

DIAGNOSTICS OF COMPETITIVE POTENTIAL OF AGRICULTURAL ENTERPRISES IN UKRAINE DURING WAR

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Abstract. The article provides an assessment of the Ukrainian agricultural market and determines that the total amount of losses caused to the agricultural industry as a result of the Russian invasion of Ukraine amounted to more than 8 billion USD at the end of 2022. At the same time, indirect losses of Ukrainian agriculture due to reduced production, blockade of ports, and growth in production costs are estimated at 34.25 billion USD. Due to a significant deterioration in the financial performance of agricultural enterprises in Ukraine, the article presents the authors' algorithm for diagnosing the competitive potential of an agricultural enterprise based on the results of a study of internal factors influencing the competitiveness of agricultural enterprises, grouped into the following groups:

- "technical level of production and sales of equipment"; - "state of production"; - "personnel and the extent of its use"; - "financial condition of society"; - "marketing resources"; - "economic efficiency of activity"; - "investment and innovation resources". It has been proven that the use of elasticity models allows to take into account the influence of a significant number of factors, and elasticity can be defined as a measure of susceptibility to changes in one or more independent variables. It has been proven that the level of competitiveness of an agricultural enterprise at any given time is determined by the overall influence of interrelated factors, acting simultaneously and in different directions, enhancing or weakening the overall effective impact. It is substantiated that an agricultural enterprise must constantly respond to the demands of an unstable environment, reconfiguring and updating its resources and competencies; move through systematic problem solving, identify opportunities and threats, make quick decisions, implement productive strategies, etc.

Keywords: agricultural enterprise, competitiveness, indicators, Russo-Ukrainian war.

Introduction

Agriculture is one of the leading sectors of the Ukrainian economy, which is aimed at providing the population with food and obtaining raw materials for a number of industries. As a result of Russia's full-scale aggression against Ukraine, the agricultural sector has been seriously damaged. According to approximate estimates of experts, the total amount of damage caused to the agricultural sector as a result of the large-scale Russian invasion, as of January 1, 2024, reached approximately 13 billion USD, which is 37% of the total value of Ukraine's agricultural assets. At the same time, indirect losses to the agricultural economy of Ukraine due to reduced production, blocking of ports and rising prices for products are estimated at 34.25 billion US dollars. The total number of economic entities that suffered losses as a result of the war is 2,653 units (arable land – 1.9 million hectares, perennial plantings – 9 thousand hectares). Today, the priority areas of activity of agricultural enterprises are increasing the efficiency of resource use, searching for potential opportunities for their conservation, and improving economic indicators in the long term. In a significant number of studies, scientists have identified the consequences of the war for the agricultural sector of the Ukrainian economy, in particular for the production and export of agri-food products [1; 2]. Researchers argue that the state of the agricultural sector in wartime is complex and requires government support for balanced functioning [3]. Military actions and export restrictions created the need to ensure agricultural stability in Ukraine. Fiott [4] confirms that the deliberate destruction of agricultural infrastructure and the blockade of logistics routes became prominent trends in the war. Mamonova [5] emphasizes that the agricultural industry is actively adapting to the conditions of military activity, especially in the context of small-scale farming that has managed to adapt to new management realities. In conditions of hostilities, it is necessary to ensure access to resources and financing for the development of agricultural enterprises. This may include external support from governmental and international organizations, including through financial loans, training programs and other support measures. The scientist Bene argues that the situation in the agricultural sector of the economy has changed due to global problems such as the COVID-19 pandemic and Russian aggression against Ukraine, which has affected international supply chains. The COVID-19 pandemic has slowed international logistics and demonstrated the advantages of small producers who are domestically focused and less dependent on external shocks, [6; 7] emphasizes the need to support

farms. At this stage, it is extremely important to assess the state of development of the agricultural sector of the economy in conditions of war and study specific aspects of adaptation of farmers to modern global challenges, the key of which is Russian aggression against Ukraine, for further development. Proposals for the post-war restoration of the agricultural sector of the Ukrainian economy and the identification of forms of management and structures of agricultural production should be a priority in post-war Ukraine, taking into account socio-economic and environmental criteria. Fundamental research on agriculture in war conditions is carried out by scientists from the Kyiv School of Economics (KSE Agrocenter) [8], in particular, they assessed the rate of decline of the agricultural sector of Ukraine in the context of regions and market segments, and researchers from the Kyiv School of Economics analyzed and came to the conclusion that productivity of the main agricultural crops in Ukraine in different economic conditions determined by environmental causes has not reached the maximum potential. Experts of the Ukrainian Agricultural Business Club [9] paid more attention to the risks and problems of the activities of agricultural enterprises in war conditions. The Ministry of Foreign Affairs of Ukraine [10] conducted a study of the impact of changes in the agricultural sector of Ukraine on the global economy; African countries have been identified as susceptible to import dependency and high price volatility, including Sudan, Kenya, Ethiopia and Somalia as the most vulnerable, countries such as Burundi and Rwanda indirectly depend on Ukrainian sunflower oil due to re-export from Egypt. Research is also carried out by foreign scientists [11-14], who in their studies most estimate the level of losses in the Ukrainian agricultural sector and make attempts to predict the development of various sectors of the Ukrainian agricultural market in the coming years in order to determine the degree of influence of the Ukrainian agricultural sector on the world agricultural market in general and the market of agricultural products of the European Union in particular.

Targeted methods of managing agricultural enterprises do not reflect the modern specifics of existing economic conditions. These targeted management methods scatter financial resources and do not take into account the real interests of producers and consumers. Insufficient use of scientific methods is observed not only in the field of agriculture, but also at various levels, including in education, etc. This has led to the impossibility of determining priority directions for development and justifying a rational structure of production for a long period, maximally adapted to modern agricultural conditions, which ensures high economic efficiency.

Materials and methods

The scientific-theoretical-methodical basis of the article was made up of an analysis of general, scientific, special, and interdisciplinary methods, as well as approaches, methods, and principles of scientific research. The following methods were used: terminological analysis – to substantiate the essence of the concepts “potential of agricultural enterprises”; methods of theoretical generalization, scientific abstraction, systemic and structural analysis – for systematization of theoretical provisions regarding the formation of indicators of the activity of agricultural enterprises; financial and economic, statistical, comparative analysis, generalization, systematization - for comprehensive diagnostics of agricultural enterprises; systematization, structural analysis, induction and deduction, generalization – for the development of methods for assessing the efficiency of the use of enterprise resources and the formation of a general indicator of the level of the enterprise competitive development potential; systematization and generalization – to justify the concept of strategic management of the competitiveness of agricultural enterprises; abstract-logical – for logical generalization of theoretical foundations and the formation of the research conclusions.

Results and discussion

The Russian-Ukrainian war created insurmountable risks for agricultural business and created an environment of general compulsion to reconstruct economic systems, restructuring and resettlement, which led to an accelerated transformation of adaptive institutions of business activity in connection with the movement of the economy and states towards the coalitions of the European Union. Over the past two years, starting in February 2022, there has been a significant narrowing of the resource base and a deterioration in the conditions for conducting economic activity: the area of agricultural land used by agricultural enterprises in 2023 compared to 2021 decreased by 16.3%, and the number of employees decreased by 13.4%. There was a significant reduction in the volume of gross output of enterprises – by

28%, as well as a decrease in the level of efficiency: net profit decreased by 64%, and profitability decreased by 14%. Therefore, there was a need to develop methodological support for assessing the potential of agricultural enterprises, taking into account the risk factors that increased for agricultural enterprises during the war. For convenience of calculations, all competitiveness factors are combined into components (subgroups). The component “Technical level of production and level of application of technology” includes indicators characterizing the availability and efficiency of use of means of production and technology for the production of agricultural products. The factor indicators include the following:

- natural (weather and climatic conditions, land quality, etc.);
- material (quantity and quality of labor, energy and financial resources, quantity and quality of applied fertilizers);
- socio-economic (form of ownership, level of specialization and concentration of production, level of production and social infrastructure, level of real income and living standards of the population);
- organizational (forms of production management and labor organization, structure of agricultural land, sown areas, livestock, fixed and working capital, etc.) [15].

The analysis was carried out according to individual indicators characterizing the technical level of production and the level of application of enterprise technologies, presented in Table 1. Important indicators of the personnel structure of an agricultural enterprise are the proportion of each category of workers [16]. This model proposes to analyze the process of personnel movement using the staff turnover rate and the recruitment rate, which determines the stability of personnel. Analysis of the formation and use of enterprise personnel involves analytical work in three main areas: number, composition and movement of personnel; staff productivity; system of material incentives and evaluation of its effectiveness.

Table 1

**Analyses of the indicators that characterize the technical level of production
and the level of technology application of enterprises**

Indicator	Formula for calculation	Conventional designation
Fund availability (F_{avail})	$F_{avail} = \frac{A_{fa}}{N_{emp}}$	A_{fa} – amount of fixed assets; N_{emp} – number of employees.
Equipment of funds (F_{eq})	$F_{eq} = \frac{A_{fa}}{S_{al}}$	A_{fa} – amount of fixed assets; S_{al} – area of agricultural land.
Capital productivity by profit (C_{pp})	$C_{pp} = \frac{A_{gp}}{A_{fa}}$	A_{gp} – amount of gross profit; A_{fa} – amount of fixed assets.
Turnover coefficient (C_t)	$C_t = \frac{Q}{Q_b}$	Q – volume of sold products; Q_b – annual balance of normalized working capital.
Energy equipment of the enterprise (E_{ee})	$E_{ee} = \frac{E}{S_{al}}$	E – energy capacity of the enterprise; S_{al} – area of agricultural land.
Material capacity of products (M_{cp})	$M_{cp} = \frac{MC}{V_{sp}}$	MC – total amount of material costs; V_{sp} – volume of sold products.

We propose to calculate only the most important factors in further research, such as the staff turnover rates (R_{st}), frame refresh rate (R_{fr}); coefficient of the ratio of accepted and released ($C_{acc-rel}$); staffing ratio (R_{staff}); level of education of employees (L_{ee}); level of providing employees with a social package (L_{peofsp}) and the indicator of the wealth of working people (I_{wofwp}). By using such a composition of indicators, it is possible to characterize the level of personnel stability in various ways, in order to develop reasonable proposals for improving the formation, use, and stimulation of the company’s employees. The “Financial condition of the enterprise” component includes indicators that are an important information link connecting a business entity with partners in market relations. Considerable

attention to the analysis of the financial condition of an enterprise and its assessment is explained by the fact that, on the one hand, it is the result of the enterprise's activities and shows achievements, and on the other hand, it identifies prerequisites for development of companies that systematize scientists' research [17; 18]. The results of this study suggest that when determining the level of the financial condition of an enterprise, one should take into account the specifics of this study, as well as the results of an analysis of the structure of sources and the financial risk of the enterprise using specific indicators as shown in Table 2. The "Marketing Resources" component includes indicators that characterize one of the main activities of any enterprise - sales. To ensure economic stability, marketing performs several basic functions such as market research; development and planning of assortment; sales and distribution (organization of product distribution and sales); sales promotion and advertising.

The effectiveness of the marketing policy should be determined by the following cost relationships: total actual costs and total sales volume; marketing research costs and total sales; advertising costs and sales volumes; costs and sales for each product and market; gross profit and sales volume (Table 3).

Table 2

Indicators of the financial condition of agricultural enterprises

Indicator	Technology of calculation and assignment of the indicator
Coefficient of financial autonomy (independence) (C_{finaut})	The share of equity in the total value of the property. It characterizes the degree of independence of the enterprise from external sources of financing. The minimum (normative) value of the coefficient is more than 0.5.
Coefficient of financial dependence (C_{findep})	Share of loan capital in the total currency of the balance sheet. When its value approaches 1, it means that the owners are fully financing their enterprise.
Coefficient of long-term financial independence (financial stability) (C_{finst})	The ratio of equity and loan capital to the total currency of the balance sheet. A state is considered normal when the ratio is greater than 1. It shows what share of the enterprise's activity is financed by long-term credits and loans.
Liquid solvency ratio (R_{ls})	The ratio of the total amount of current assets to the total amount of financial and current liabilities. This coefficient should exceed 1.
Debt ratio (R_b)	The ratio of loan and equity capital to external sources of financing. Normal is considered a state when the unit ratio is 1. It shows the share of liabilities in the total value of equity capital.
Current asset coverage ratio (C_{ast})	The ratio of current assets to equity. The minimum (normative) value of the coefficient is more than 0.5.
Financial leverage ratio (R_{fl})	The ratio of long-term liabilities to equity. The normative value of this coefficient should not exceed 0.25. It indicates the dependence of the enterprise on long-term obligations.
Financial risk factor (R_{fr})	The ratio of loan capital to equity. The normative value of this coefficient should not exceed 1.

Component "Economic efficiency of activities". In the agricultural sector of the economy, production efficiency is a complex category that characterizes the efficiency of activities. For the agricultural sector of the economy, the main goal is to obtain the maximum amount of production from a unit of resource (soil) at the lowest economic costs. Enterprise efficiency is a comprehensive assessment of the final results of the use of fixed and current resources, assets, labor and financial resources, as well as intangible assets over a certain time [19]. It is advisable to build a system for measuring the economic efficiency of agricultural production in such a way that it can most fully reveal two interrelated and complementary effective aspects of the activities of agricultural enterprises – the rationality of their use of land through indicators of the total effect reduced to a unit area of agricultural land, and the production economy, according to which it was possible to identify what caused this effect.

To assess the economic efficiency of activities, it is more expedient to use such a system of indicators (Table 4). "Investment and innovation resources" component. Investments and innovations are an important component of the economy growth as a whole and of an individual enterprise as one of

the driving factors of its development, which is an important feature during the war. The level of attracting investments and innovations shows the potential of an agricultural enterprise in the future, which has a multidirectional impact on all subgroups of resources, such as compliance of the quality of the products produced with consumer requirements, profitability of operations, profitability and competitiveness of enterprises. As an alternative indicator that reflects the degree of use of the achievements of the scientific and technical process, we suggest using the indicator of innovation potential, which can be determined by the following formula:

$$IP = \frac{MB_p + MB_m + A}{K_n} \quad (1)$$

where MB_p – material costs in crop production;
 MB_m – material costs in animal husbandry;
 A – depreciation of machines and equipment;
 K_n – number of agricultural workers [8].

To assess the innovative potential and test this indicator, we assessed the innovative potential of 4 state agricultural enterprises from 3 regions of Ukraine – State Scientific Research Enterprise (SE SRE) “Stepne” of the Poltava region (1), SE SRE “Pasichne” of the Khmelnytsky region (2), SE SRE “Dekabrist” of the Poltava region (3) and SE SRE “Oleksandrivske” of the Vinnitsa region (4). And using this indicator, we determined that the greatest innovative potential is in 1, then 4, 2, 3.

Table 3

Indicators of analysis of marketing resources of agricultural enterprises

Indicator	Calculation technology for the indicator
Profitability of sales (P_s)	The share of profit in the total cost of sold products. It characterizes the efficiency of the enterprise's sales activity.
Profitability of promotion and sales expenses (P_{pse})	The ratio of the amount of profit from the sale of products to the amount of expenses for promotion and sales. It characterizes the effectiveness of sales costs.
Profitability of marketing expenses (P_{me})	The ratio of the amount of profit from the sale of products and the total volume of marketing expenses. Illustrates the effectiveness of marketing measures implemented by the company.
Load factor (L_f)	The ratio of changes in the balance of finished products and the volume of sales of the company's products. The value of the indicator should be negative, which indicates a reduction in the balance of unsold products.
Coefficient of stimulation of sales and realization of products (C_{ssrp})	The ratio of sales promotion costs and the volume of products sold. It characterizes the costs of the enterprise for the promotion of products to the consumer market.
Cost ratio for marketing research (R_{mr})	The ratio of costs for marketing research and the total volume of products sold. It characterizes the company's expenses for marketing research.
Rate of growth of the volumes of sold products (R_{rgvsp})	The ratio of the volume of products sold in the current year to the previous year. It characterizes the dynamics of changes in the volume of products sold.

In our opinion, it is more expedient to use such a system of indicators to assess innovation and investment sustainability (Table 5).

The indicators of the evaluation of the innovation-investment component are given in Table 5 to make a final decision regarding the effectiveness of the investment project and minimize risks when carrying out long-term investment operations.

Table 4

**List of indicators for analyzing the economic efficiency
of activities of component enterprises**

Indicator	Calculation technology
Product profitability (P_{prod})	The ratio of profit to the total cost of goods sold.
Level of profitability of operational activity (P_{oa})	The ratio of operating profit to the sum of administrative expenses, sales expenses, and other operating expenses.
Level of profitability of ordinary activities (P_{orda})	The ratio of the financial result from ordinary activities to the sum of the cost of goods sold, financial expenses, and other expenses.
Additional profit per hectare of agricultural land ($P_{al.}$)	The ratio of additional income to the area of agricultural land.
Annual labor productivity (P_{al})	The ratio of the volume of products sold to the number of employees.

The potential capabilities of agricultural enterprises form the level of development of their competitive potential and are indirectly dependent on the efficiency of the use of internal resources [20]. The methodology for calculating the effective indicator of the level of competitive potential of an agricultural enterprise is based on the use of the elasticity model:

$$Y = \prod_{j=1}^m X_j^{\varepsilon_j}, \quad (2)$$

where Y – performance indicator;

$X_j > (j = 1, 2, \dots, m)$ – output factors;

ε_j – coefficient of elasticity of the influence of the initial factors on the performance indicator.

Coefficients of elasticity ε_j for each factor are defined as the ratio of the relative change of the performance indicator to the relative change of the factor:

$$\varepsilon_j = \frac{\Delta Y / Y}{\Delta X_j / X_j}, \quad (3)$$

where ΔX_j – increase in the value of the j-th factor;

ΔY – increase in the performance indicator.

We also calculated the indicator of the level of competitive potential of an agricultural enterprise on the basis of 4 state agricultural enterprises from 3 regions of Ukraine – State Scientific Research Enterprise (SE SRE) “Stepne” of the Poltava region (1), SE SRE “Pasichne” of the Khmelnytsky region (2), SE SRE “Dekabrist” of the Poltava region (3) and SE SRE “Oleksandrivske” of the Vinnitsa region (4). And using this indicator, we determined that despite the fact that the greatest innovative potential is in 1, then 4, 2, 3, the level of competitive potential is the greatest in 4, then 1, 3, 2.

Table 5

List of indicators for the analysis of the innovation and investment component of enterprises

Indicator	Calculation technology
Volume of investments in manufactured products (Q_{inv})	The ratio of the number of intangible assets, unfinished construction, and fixed assets to the volume of products sold.
Rate of return on timely capital (R_{rtc})	The ratio of the financial result from ordinary activities to the average annual cost of equity.
Return on assets (R_a)	The ratio of net profit to the average annual value of the company's assets.
Profitability of financial investments (R_{finv})	The ratio of the amount of income from securities and income from equity participation in an agricultural enterprise to the amount of long-term and short-term financial investments.
Innovative potential (I_p)	The ratio of the amount of depreciation and material costs in the branches of the company to the average annual number of employees.

Table 5 (continued)

Indicator	Calculation technology
Level of innovation implementation (L_{inv})	The ratio of the amount of costs for the implementation of innovations to the total amount of investment costs.
Level of profitability of innovations (PL_{inv})	The ratio of the amount of additional profit from the introduction of innovations to the amount of investment costs.
Investment ratio (R_{inv})	It characterizes what share of fixed assets is financed from the own budget.

The use of elasticity models allows taking into account the influence of a significant number of factors. If the resulting variable depends on several independent economic factors with different elasticity, then the factors to which the resulting value reacts to the greatest extent are determined. That is, the relative change of which leads to the largest relative change of the dependent variable. Thus, the factors that have the greatest influence on the dependent variable are revealed. The absolute value of the elasticity coefficient characterizes the influence of the corresponding factor on the resulting variable as follows:

- for $|\varepsilon| < 1$ – change in the factor weakens the change in the dependent variable;
- for $|\varepsilon| > 1$ – change in the factor increases the change in the dependent variable.

Thus, the calculation of the indicator of the level of development of the competitive potential of an agricultural enterprise using the elasticity model is carried out according to the formula:

$$Y_{CP} = \prod_{j=1}^n X_j^{\varepsilon_j},$$

$$\varepsilon_j = \frac{\Delta Y_{CP} / Y_{CP}}{\Delta X_j / X_j} = \frac{1/1}{(1 - X_j) / X_j} = \frac{X_j}{(1 - X_j)}, \quad (4)$$

- where ΔY_{CP} – increase in the potential of the enterprise, taken equal to one, i.e. the maximum increase in potential in the range from 0 to 1;
- Y_{CP} – value of the enterprise's potential, i.e. 100% use of resources, or $Y_{CP} = 1$;
- $X_i (i = 1, \dots, 4)$ – indicator of the level of efficiency of resource use, expressed in fractions of a unit;
- ΔX_i – increase in the indicator of the level of efficiency of resource use, equal to the difference between the maximum level of use (unit) and the actual value.

The value of the increase in the potential of the enterprise ΔY_{CP} in the calculations is taken equal to one, since the actual level of resource utilization efficiency, striving for the maximum value, will ensure the orientation of the potential value to the maximum.

We also calculated the indicator of the level of development of the competitive potential of an agricultural enterprise using an elasticity model based on formula 4 on the basis of 4 state agricultural enterprises from 3 regions of Ukraine – State Scientific Research Enterprise (SE SRE) “Stepne” of the Poltava region (1), SE SRE “Pasichne” of the Khmelnytsky region (2), SE SRE “Dekabrist” of the Poltava region (3) and SE SRE “Oleksandrivske” of the Vinnitsa region (4). And using this indicator and previous calculations, we graded these enterprises and determined that enterprises 1 and 4 have the greatest competitive potential, with enterprises 2 and 3 slightly behind.

Conclusions

The total cost of losses to agricultural enterprises due to decreased yields is estimated at 157.3 million USD. A decrease of 5.1 percent compared to 2021, with the largest decrease in the yield recorded in the front-line regions (10.4 percent). The average increase in production costs was 46 percent. This was reported by 93 percent of all businesses, totaling an estimated 1.533 billion USD. The sharpest increase in the cost of agricultural products is noticeable in the front-line regions (52 percent compared to 2021), and the lowest in the western regions (34 percent). Losses from mine clearance costs (0.8 USD per m²) of the contaminated and uncleaned area (about 70.3 thousand hectares) are estimated at 562.4 million USD and are almost entirely associated with the front-line regions. At the

same time, about 5 percent of agricultural enterprises reported additional costs for eliminating the consequences of the war (not included in increased production and demining costs) in the amount of 21 million USD. The largest share of agricultural enterprises with additional costs is registered in the western regions (8 percent), and the smallest in the front-line regions (4 percent). A total of 7.8 percent of agricultural businesses reported 4 million USD in additional war mitigation costs. The largest share of agricultural enterprises with additional costs is observed in the front-line regions (10.5 percent), followed by the western regions (9.6 percent) and the central regions (4.8 percent).

A methodology for diagnosing the competitive potential of an agricultural enterprise is proposed, which differs from existing ones, as it proposes changes in components and groups of indicators that allow to take into account the difficult situation in which agricultural enterprises found themselves in connection with the war in Ukraine. The novelty of the methodology lies in the fact that the methodology, with the help of preliminary expert research, groups exactly those groups of factors and indicators that are most relevant specifically for agricultural enterprises and allow to assess the impact of war on the activities of agricultural enterprises. The results obtained as a result of applying the proposed methodology make it possible to quantify the strengths and weaknesses of the enterprise without subjective expert assessments. The agricultural sector of Ukraine and agricultural enterprises continue to function, find ways to solve problems with the production and sale of products, and support the state economy, despite military circumstances. The advantages of the proposed method include:

- calculations are made on the basis of the reporting information of the enterprise on the basis of standard coefficients, the calculation of which does not present difficulties for the enterprise;
- practical use of the obtained calculation results;
- the ability to assess the efficiency of use of each resource, as well as the integral indicator of the level of development of the potential of an agricultural enterprise to determine the contribution of each type of resource to the final assessment.

We conducted a preliminary adaptation of the model at 4 state-owned enterprises which are part of the structure of the National Academy of Agrarian Sciences of Ukraine, and which carry out innovative developments, we assessed the innovation and investment potential, determined the level of competitive potential of the enterprises under study. The calculation showed the effectiveness and practical value of the methodology, which allows to assess the potential of agricultural enterprises, taking into account the problems and risks associated with the war in Ukraine.

Author contributions

Writing – original draft, Data curation; Formal analysis, Funding acquisition, O.N.; Conceptualization, supervision; Writing – original draft; and Writing – review editing, supervision, O.L.; Investigation; Methodology, Software, Formal analysis; Writing – original draft, visualization, I.N.; Methodology, supervision, Writing – review editing; final approval of manuscript, A.D. All authors read and approved the final manuscript.

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