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RESEARCH ARTICLE

Studies on the effect of COVID-19 on the construction industry in the Kuantan district

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Abstract - The whole world is plagued with infectious diseases that are more dangerous than the common fever that can cause death if not treated early. Therefore, many countries have implemented movement control orders that are just sitting at home. It indirectly has a devastating impact on employment sectors, especially construction companies around the world. Construction delays are one of the biggest problems faced by the construction industry; they will directly affect the parties involved in the contract, contribute to costs and overtime, litigation, and late transfer of projects to owners. Therefore, an online questionnaire survey was conducted to study the main cause of the project timeline disruption, which led to the Extension of Time requirement in ongoing construction projects and the financial loss of the construction industry due to COVID-19 in Kuantan District. Survey questionnaires were distributed to Consultants, Contractors and Public Authorities in the Kuantan District. The main objectives of this research have been achieved. In this research, the data analysis shows the main cause of the project timeline is the Movement Control Order (MCO) and SOPs set by the government. The factor for the shortage of labour is the closure of the national border. The company manages the delayed project by complying with SOPs that have been set in the workplace. The cause of material shortage delays in terms of delivery of materials. Much of the financial loss is more than RM 100 001. Therefore, rising building material prices impact financial losses, and using credit loans is the best way to manage financial problems.

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1. Introduction

The COVID-19 pandemic has been an enormous global disruption with immense economic, environmental, and social impacts worldwide. During the past two decades, three zoonotic coronaviruses have been identified as the cause of large-scale disease outbreaks⁻: severe acute respiratory syndrome (SARS), Middle East Respiratory Syndrome (MERS), and Swine Acute Diarrhoea Syndrome (SADS). SARS and MERS emerged in 2003 and 2012, respectively, and caused a worldwide pandemic that claimed thousands of human lives, while SADS struck the swine industry in 2017 [1]. It has been reported that the virus can be transmitted from person to person and causes symptoms that include fever, dry cough, fatigue, and shortness of breath. As of January 2021, the virus had spread to more than 200 countries, affected 91.5 million people, and caused 1.96 million deaths. The most critical part of the outbreak has been its rapid spread and long incubation period. A novel aspect of the COVID-19 pandemic has been the speed of its global spread. This pandemic affects not only everyday life but also construction projects, transportation, food supply and public health activities. The COVID-19 pandemic has also illustrated the complementarity of the transportation and public health systems. In addition, transportation helps spread the virus but also keeps critical supplies available [2]. Businesses and the economy in general were severely affected by the virus and the measures implemented to try to control it. For example, the crude oil price benchmark, West Texas Intermediate, dropped into negative territory, a historical low, around a month after the WHO declared COVID-19 a pandemic. Much like everything else, the construction industry in Malaysia was severely affected by the COVID-19 pandemic. Most construction work, except that classified as critical or essential services, was halted throughout the MCO. Even after the MCO was lifted, contractors have continued to encounter disruptions, such as the need to implement stringent standard operating procedures for health and safety measures ("SOPs") on construction sites. Such disruption has prevented them from carrying out their work as initially envisaged and as customarily practised. Among the sectors that have experienced considerable disruptions are materials, subcontractors, and the supply chain. The ripple effect of the materials supply chain has suspended production, issuance, and distribution. Contractors face impacts from the availability, delays, and rising costs of imported materials and off-site construction items, such as steel, tiles, and internal fittings. Financial constraints are the immediate impact of COVID-19 on most contractors. Given that companies are not generating any net or operating profits due to work cessation, suppliers of the prescribed materials have incurred significant losses. The implementation of MCO meant suspension of work and payments, and contractors assumed the recurring costs of rental expenses, salaries, and fixed costs. In addition, the cessation of material sales and the shutdown of the construction industry have resulted in the government losing adequate tax revenue, which has a direct impact on the country's economy.

Construction is crucial as it represents the economy, wellness and quality of life in the country [3]. As construction is the backbone of economic growth in all countries, it affects the performance of all industries at all levels of the economy. The construction industry relies heavily on developing countries to achieve their long-term development [4]. As the COVID-19 pandemic spread worldwide, the construction industry, particularly building projects, has been affected [5].

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A delay in any major construction projects would have a significant impact on Malaysia's economic development. Table 1 shows that the pandemic has a severe impact on construction projects [6].

Table 1. Severe Impacts of The Pandemic on Construction Projects

Description	References
Delays in construction projects	[7][8]
Impact on the labour market and job losses	[9][10]
Overrun in terms of time and expense	[11][7][8]
Scarcity of supplies and resources	[8][12]
Mobility prohibitions and restrictions on movement at work	[12][10]
Materials shortages to sustain ongoing projects, as well as price fluctuations	[13][5]
Transportation problems for materials and labor	[5][8][11][14]
Extra time for project completion	[8][12][15]
Restricted supply of human resources	[8][13]
Rise in the cost of development	[7][12]
Effect on currently completed tasks	[5][8]
Decrease in productivity and efficiency	[13][16]
Safety and health	[10][12]
Conflicts, litigation, and complaints are anticipated to rise	[13][16]
The influence of socioeconomics	[12][15]

The COVID-19 pandemic in the country left a lasting impact on the construction industry, with project suspensions and delays. Apart from that, it had to bear excess costs, which covered more than 4,000 infections at various work sites as of December 21, making it very vulnerable. Records from the Construction Industry Development Board of Malaysia (CIDB) show that the value of construction projects awarded dropped 42% to RM55.3 billion for the period January to October 2020, compared to RM94.6 billion in the same period last year. CIDB Chief Executive Datuk Ahmad 'Asri Abdul Hamid said it was estimated that the construction industry suffered a loss of about RM11.6 billion in the period March 18, when the Movement Control Order began, until April 14 this year, and another RM6.9 billion was recorded following the opening are 13 sub-sectors from April 15 to May 1 2020 [17]. Delays can be further grouped into critical and non-critical delays, reasonable and unreasonable deferrals, compensable and non-compensable deferrals, and simultaneous postponements [18]. Delays affecting the project's completion or, in some cases, milestone dates are considered critical delays; delays that do not affect the essential dates of the project's completion are non-critical. The concept of “critical” delays originates from the Critical Path Method (CPM) scheduling. An excusable delay is a delay that is due to an unforeseeable event beyond the Contractor’s or the Subcontractor’s control, such as fires, floods, owner-directed changes on the design, intervention by outside agencies, lack of action by government bodies and errors or omissions in the plans and specifications. Construction delays mean the project will be completed later than its specified completion date, and they will increase construction costs. Project delays that occur unexpectedly are uncontrolled and have a detrimental impact on project operations and outcomes. An unanticipated delay increases project expenses by extending the project's duration. It has time-related cost consequences, which means it consumes more resources and takes longer to complete the job. It is appropriate to build in a delay tolerance at the start of a project to mitigate the negative impact of delays. A delay allowance is the time included in the project plan to account for unforeseen events and minor delays. It is a method for enhancing project safety by eliminating interruptions to activities and establishing time buffers.

The construction industry in Malaysia has been severely affected by the COVID-19 outbreak. Most construction work, except for critical or essential services, has been halted throughout the MCO. Even after the MCO was lifted, contractors continued to experience disruptions, including those arising from the need to implement strict standard operating procedures for health and safety measures (“SOPs”) on construction sites. Such disturbances have prevented them from carrying out their work as originally envisioned and customary. The main challenge Contractors faced during the COVID-19 pandemic was cash flow problems, as project payments are usually assessed based on the amount of work done. The suspension of almost all construction activities during the MCO means that no work is carried out and, therefore, no payments are made. However, contractors continue to bear their recurring costs, such as rental charges, wages, and overheads. Many contractors have successfully claimed extensions of time for MCO periods under contracts when their projects are suspended and all site activities are halted. However, in many cases, contractors continue to struggle to get time extensions for events after the MCO. A well-established component of the editorial process is plagiarism screening. Turnitin software will be used to verify all submitted manuscripts for plagiarism checks.

2. Materials and Methods

Since this study is generally opinion-based, a questionnaire is used as the research instrument to collect respondents' opinions. Questionnaires are an effective way to quantify data from a sample group and to assess emotions or preferences. This method is very cheap and easy, especially when the budget is a problem, and gives an element of scale to opinion and emotion. These figures are arbitrary, but at least give a directional method of measuring intensity [19]. The study's information and data are collected through a literature review and questionnaire. Questionnaires serve as the primary data

for analysis to achieve the study's objectives. The respondents to the questionnaire are construction industry players in the Kuantan District, Pahang, such as engineering consultant firms, contractors, quantity surveyors, public authorities, land surveyors, developers, and so on. The sampling method is probability sampling; the random sampling method is easy to choose because it avoids bias: all subjects in the population have an equal chance of being selected as respondents. Data collection is conducted online (virtually), and an online survey is the systematic gathering of data from the target audience, characterised by the invitation of respondents and the completion of the questionnaire over the World Wide Web. Google Forms was selected as a web survey tool for this study because it offers a variety of ways to present Internet questionnaires. Google Forms can create an unlimited number of surveys and acquire more than 1,000 responses with this free survey service [20]. Furthermore, another reason Google Forms was selected is that it is free and easy to collect data. In addition, this method can save time and make it easier for respondents to complete the Google form.

The questions are mainly focused on the effects of the project timeline and the cost losses in the construction industry due to COVID-19 in Kuantan District, Pahang. The review period runs from November 2021 to April 2022. The questionnaire was distributed during the survey, and the results were recorded and analysed using Microsoft Excel. The study's limitation concerns the extent to which the findings can be generalised. The respondents in the sample were chosen at random. 100 people were randomly selected to complete the questionnaire. The Google Forms questionnaire was distributed via WhatsApp, Facebook, and Twitter applications. This method was preferred because it made distribution easier and was more cost-effective and time-saving. There are more than 100 distributed questionnaires. When 100 responses are received, the further analysis process begins, as the sample already approximates the average population in a simple random sampling. This questionnaire is divided into three sections: (i) the respondent's background, (ii) the project timeline disrupted, and (iii) financial loss. The researchers analyse and present the data from 100 respondents in the form of pie charts, bar graphs, and schedules. Analysis or discussion of the data is incorporated along with the data presented. Graphs are chosen because they are a powerful tool for displaying quantitative data that can be measured and focus on numbers and statistics. The data presented in this study only includes 100 random respondents, which are grouped into simple categories to be presented in pie charts and bar graphs.

3. Results and Discussion

The purpose of analysing the results is to identify the leading cause of project timeline disruption, which is leading to the Extension of Time (EOT) requirement in ongoing construction projects and to the financial loss of the construction industry due to COVID-19 in Kuantan District. The online survey questionnaires were distributed to the Consultant, Contractor and Public Authorities in Kuantan District.

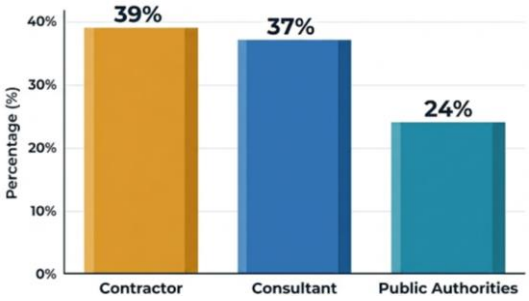

Figure 1. Group of respondents

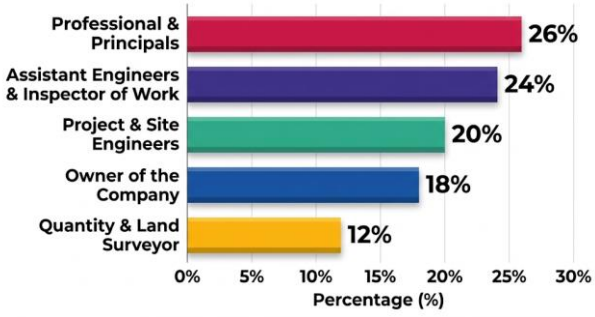

Figure 2. Position of respondents

3.1 Respondent Demographics

The questionnaire was completed by 100 respondents from various positions, including engineers, project managers, site managers, quantity surveyors, and land surveyors from consulting firms, developers, and construction companies, as well as officers from public authorities. However, information on ethnicity, respondents' ages, and different fields of engineering was not included in the consideration. Figure 1 shows the percentage of respondents who volunteered to complete the online questionnaire distributed. Most respondents (39%) are employees of engineering consulting firms, including principals, engineers, professionals, assistant engineers, and work inspectors. In comparison, 37% of the respondents are workers in construction and developer companies, and the remaining 24% are officers working in public

authorities such as JKR, IWK and JPS. Meanwhile, Figure 2 shows the positions of respondents: 26% are principals and professionals, most of whom are owners of engineering firms (Civil & Structural and Mechanical & Electrical Consultants), while 24% are assistant engineers and inspectors of work who work entirely on construction sites. A total of 20% of respondents are project managers and site engineers, while another 18% of respondents are construction company owners and developers. Since the number of land and quantity surveyors in Kuantan is small, only 12% of respondents are individuals in this field.

3.2 Project Timeline Disrupted

Project timelines are vital in project management and significantly impact a project's success. To complete a project on time and within budget, it is crucial to comprehend project milestones and potential delays. Delays are a frequent challenge in projects and can substantially affect the project's overall timeline and success. A common reason for project delays is often a shortage of resources, including insufficient budget, manpower, or equipment. When a project lacks the necessary resources, it can lead to delays in completing tasks or milestones. External factors, such as changes in government regulations, natural disasters, or supplier delays, can also cause project delays. While these factors may be beyond the project team's control, they significantly impact the project timeline. Table 2 presents the distribution of causes of interrupted project timelines by number of respondents. The Movement Control Order and SOPs set by the government have a significant impact on the construction industry sector, and 45% of respondents agreed to this reason. It is because when a Movement Control Order is in place, no one is allowed to leave the house. People had to obey government instructions to avoid contracting COVID-19. For that reason, ongoing site projects had to be postponed, which impacted the project timeline. Therefore, the Movement Control Order and the government's SOPs are the leading causes of disruption to the project timeline. Lack of Labour also received attention from 33% of respondents, ranking second among the causes of the timeline of this disrupted project. Labour workers are among the most critical assets in the construction industry, apart from capital, machinery, materials, and expertise. Labourers in the construction sector can be categorised into three main groups: general labour, semi-skilled labour, and skilled labour. Although the construction industry needs manpower, the country must import foreign workers from neighbouring countries to address the increasingly critical shortage of local manpower. This result is in good agreement with RHB Investment Bank (RHBIB) analyst Adam Mohamed Rahim, who said the company's application needs to go through the evaluation committee of the Ministry of Home Affairs to determine the number of foreign workers eligible to work, resulting in a shortage of labour, causing construction works to be delayed [21]. Labourers are desperately needed to do the construction work. The need for more labour significantly affects the project timeline, making it unable to proceed.

Meanwhile, the need for more material and logistics, in third place, affects the project timeline (21%). Construction materials are essential in every project. It can disrupt a project due to the absence of these building materials. The MCO and global lockdown resulted in a considerable reduction in material output, causing significant delays in construction projects. This aligns with China, the world's leading exporter of building materials. The reduction in production output during the nationwide shutdown has had a global impact on buildings. Most structural steel materials (excluding steel bars), sanitary products and tiles, and some building equipment and machinery are imported into Malaysia from China. Furthermore, the industry must comply with new standards, such as social distancing and meeting health criteria, and it may face supply and labour shortages. These new standards will undoubtedly increase construction costs and reduce productivity [21]. In addition, only 1% of respondents attributed project timeline disruptions to increased material prices. The price of steel reinforcement bars has risen the most since 2020, up 56 per cent between October 2020 and March 2022, according to CIDB's Ahmad 'Asri. Many previously widely available building materials have become scarce due to the pandemic. The lack of materials has also led to higher prices, which is related to rising transportation costs.

Table 2. Position of the causes of interrupted project timelines

Cause of Project Timeline Disrupted	Rank
Movement Control Order (MCO) and SOPs set by the government	1
Lack of labour	2
Lack of Material/Logistic	3
Material Price Increase	4

Table 3. Labor shortage factor

Labor Shortage Factor	Rank
Closure of National Border/ Government Restrictions	1
labour is infected with Covid-19 and needs to be quarantined	2
Rotation of employees in the workplace/ Work from home	3

3.3 Factors of Labour Shortage

According to the findings presented in Table 3, 45% of respondents ranked the closure of national borders first as a labour shortage factor. In comparison, 33% of respondents stated that the labour shortage was caused by workers contracting Covid-19 and being quarantined for an extended period. Employee turnover at work or working from home ranked third, with 22% of respondents agreeing with this situation. The closure of national borders is the main reason for the need for

more workers in the construction sector. This is because each country has ordered the closure of its borders to prevent the entry of people from countries where COVID-19 is prevalent, including Malaysia. It indirectly reduces the number of foreign workers available to work here. Many workers have been infected with COVID-19 at work or in their home neighbourhoods. They need to be quarantined to prevent the virus from spreading further. The rotation of employees between the workplace and working from home is also one of the reasons employees experience redundancies. In this case, they are still working and unable to carry out monitoring tasks on the construction site.

3.4 Causes of Material Shortage

The study's findings show that 51% of respondents agree that the leading cause of the shortage of building materials is delayed delivery. Meanwhile, the increase in material prices ranked second, with 34% of respondents agreeing with this reason. In comparison, another 7% of respondents said the shortage of materials resulted from factory and supplier closures. Delays in the delivery of materials affect the need for more materials at the construction site. This happens because the transportation movement of these materials could be improved. The ordered materials arrive late at the construction site, delaying many other items. It made a significant impact on this construction project. The global epidemic has driven up the price of materials. It can also be the reason why building materials are in short supply. In the end, the factory had to close because the MCO was one of the reasons that construction materials could not be produced as requested by their customers. Table 4 represents the causes of the construction materials shortage.

Table 4. Causes of materials shortage

Causes of Materials Shortage	Rank
Delay in terms of delivery of materials	1
Rising material prices	2
Factories were closed	3

3.5 Methods of Managing Project Delays

The global health pandemic has altered the world as we know it, prompting millions of businesses worldwide to reconsider their work practices. The impact on how firms execute projects and meet productivity targets while working remotely has been enormous. A new normal is the state in which an economy and society settle after a crisis, when they differ from the state that existed before the crisis began. This new standard is a new norm in many industries worldwide, especially the building industry. Construction companies must comply with additional requirements for managing assets and projects, in addition to regular construction operating procedures (SOPs), as a result of the COVID-19 pandemic [22]. According to responses in Table 5, 63% of respondents agreed that compliance with established workplace SOPs is one of the main ways companies manage project delays. This is because the company has no choice but to comply with the government-set SOP. Complying with workplace SOPs is the main thing that needs to be implemented by every company's management when allowed to operate again after receiving a government concession. It is a precautionary measure to prevent the COVID-19 virus from spreading to the point that it results in a company closure order or the workplace area being quarantined within a specified period. An example is with social distancing and wearing a mask. 44% of respondents stated that applying for permission to operate through CIMS MITI is a method the company uses to ensure that the project can continue. MITI's mission is to attract quality investment and innovative industry activities to produce high-quality products and services, atond as increase Malaysia's competitiveness, which is on par with other great countries in trade and industry. In other words, they are the ones responsible for upgrading Malaysia's industrial sectors so that the Malaysian economy will continue to improve. Lastly, ensuring that all employees have been fully vaccinated as one of the measures taken to avoid project delays is in third place, which is agreed by 7% of respondents. This is because with this vaccine injection, it can reduce the risk of contracting the Covid-19 virus as well as help the company to continue the project that has been interrupted before.

Table 5. Company methods of managing project delays

Company Methods of Managing Project Delays	Rank
Comply with SOPs that have been set in the workplace	1
Apply for permission to operate through CIMS MITI	2
Ensure all employees have been fully vaccinated	3

3.6 Cost and Financial Loss

Since construction costs are incurred over the whole construction period of a project, it is generally expected to decide the sums to be spent in different periods to infer the income profile, particularly for large projects with extended terms. Thus, it is critical to consider the level of work expected to be completed at different time spans for which the expenses would be charged [23]. The costs and financial losses resulting from the COVID-19 pandemic were analysed in this study. Based on the findings in Table 6, Financial loss of more than RM 100,001 ranked first (37%), suggesting that a significant proportion of businesses in the construction industry experienced substantial financial losses exceeding RM 100,001 due to the pandemic. Meanwhile, RM 50,001 to RM 100,000 ranked second with 27% of respondents, and RM 10,001 to RM 50,000 ranked third with 19% of respondents. Another 16% of respondents stated that the financial loss due to COVID-19 is less than RM10,000. Although this percentage is smaller, it still highlights that most businesses face a relatively

small financial impact. The study indicates that both consultants and contractors were significantly affected by COVID-19-related financial losses. This underscores the widespread impact across different segments of the construction industry. The findings prove that COVID-19 had a profound economic impact on the construction sector in Malaysia, leading to substantial financial losses across various scales. This has implications for the industry's overall economic health, including employment, project viability, and business financial stability. In summary, the study outlines the significant financial challenges posed by COVID-19 to the construction industry in Malaysia, emphasising the need for adaptation strategies and robust financial management practices to weather the disruption and recover.

Table 6. Amount of financial loss

Financial Loss Amount (RM)	Rank
More than RM 100,001	1
RM 50,001 to RM 100,000	2
RM 10,001 to RM 50,000	3
Less than RM 10,000	4

3.7 Cause of Financial Losses

According to the results, 40% of respondents chose the increase in construction material prices as the leading cause of financial loss. Rising material prices directly impact project costs, reducing profit margins and potentially leading to losses if contracts are fixed price. Meanwhile, 23% of respondents identified high machinery rental costs as a significant factor contributing to financial difficulties. High rental costs increase operational expenses, reducing profitability for construction companies. Rising prices of building materials have had a significant impact on the construction industry, which is experiencing financial difficulties. In addition, machine rental has been one of the second effects that make it difficult for the construction industry to use machines. In addition, the difficulty in obtaining tenders also results in fewer construction projects. This results in fewer construction projects being awarded to the company. A reduced project pipeline limits revenue opportunities and can lead to financial losses if existing projects are completed without new ones to replace them.

Table 7. The method of dealing with financial problems

The Method of Dealing with Financial Problems taken by company	Rank
Credit Loans	1
SKWAK (Skim Kumpulan Wang Amanah Kontraktor)	2
I-Factoring facility (I-Contract Financing Scheme)	3
Investment from Venture Capitals & Cooperative Scheme	4
Own Company Financial	5

3.8 The Company's Method of Dealing with Financial Problems

The pandemic adversely affected the construction industry, and many companies faced significant financial challenges. During the early stages of the COVID-19 pandemic, many contractors needed more monetary resources to cover employee wages and keep their businesses afloat. Government intervention, through programs such as the employee retention tax credit and the SBA Paycheck Protection Program, somewhat eased contractors' concerns during the pandemic. Based on Table 7, the survey found that 43% of respondents used Credit Loan facilities as their primary method for solving financial problems. In addition, the SKWAK (Contractor Trust Fund Scheme) is the second most popular method, chosen by 28% of respondents, to help their respective companies financially. Meanwhile, another 22% of respondents use the I-Factoring Facility (I-Contract Financing Scheme) to address their financial problems. At the same time, 3% and 2% of respondents, respectively, suggest investing in venture capital and cooperative schemes to help their finances. In contrast, another 1% use their company's finances to address this lack of funds.

4. Conclusions

This research examines the effects of COVID-19 on the construction industry in Kuantan District, focusing on disruptions to project timelines and financial losses. A survey involving a hundred individuals from the construction sector was conducted via online questionnaires. The study reveals that COVID-19 significantly affects ongoing construction projects, particularly by causing delays in completion and financial setbacks. The primary cause of project timeline disruptions identified in the study is the Movement Control Order (MCO) and government-mandated Standard Operating Procedures (SOPs). These measures halted construction, resulting in project delays. Financially, most construction firms in Kuantan suffered losses exceeding RM 100,001. Factors contributing to these losses include rising construction material prices and increased rental rates for machinery. In response to these challenges, construction firms have resorted to credit loans as a key strategy to manage their financial difficulties, complemented by other government loan facilities.

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Declaration of Competing Interest
The author declares no conflicts of interest.

CRediT Authorship Contribution Statement
A. Zukri (Methodology; Data analysis; Writing - original draft, review & editing; Resources)
R. Kassim (Conceptualization; Data collection; Funding acquisition; Supervision)

Availability of Data and Materials
The data supporting this study's findings are available on request from the corresponding author.

Ethics Declarations
This study did not involve human participants or animals. Ethical approval was therefore not required.

Generative Artificial Intelligence Declarations
The authors claim that artificially intelligent-assisted technologies, such as generative AI, were not used to generate content, ideas, or theories. We have just utilised AI to enhance readability and refine the language. This was used with extreme human control and oversight. The authors take full responsibility for reviewing and approving the content.

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