the most frequent (40.8%; $n = 247$), followed by falls (37.0%; $n = 224$). It should be noted that both mechanisms accounted for nearly 80% of all traumas. Assault-related cases resulted mostly in penetrating trauma (84.0%, $n = 21$), while falls, road accidents, and hit-and-run accidents resulted mostly in blunt trauma (86.2%, $n = 193$; 88.3%, $n = 218$; and 81.8%, $n = 36$, respectively). The most common injury site was the head (44.7%; $n = 271$), followed by the lower limbs (38.4%; $n = 233$). The number of injury sites ranged from one (46.0%; $n = 279$) to more than four (9.1%; $n = 55$).

Table 1

Characterization of trauma victims

Characteristics	*n* (%)
Age	
Mean (*SD*)	53.3 (19.6)
Minimum	18
Maximum	96
Gender	
Male	402 (66.3)
Female	204 (33.7)
Type of trauma	
Blunt	481 (79.4)
Penetrating	95 (15.7)
Blunt and penetrating	30 (5.0)
Injury mechanism	
Assault	25 (4.1)
Fall	224 (37.0)
Road accident	247 (40.8)
Hit-and-run	44 (7.3)
Others	66 (10.9)
Injury site	
Head	271 (44.7)
Neck	99 (16.3)
Chest	206 (34.0)
Abdomen	102 (16.8)
Pelvis	84 (13.9)
Upper limbs	200 (33.0)
Lower limbs	233 (38.4)
Spine	133 (21.9)
Number of different injury sites	
= 1	279 (46.0)
2 - 4	272 (44.9)
> 4	55 (9.1)

Note. SD = standard-deviation.

Table 2 shows that the mean time between the activation of ILSA and the arrival on-scene was 18.4 minutes (±13.4). Two moments stood out in the delivery of prehospital nursing care: the on-scene time, with a mean time of 32.1 minutes (±15.6), and the transport to the reference health unit, with a mean time of 37.8 minutes (±22.7).

Table 2

Response times of Immediate Life Support Ambulances

Response in minutes	Mean (*SD*)
Time from call to arrival on scene	18.4 (13.4)
On-scene time	32.1 (15.6)
Time from leaving the scene to hospital arrival	37.8 (22.7)
Time from arrival on scene to hospital arrival	69.8 (29.1)
Total response time	88.1 (34.8)

Note. SD = standard-deviation.

The list of interventions administered by ILSA nurses (Table 3) reveals that most victims required hemodynamic support interventions (88.9%; *n* = 539) and immobilization techniques (79.7%; *n* = 483). The several pain relief interventions were divided into two major groups: pharmacological and non-pharmacological measures. It should be noted that the majority of victims (90.6%; *n* = 549) received non-pharmacological pain relief interventions.

Table 3

Interventions by Nurses of the Immediate Life Support Ambulances

Application of Clinical Interventions	*n* (%)
Life support measures	220 (36.3)
Hemodynamic support measures	539 (88.9)
Warm-up measures	455 (75.1)
Pharmacological pain relief measures	428 (70.6)
Non-pharmacological pain relief measures	549 (90.6)
Wound treatment	414 (68.3)
Immobilization techniques	483 (79.7)

Trauma severity, assessed by MGAP, reveals that 20.0% (n = 121) of the victims presented an unfavorable clinical status at baseline (Table 4).

The results obtained on the RTS revealed a positive and statistically significant clinical evolution of trauma victims assisted by ILSA nurses between baseline and the final evaluation (MD = 0.04; 95%CI = 0.02 - 0.07; p < 0.001). This improvement is supported by the clinical results obtained in the SI (MD = -0.02; 95%CI= -0.03 - -0.01; p < 0.001).

Table 4

Characterization of the victims according to Trauma Severity Indices

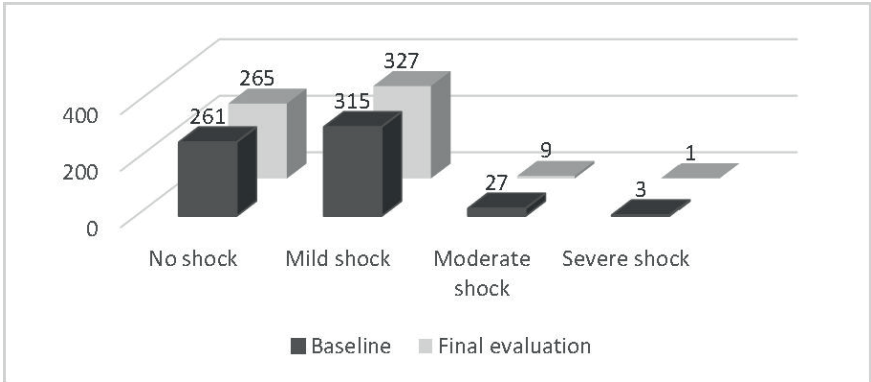
Trauma severity indices	Baseline	Final Evaluation	*p*-value
MGAP Baseline, *n* (%)			
< 18	11 (1.8)	N/A	N/A
18 – 22	110 (18.2)	N/A	N/A
> 23	485 (80.0)	N/A	N/A
RTS, *M* (*SD*)	7.70 (0.51)	7.74 (0.42)	<0.001
Shock Index, *M* (*SD*)	0.65 (0.18)	0.63 (0.14)	<0.001

Note. MGAP = Mechanism, Glasgow Coma Scale, Age, and Arterial Pressure; RTS = Revised Trauma Score; *M* = mean; *SD* = standard deviation; N/A = not applicable.

The stratified SI (Figure 1) revealed a decrease in the percentage of victims with moderate shock (4.6%; n = 27 *vs* 1.5%; n = 9) and severe shock (0.3%; n = 3 *vs* 0.2%; n = 1) from baseline to the final evaluation, with these results being statistically significant (p < 0.05).

Figure 1

Stratified distribution of the Shock Index by evaluation moment.



Discussion

This study is the first study conducted in Portugal to characterize prehospital nursing interventions for trauma victims. The results indicate that nurses' decisions, as leaders of the ILSA team, regarding the interventions provided to trauma victims were effective in their hemodynamic and clinical stabilization, which was demonstrated by the victims' positive evolution in the RTS and SI scales. In mainland Portugal, INEM is responsible for coordinating the Integrated Medical Emergency System (*Sistema Integrado de Emergência Médica*, SIEM) to ensure the delivery of prehospital care to the community (Ministério da Saúde, 2017), sending ILSA to top-level emergencies. Therefore, it can be inferred that nurses are a relevant asset of utmost importance in this context.

During the study period, nurses reported 606 trauma situations in the population aged over 18 years assisted by ILSA teams. These results are in line with those of other authors who report that trauma is an event with a high incidence in adults and young adults (ACS, 2012). The personal, social, and economic impact of this reality should encourage health authorities to focus on strategies for preventing trauma situations and enhancing the capacity for emergency responses to trauma situations.

Most trauma victims require a hospital surgical response, so it is not expected that all factors associated with increased risk of mortality will be corrected in the prehospital context. A significant number of people die immediately or in the first minutes, and accident prevention is the only available strategy to correct this phenomenon (Alvarez et al., 2016). On the other hand, many victims require assistance to avoid the second peak of mortality. As already pointed out, in most cases, the definitive treatment is surgery, and the rescue teams must implement measures to *buy time* for the victims, stabilizing them and reducing time until definitive treatment (Spahn et al., 2019). ILSA nurses' interventions aim to respond to different needs such as life support, hemodynamic stabilization, or pain management with the purpose of identifying and controlling external bleeding, recognizing symptoms of internal bleeding, and, thereby, prioritizing the rapid transport to reference surgical units. They also provide comfort to the victims in a hostile environment and promote an approach for personal protection against possible injuries that are impossible to diagnose in the prehospital context. Wound treatment and immobilization measures result from the need to prevent the victim's condition from worsening in the prehospital post-rescue context. In addition to safeguarding musculoskeletal integrity and structure, these measures reduce the number of infections inherent to the kinematics of trauma events through impaired tissue integrity and to the healthcare-associated infection itself.

Despite the key role of rescue teams in trauma victims' survival, no studies have yet been developed in Portugal to confirm their effectiveness. On the other hand, at an international level, the role of prehospital nursing is deeply hidden and omitted in research because rescue teams are often led by other health professionals. This study proved to be a pioneer study also in this area. For the first time and using the several trauma severity indices (MGAP, RTS, and SI), the effectiveness of nurses' intervention was confirmed by the statistically significant improvement in the victims' condition. This clinical finding is documented by the results obtained through the application of RTS and SI, which revealed a clinical improvement of the victims' hemodynamic condition [MD = 0.04 and 0.02 ($p < 0.001$), respectively]. The stratification of the SI (Mutschler et al., 2013) also showed a reduction of more than 50% of the victims classified in the two most severe levels (*moderate* and *severe shock*). This *clinical improvement* results from the implementation of complex advanced life support measures by nurses.

Although nursing interventions focus on the victims' physiological stabilization through life support and hemodynamic support measures, they are also in line with the essence of nursing – the act of caring - through the strong *concern* with the implementation of measures for promoting comfort and managing pain (Mota, Cunha, Santos, Silva, et al., 2019). This study also concluded that nurses focus on more than the administration of pharmacological measures for pain and discomfort relief, given that most victims had received non-pharmacological interventions.

Based on the mean response times, it can be concluded that on-scene response management reveals the ILSA nurses' concern with administering interventions as fast as possible because, on average, on-scene time was 32.1 minutes (±15.6). It should be highlighted that the total response time is, on average, almost three times longer than on-scene time [88.1 minutes (±34.8)], certainly due to the geographical distances. The quality of the emergency response should, therefore, be assessed with caution because the distance between the ILSA and the emergency site and the distance between the emergency site and the reference hospital units can influence the victim's clinical status, without being possible for the interventions administered to have any effect/influence at this level. Shortening these times will depend more on political decisions regarding the distribution of differentiated health care resources and units than on the improvement of clinical interventions.

This study also reported a high prevalence of polytrauma as approximately half of the victims had more than one injury site, and 9.1% ($n = 55$) had five or more injury sites. Thus, INEM intervention protocols should include different approaches to the types of injury, and its training model, which is currently very focused on interventions in specific injury sites, should take into account the reality of clinical practice.

Although this study contributes to a better understanding of trauma situations treated by ILSA teams in Portugal and boosts the development of prehospital nursing, it is not exempt from limitations. First, regardless of being a multicenter study with a large sample, only trauma victims rescued by ISLA teams were included, which may not represent the Portuguese reality about trauma. Second, trauma severity indices were operationalized to assess the effectiveness of nurses' interventions in prehospital

care. The multiplicity of injuries associated with each victim's clinical status also makes it difficult to infer the data. This clinical heterogeneity has limited the extrapolations of the tested models. In the future, more robust study designs should be used to support these data and analyses. Nevertheless, the study contributed to a better understanding of the effectiveness of ILSA response to trauma victims and identified relevant aspects that can be used in future research.

Conclusion

Trauma is a highly prevalent and impactful phenomenon that requires a complex response due to its multiple forms of presentation.

ILSA nurses administer a wide range of measures to manage trauma, namely hemodynamic support and non-pharmacological pain control measures. Overall, the interventions improved all severity scores of trauma victims, from the initial moment of the emergency response to the arrival at the reference hospital unit.

Concerning the implications for practice, this study is particularly important because it is the first study to provide an overview of prehospital trauma care in Portugal and offer relevant data for optimizing intervention protocols and adjusting training models to the current reality.

Author contributions

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