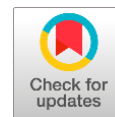


# Analysis of the competitiveness of higher education institutions in Ukraine in the context of recovery and development after the war



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**Abstract** The article examines the challenges that arise before the education system in the conditions of military aggression. The changing political and social situation during the conflict seriously affects educational institutions and their ability to provide quality education. The purpose of the study is to create a structural and functional set of criteria for ensuring the processes of forming the competitiveness of educational institutions in the conditions of full-scale military aggression and post-war reconstruction. The article analyzes the effects of military conflict on education infrastructure, access to education, and the psychological well-being of students and staff. She reveals the need to adapt the criteria for assessing the competitiveness of educational institutions pays attention to the flexibility of the educational process and the ability to respond to emergency situations. The article used the method of literature analysis, which made it possible to systematize the results of the analysis of scientific studies, articles, reports, and other sources of information related to the competitiveness of educational institutions in the conditions of military aggression and post-war reconstruction. This allows you to establish the presence of problems, identify factors and determine previous theoretical approaches to the assessment of competitiveness. Analytical methods, including statistical data analysis, modeling, and other analytical approaches for assessing competitiveness, are used to identify relationships and important factors affecting the competitiveness of an educational institution. Based on the use of these methods, a model for assessing the competitiveness of educational institutions was developed. Using the competitive assessment model helps higher education institutions improve their strategic plans. This allows them to identify their strengths and weaknesses, identify competitive opportunities and threats, and develop effective development strategies. The competitiveness assessment model contributes to the improvement of the quality of education.

**Keywords:** assessment of competitiveness, competitiveness, higher education, institutions of higher education, model.

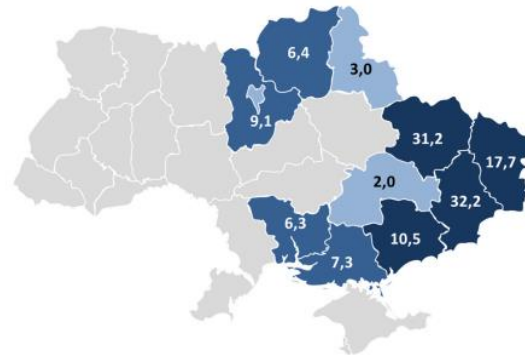
## 1. Introduction

After the beginning of the full-scale military invasion of the Russian Federation into Ukraine in connection with the conduct of active ground combat operations and missile attacks, the infrastructure was significantly destroyed. One of the most affected spheres is the sphere of education, as the number of damaged educational institutions of various levels is very high. The educational infrastructure in the Donetsk, Kharkiv, Luhansk, Mykolaiv, Zaporizhzhya, Kyiv, Sumy and Chernihiv regions of Ukraine is the most affected by the full-scale military aggression. Among the cities that suffered the most during the war, Maryinka, Mariupol, Irpin, Kharkiv, Chernihiv, Severodonetsk, Lysychansk, Vugledar, Sumy, Rubizhne, Izyum, Mykolaiv, Bakhmut, Volnovakha. We present a map of damage assessment of educational infrastructure in the most affected regions of Ukraine in Figure 1.

The final assessment of the amount of damage and destruction is possible only after the end of hostilities on the territory of Ukraine, however, in connection with the need to restore the educational process, it is advisable to determine the priorities of reconstruction, determine the criteria for restoring the competitiveness of educational institutions affected by military aggression in the regions, as well as competitiveness in general of the educational system of Ukraine, taking into account the destruction and the European integration vector of development, which determines the openness of educational systems, accordingly, the need to ensure the high quality of educational processes. Accordingly, it is expedient to determine the



prospects for the development of the educational system of Ukraine in the face of new challenges, including the processes of restoration, ensuring the safety of education, and post-war reconstruction.



**Figure 1** Damage map of the most affected areas of the country, billion US dollars.  
Source: Kyiv School of Economics.

So, considering the relevance and practical importance of the problem of post-war reconstruction, the purpose of the study is determined, which consists in creating a structural and functional set of criteria for ensuring the processes of forming the competitiveness of educational institutions in the conditions of full-scale military aggression and post-war reconstruction.

To achieve the goal of the study, the following tasks were performed:

- an analysis of the extent of damages and losses in the educational sector was carried out;
- identified requests to the education system in the new realities of full-scale military aggression and post-war reconstruction;
- a set of criteria was developed for assessing the competitiveness of educational institutions in new realities;
- developed models for assessing the competitiveness of higher education institutions in Ukraine;
- methodological approaches to the practical implementation of the model for assessing the competitiveness of higher education institutions in Ukraine are proposed.

## 2. Literature review

In today's increasingly globalized world, higher education institutions face increasing competition, so understanding their competitiveness is critical to their success. The study uses a comprehensive assessment methodology to analyze various aspects of the competitiveness of the national higher education system. It considers factors such as academic achievement, academic reputation, student engagement and satisfaction, funding and resources, international collaborations, and relevance of curricula to labor market needs. Using a combination of quantitative data analysis and qualitative assessments, the article provides insight into the strengths and weaknesses of the national higher education system. It identifies directions for improving competitiveness and proposes strategies for optimizing resources, stimulating innovation, and improving the quality of teaching and research (Stonkiene et al., 2016).

The article "Improving the competitiveness of educational institutions – the underestimated potential of ABC" is devoted to the problem of improving the competitiveness of educational institutions. This study explores how the potential of a three-pronged approach – academic standards, business practices and cooperation - can contribute to the development and strengthening of the competitiveness of educational institutions. The article analyzes the reasons why this ABC potential is often underestimated and untapped. It highlights the challenges that make it difficult to realize this potential, such as the lack of coherence between academic standards and business practices, insufficient cooperation between educational institutions and enterprises, and insufficient attention to the introduction of innovations in educational programs. The article offers specific recommendations and strategies for improving the competitiveness of educational institutions using the ABC approach. She emphasizes the importance of establishing strong connections between academic standards and the needs of the labor market, promoting active cooperation with the business environment, and introducing innovative methods and approaches to the educational process (Sorros et al., 2022).

The article "States, Demographics, and the Competitiveness of America's Best Universities" examines the influence of states and demographic factors on the competitiveness of the best universities in the United States. She focuses on studying how different states and their demographics affect university rankings and attractiveness. The paper analyzes data from well-known university rankings and performs statistical analysis to determine the relationship between states, demographics, and university competitiveness. It examines factors such as population size, ethnic composition, economic development, access to resources, and scientific achievement of states. The research findings reveal important relationships between states, demographics, and university competitiveness. They indicate that some states are well positioned to develop high-quality

education and attract outstanding students and scholars, while others may face challenges related to competition and resources (Waheeduzzaman, 2007).

The study analyzes the concept of a virtual university as a learning model based on the use of Internet technologies and online resources. She examines the impact of virtual learning on skill development, student autonomy, educational accessibility, and teacher-student collaboration. The article also considers the importance of creating a conducive learning environment of a virtual university that promotes active learning, student engagement, and support for social interaction. It provides recommendations on the development of immersive technologies, the use of virtual reality and ensuring the quality of learning in an online environment (Davies, 1998). Application of the digital environment in a higher educational institution for training future economists and their professional competencies (Bakhmat et al., 2023), and improvement of professional education and training in modern conditions (Abiltarova et al., 2022).

The authors of the article consider the importance of a balanced approach to community growth and global competitiveness of universities. The article discusses the challenges facing higher education institutions in today's world, in particular the need to ensure the economic development of the community and increase competitiveness at the international level. The authors analyze the factors affecting the economic development of universities, including the attraction of investments, the development of the entrepreneurial environment, and the attraction of international students. The article proposes an innovative model that considers the importance of the relationship between community development and global competitiveness. The authors argue that ensuring sustainable economic development in universities should be accompanied by strengthening ties with the community, supporting the local economy, and creating innovative partnerships with businesses and public organizations (Mars, 2011).

The article "Factors that increase the perception of quality and satisfaction of students in specialized postgraduate education programs: the role of identity" examines the influence of various factors on the perception of quality and satisfaction of students in specialized postgraduate education programs. Particular attention is paid to the role of identity in this process. The article examines the concept of identity as a key factor influencing the perception of program quality and student satisfaction. The authors conduct an empirical study using questionnaires and interviews with students of specialized postgraduate programs. They analyze the relationship between students' identity, their expectations, perceptions of program quality, and overall satisfaction with learning. The article highlights different aspects of identity, such as a sense of belonging to the program, identification with the professional community, and personal development through learning. The authors also consider the impact of other factors, such as the quality of instruction, support from faculty and program staff, access to resources, and opportunities for professional growth (Park, 2023; Brown, N. and Leigh, J. (2018)). Ukrainian authors consider upgrading the qualifications of graduates of educational institutions in machine-building enterprises (Latysheva et al., 2020), agricultural enterprises (Ostapenko et al., 2020), nuclear power plant personnel (Popov et al., 2021; Ripkey, S.L. (2017)), in public administration (Kryshtanovych et al., 2022), (Semenets-Orlova et al., 2022), and the quality of management in tourism (Bayev et al., 2022). Developing the potential of public administration education (Semenets-Orlova et al., 2022), project management technologies (Aleinikova et al., 2020), and state business support programs (Alekseieva et al., 2023).

The study draws on the experience of established partnerships and considers the importance of knowledge management in this context. The article examines the main aspects of partnerships in higher education, in particular inter-university partnerships, cooperation with industry and other forms of partnership relations. The authors emphasize the importance of knowledge management in managing partnerships, in particular knowledge sharing, joint knowledge creation and the use of knowledge management tools. The article uses research methods such as document analysis, interviews, and analysis of practices of higher education institutions. The authors provide specific examples of partnerships in higher education in the UK and explore how they apply knowledge management principles to achieve success (Elezi, 2022).

The article "Conceptualization and validation of resource recombination in the context of competitiveness of higher educational institutions" is devoted to the study of conceptualization and validation of resource recombination in the context of competitiveness of higher education institutions. The authors of the article propose a theoretical model and methodology for studying this phenomenon. The article examines the concept of resource recombination as a strategic approach that allows higher education institutions to combine available resources to achieve competitive advantage. The authors analyze various types of resources, their impact on competitiveness and the possibilities of their recombination. The article uses empirical research, including questionnaires and interviews with representatives of higher education institutions. Statistical methods are used to analyze and validate the obtained data (Muneeb et al., 2020; Tight, M., 2022).

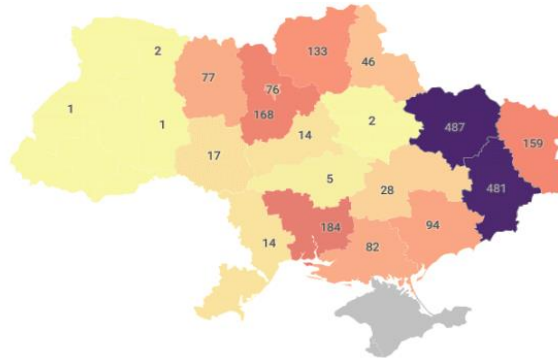
### 3. Methods

The article uses the method of statistical data analysis to determine the consequences of destruction in the field of education. The analysis of literary sources made it possible to identify factors of competitiveness that are characteristic of educational institutions. As a result of the analysis, an information base for further research and a theoretical foundation was formed. Using the methods of synthesis and induction, a set of criteria was developed to assess the competitiveness of educational institutions. Based on the formed population, by using projection and modeling methods, proposals were developed for the formation of a criterion model for assessing the competitiveness of educational institutions. Through the

analysis of literary sources and reports of international financial and economic institutions, statistical data, methodological recommendations for the practical implementation of the developed model were proposed.

#### 4. Results

Direct documented damages from the destruction of educational institutions amount to \$8.94 billion. In total, because of hostilities, at least 915 educational infrastructure objects have already been destroyed and 2,165 have been damaged. The greatest losses from destruction and damage to educational institutions are in Kharkiv, Donetsk, Chernihiv, Zaporizhzhia, and Kyiv regions. A total of 42 higher education institutions were damaged in Ukraine as of April 2023, 4 were destroyed. The number of losses in financial terms is 330 million US dollars (expenses required for the restoration of damaged and destroyed institutions of the supreme council). In general, the number of damaged and destroyed educational institutions by region can be presented in the form of the following map in Figure 2.



**Figure 2** Statistics of the number of damaged or destroyed educational institutions by region of Ukraine, units, as of April 2023. Source: portal of the Ministry of Education and Science of Ukraine "Education under threat".

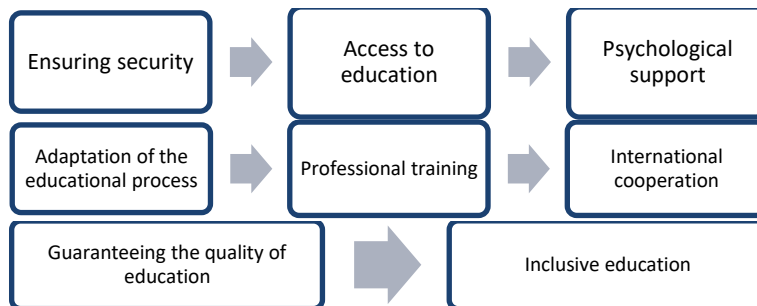
Therefore, the scale of the damage is significant, which will affect the competitiveness of higher education institutions both from the point of view of those educational institutions that were partially damaged or destroyed, and those educational institutions that are located in the most affected regions, as well as Ukrainian educational institutions that have to withstand cooperation with European educational institutions in the conditions of a large number of refugees who do not return to Ukraine due to the continuation of hostilities and choose to study for their children abroad.

In the new realities of full-scale military aggression and post-war reconstruction, the education system faces numerous challenges and needs. Some requests to such a system may include the following:

- The primary task of the education system in the conditions of military aggression is to ensure the safety of pupils, students and employees of educational institutions. This may include developing and implementing emergency plans, training staff on safety and evacuation measures, organizing security checks, etc.
- Ensuring access to education for all population groups is an important task. The conditions of military aggression and post-war reconstruction can lead to the destruction of schools and other educational institutions, displacement of the population and other factors that complicate access to education. The education system should develop strategies to ensure access to learning in emergency situations, for example by creating temporary learning centers or using distance learning tools.
- War and conflicts can have a serious impact on the psychological state of pupils, students and teachers. The education system should take this aspect into account and provide psychological support to those affected by the war. This may include conducting trainings for teachers on recognizing and supporting students, providing psychological counseling, and conducting special programs to restore the emotional state of children and youth.
- The conditions of military aggression and post-war reconstruction may require changes in the educational process. The education system must take into account these changes and adapt training programs and methods to meet the new conditions. For example, this could mean the introduction of practical training modules related to the restoration of damaged areas or the training of skills necessary for rebuilding.
- In the conditions of military aggression and post-war reconstruction, priorities and needs in the labor market may change. The education system must respond to these changes and provide vocational training that meets the needs of post-conflict recovery and development. This may include providing specialized courses in construction, reconstruction, medicine, and other fields that are important during recovery.
- In situations of military aggression and post-war reconstruction, international cooperation is of great importance. The education system should cooperate with international organizations, non-governmental organizations, and other countries to share experiences, receive assistance and coordinate efforts to restore the education system. This may include exchange of internship programs for teachers, joint research and educational development projects, as well as financial support to restore the infrastructure of educational institutions.

- In the uncertain conditions of military aggression and post-war reconstruction, it is important to ensure the quality of education. The education system should develop mechanisms for monitoring and evaluating the quality of education to ensure the effectiveness and level of education despite the difficult conditions. This may include conducting assessments, establishing quality standards and ensuring compliance.
- In the conditions of conflict and post-war reconstruction, it is important to ensure inclusive education, which gives the opportunity to receive education to all students, regardless of their gender, ethnicity, social status or developmental characteristics. The education system should develop programs and methods aimed at creating a barrier-free learning environment and ensuring equal opportunities for all students (Kondratieva, 2022).

The results of the study are accumulated in Figure 3.



**Figure 3** Challenges for the Soviet system in Ukraine.  
Source: developed by the author.

In these new realities, the education system must be flexible, respond to challenges and needs, as well as direct its efforts to restore, develop and ensure the quality of education in the conditions of military aggression and post-war reconstruction.

The analysis of literary sources and the report of international organizations made it possible to form a set of criteria that influence the formation of the competitiveness of higher education institutions. The set of criteria and indicators for their calculation are presented in Table 1.

**Table 1** Criterion support for assessing the competitiveness of higher education institutions.

Indicators	Calculation formula	Parameters
Attractiveness Index	$A = \frac{(KK * VZ)}{KR}$ KK – number of competitors; VZ – percentage of graduates who find a job after graduation; KR – the number of rating indicators by which a higher education institution is evaluated.	0,2-0,35
Competitiveness Index	$IK = \frac{(RN * KK)}{VC}$ RN – rating score of a higher education institution; KK – number of competitors; VC – the percentage of vacant places in a higher education institution.	0,2-0,25
Development Index	$IP = \frac{(ON * ZP)}{RN}$ ON – volumes of scientific research and innovative projects carried out in the institution of higher education; ZP – the general budget of the higher education institution; RN – rating score of a higher education institution.	>1

Source: developed by the author based on the analysis of world rankings of educational institutions.

It is worth noting that specific formulas may vary depending on specific contextual conditions and methods of assessing competitiveness. It is also important to consider that in martial law some usual indicators may be compromised or unavailable, so adaptation of assessment methods may be necessary.

Based on the analysis, it is proposed to use the following indicators as criteria: Attractiveness Index, Competitiveness Index, Development Index. Based on the proposed criteria, a model of competitiveness assessment was developed, which is represented by the following set of measures for implementation:

1. Collect data for each criterion:
  - For the Attractiveness Index: the percentage of graduates who find a job after graduation, the rating score of the educational institution.



- For the Competitiveness Index: the rating score of the educational institution, the number of competitors, the percentage of vacant places in the institution.
  - For the Development Index: the amount of scientific research and innovative projects in the institution, the general budget of the institution, the rating score of the institution.
2. Determine the weight of each criterion:
    - Assign a weight to each criterion depending on its importance in the context of the competitiveness assessment. For example, the weight of the Attractiveness Index can be 0.4, the Competitiveness Index - 0.3, and the Development Index – 0.3. Scales must add up to 1.
  - 3 Normalize the data:
    - Bring the data to the same scale for each criterion, using, for example, minimax scaling or standardization.
  4. Calculate indicators for each index:
    - For the Attractiveness Index: apply the formula  $(KK * VZ) / KR$ .
    - For the Competitiveness Index: apply the formula  $(PH * KK) / VC$ .
    - For the Development Index: apply the formula  $(OH * ZP) / PH$ .
    - Perform calculations for each educational institution.
  5. Multiply the indicators of each index by the weight of the criterion to consider their significance.
    - Add the results to get a total competitiveness score.
  6. Compare results:
    - Make a comparison between educational institutions based on the obtained competitiveness scores. Institutions with higher overall scores will be considered more competitive.
  7. Consider the context of martial law:
    - Under martial law, special circumstances may arise that may affect the assessment of competitiveness. For example, a reduction in funding, a change in priorities in the educational process or access to resources. It is worth considering these factors when assessing competitiveness in the context of martial law.
  8. Constantly update data:
    - Martial law conditions can change over time, so it is important to constantly update the data and periodically assess the competitiveness of educational institutions. This will allow you to detect changes and make the necessary adjustments.

To determine the weighting coefficients of the influence of the resulting factors, an analysis of correlation dependence was carried out on the example of five institutions of higher education of Ukraine, which suffered as a result of full-scale military aggression. Correlational dependencies were calculated based on the analysis of the reporting data of educational institutions (we code them as A, B, C, D, E) – the results are summarized in Table 2.

**Table 2** Summary calculations of correlation dependence results.

	A	B	C	D	E	Correlation coefficient
A	0,36	0,52	0,19	0,4	0,52	0,51
IK	0,32	0,19	0,31	0,3	0,2	0,70
IR	0,19	0,25	0,3	0,3	0,31	0,15
Level of competitiveness	0,35	0,3	0,31	0,37	0,2	

Source: developed by the author based on calculations.

By automated calculation using the correlation formula in MC Excel, the weighting factors of the resulting factors were calculated, which made it possible to develop a formula for calculating the Level of competitiveness – Formula 1.

$$LC = \sum_n(0,51 * A + 0,7 * IK + 0,15 * IR) \quad (1)$$

The level of competitiveness of educational institutions allows us to determine its potential to attract and retain students, influence the labor market and provide quality education. Analysis of ratings and rating lists allows you to compare educational institutions according to various criteria, such as the quality of education, scientific activity, infrastructure, etc. Ratings can be used to compare the competitiveness of institutions. Tracking the career development of graduates and their success in the labor market can serve as a sign of the institution's competitiveness. A high percentage of graduates who find work immediately after graduation or succeed in their field may indicate the attractiveness of the institution to potential students. Assessment of student satisfaction with education, availability of resources, quality of teaching and support from the educational institution can provide insight into the level of competitiveness. High student satisfaction can indicate the attractiveness of the institution. Analysis of scientific achievements, research projects and publications of teachers and students can serve as an indicator of activity and innovativeness of the institution.

There are several practical steps for implementing the model of assessing the competitiveness of an educational institution in practice:



- Collect data: Collect the necessary data to evaluate each criterion. This may include statistical data, student survey results, labor market research and other relevant sources of information.
- Set metrics: Set metrics to evaluate each criterion. For example, the quality of education can be evaluated based on student success rates, the percentage of graduates who find employment, and other indicators.
- Assign weights: Set weights for each criterion, reflecting their relative importance. For example, the quality of teaching may have more weight than other criteria.
- Calculate metrics: Apply formulas and methods to calculate competitive metrics based on collected data and established metrics.
- Compare the results: Compare the results of the competitiveness assessment of different educational institutions using the calculated indicators.

## 5. Discussion

The analysis of the competitiveness of higher education institutions in the conditions of martial law and post-war reconstruction raises several debatable issues that can be taken into account in the article. Some of them include:

- Impact of conflict on the quality of education: Martial law and post-war reconstruction can have a negative impact on the infrastructure, resources, and quality of education in educational institutions. The question is how these factors affect the competitiveness of institutions and how they can be ensured and improved.
- Access to education for students: Military conflict can lead to limited access to education due to evacuations, destruction of infrastructure, and other factors. It is important to discuss what measures can be taken to ensure the availability of education in these conditions and how this affects the competitiveness of institutions.
- Reorganization of educational programs: Martial law conditions may require revision of educational programs, in particular, considering the specific needs of society and the economy. Discussing what changes in programs can ensure that students are prepared for the challenges of the post-war period is an important aspect of the competitiveness analysis.
- Interaction with the labor market: The post-conflict period is often accompanied by economic reconstruction and recovery. Research on how educational institutions can cooperate with the labor market.
- It is important to discuss how higher education institutions can implement innovative methods and technologies in the educational process in the post-war period, and how this can impact the attractiveness and competitiveness of the educational institution in the eyes of students and international partners.
- In the context of post-war recovery and development, it is crucial to discuss the role of international collaboration and student exchange in enhancing the competitiveness of Ukrainian higher education institutions.
- The effectiveness of marketing strategies and promotion of higher education institutions in the midst of military events and subsequent reconstruction is a subject of debate.
- The impact of the socio-economic situation on the chosen directions of study is also a debatable issue (Tight, 2022; Ripkey, 2017; Brown, 2018).

## 6. Conclusions

Challenges to the education system in the conditions of military aggression create serious challenges and require an active response and adaptation. A military conflict can lead to the destruction of educational institutions, laboratories, libraries, and other infrastructure facilities. This creates a challenge for the restoration and reconstruction of these facilities to ensure the normal functioning of the education system. Martial law can lead to limited access to education through evacuation, destruction of schools and universities, disruption of the educational process and displacement. This is especially true for populated areas on the front line. The development and implementation of alternative learning methods, such as distance learning or learning through mobile platforms, can help ensure access to education in these settings. With the beginning of the full-scale military invasion in Ukraine, institutions of higher education suffered significant destruction. The article proposes a model for assessing their competitiveness, considering modern realities. Martial law requires a review and adaptation of the criteria for assessing competitiveness. Factors that become particularly important in these circumstances may include the institution's ability to ensure student safety, flexibility in the learning process, and the ability to respond to emergency situations. Martial law conditions emphasize the importance of cooperation between educational institutions, the public and the authorities. Developing partnerships with authorities and active public involvement can help educational institutions respond effectively to the challenges of martial law and ensure the safety and quality of education. Martial law may require a review of the strategy and business plans of educational institutions. This includes setting priorities, developing contingency plans, as well as attracting additional resources to ensure the functioning of the institution and the quality of education. Martial law can become an incentive for the introduction of innovative technologies into the educational process. Therefore, the developed model fully meets the above requirements and can be applied in practice.

## Ethical considerations

Not applicable.

## Conflict of Interest

The authors declare no conflicts of interest.

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