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Urban Forest and Recreational Facilities along Treated Malir River

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ABSTRACT

Nature is the best teacher and reconnects the mechanically lost man with originality. Considering the fundamental role of nature in the nurture of mankind, this study aims to emphasise the need for green spaces within the urban metropolis for improved lifestyles and a sustainable environment. The conditions of the United Nation Sustainable Development Goals (UN-SDG) necessitate a cleaner environment, clean air, water and sanitation. The quantitative research proposes jogging track, artificial forest implementation and recreational facilities along with the treated Malir river water sections. For this research, a questionnaire-based analysis is conducted. This study proposes a notion of urban forest recreation for the citizens, dwellers and monetary contribution for maintaining such facilities based on the quantitative analysis of the collected data. As a result, the analytics of the survey reveals that people would welcome the use of such options for recreation. According to the data received, the respondents ponder that these green places could enhance their quality of life with a preference for sharing green space with their family and friends and also increase some soothing hobbies in urban areas. Most respondents prefer urban forestry supporting water sports, boating and fishing areas in Karachi. The feasibility of the proposed model is ensured with critical analysis and assessment of public income for Tax, preferences of green places assessment, use of recreational areas, and willingness to pay for entry in the green area.

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INTRODUCTION

It is natural to crave leisure activities and recreational places to spend time in solitude to release the environmental stress of an overwhelming schedule and recharge for fresh back to work (Hasan et al., 2011). Individuals require leisure to gather positive energy to perform better at their routine places. Well-being improvement is associated with wide-ranging terms and activities, including happiness, positive effects and satisfaction in life (Yang, 2021).

Unfortunately, the ratio of unsatisfied and mentally distressed population is increasing in society day by day (Gerstenberg et al., 2020). They extensively require access to recreational areas, where these people can get some refreshing vibes and recover some happiness and hope in their lives (Lyu & Lu, 2019). To avail positive effects on emotional, intellectual, social, and physical landscape, people need to spend more time in recreational areas (Zheng et al., 2019). This is more prominent in urban metropolises where a lack of open spaces and intense traffic conditions make lives distressful (Wajchman-Świtalska et al., 2021).

The urban forest comprises of variants of trees like 'pyrus' and 'palantus' trees in a fully workable urban area (Ismail et al., 2018). These trees can be clusters or individuals placed in a linear fashion inclusive of individual street trees and clusters of park trees (Lamhamedi et al., 2021). The slum areas consist of pseudo-urban forests that extend to the outer areas of the metropolis. This includes the periphery of the north, west and east portion of Karachi.

Urban forests not only provide individual benefits but also contribute to the United Nations Sustainable Development Goals (UNSDGs) (Campbell-Arvai & Lindquist, 2021). More specifically, it leads to reduced poverty, aids zero hunger objectives, promotes health and well-being as well as clean water and sanitation. Moreover, the SDGs linked to forest deregulation, are related to Affordable and Clean Energy as well as the SDG denoting Industry, Infrastructure, and Innovation. Urban forests are linked directly and indirectly to the implementation of SDGs (Kopeva et al., 2018; Maruna et al., 2019)

The urban forest implementation and recreational facilities design faces acute challenges to be addressed for feasibility and adoptability (Jim et al., 2018). The four main challenges are divided into four main sections: treatment of river water; urban forest; impact of recreational areas; and importance of green places.

Treatment of River Water

There are many ways with which river water can be treated, 35% to 54% of dissolved organic carbon can be removed by using hybrid coagulation and ceramic membrane process (Li et al., 2011). Inorganic pollutants and suspended solids can be removed by Riverbank filtration (RBF), which is a cost-effective in situ water treatment process (Ahmed & Marhaba, 2017). While flocculation using chitosan and bean straw flour as bioflocculants is an eco-friendly approach towards the treatment of river water (Picos-Corrales et al., 2020).

Urban Forest

Urban forests can be useful for the conservation of ecosystems. The linkage of urban forestry and ecological engineering can provide opportunities on nature building to achieve renewably powered and system-based self-design (Endreny, 2018). There are hundreds of benefits of urban forests (Dunn & Welch, 2021). Some methods and techniques are given, such as Miyawaki Method, a well-known method originally pioneered by Professor Akira Miyawaki. It refers to the prevention of depletion of greenery by using the concept of potential natural vegetation resulting in more density and growth based on diverse biosystems (Lewis III, 2005) .

Impact of Recreational Areas

Recreational activities can have a great impact on human life, cited studies have shown that recreational activities have a significant impact on human health, especially on the lipid profile (Faria et al., 2020).

Benefits of Green Places

There are many benefits of having green places in the neighbourhood, which include mental, physical, emotional, and spiritual health (De Kleyn et al., 2020). Green places also help to reduce Green House Gases(GHG) (Marchand et al., 2015).

Key Contributions of this work include the implementation framework for the Malir river water section. The cross-section of jogging track, natural reservoir management and artificial forest has been proposed. The feasibility of the proposed model is ensured with a novel analysis and assessment of public income, personal preferences as well as green area categorization.

LITERATURE REVIEW

Karachi, the city of lights, is the largest metropolitan city in Pakistan. As per last census, the population is over 21 million (Sahoutara, 2023). Not only in terms of area and population but also in terms of strong employment ratio, fastest-growing business potential, fastest life of citizens, and extremely affordable housing schemes. As declared by the Economist Intelligence Unit (EIU), economically, Karachi is one of the most affordable cities in the world (Hayder, 2018).

Based on the above, it is extremely considerable and need of time to construct and enhance recreational areas in urban places (Shah & Irandu, 2022) especially, in Karachi. If the design is implemented rigorously, these recreational areas could be transformed into environmental hubs, where residents of Karachi can revitalize themselves, eventually finding peace and positive energetic vibes for personal satisfaction.

Malir river originates in the northest part in the outskirts, nearly 40 km north of the Karachi city as per Government of Sindh. It cuts through the city dumping the seasonal load to the Arabian Sea. The construction of dam on the river was designed to prevent over flow. However, most recently the Malir River has been highlighted in the news due to various factors.

As per Asian Development Bank (ADB) recent survey document on supporting public-private partnership investment projects in Sindh Province, Malir Expressway project, risk mitigation for excess noise through the plantation to reduce the impact of noise levels, is recommended in this project as the most cost-effective and efficient option (ADB, 2022) . Malir Expressway which is around 40km 6 lane expressway hugging the Malir River basin from Qayyumabad in South, terminating near the Bahria Town interchange in the north. The construction has received mixed responses

The urban forest adding to the green places comprises of variants of trees like pyrus and palantus trees in a fully workable urban area. These trees can be clusters or individuals placed in a linear fashion inclusive of individual street trees and clusters of park trees. The slum areas consist of pseudo-urban forests that extend to the outer areas of metropolis. This includes the periphery of north, west and east portion of Karachi. The concept of artificial lake has been explored previously (Picos-Corrales et al., 2020) and the urban wetland is highlighted in a case study in China as detailed in Yang (2021).

The demand of green spaces like urban forests has increased and possesses vital importance because of the rising population and adverse health effects. The citizens are aware that an increase in population density negatively impacts environmental conditions (Arofah et al., 2019). People of Karachi have become

very detached from the natural environment and have been restricted to living amongst steel and concrete structures (Baumeister et al., 2020).

OBJECTIVE OF THE STUDY

The study aim consists of two folds i.e. proposal of up to 5 km long urban forest spanning on both sides of treated Malir River with multiple recreational activities, and study the behaviour and reaction of people about green recreational areas.

PROPOSAL OF URBAN FOREST

Less than a decade ago, a new infrastructure project was announced by the Sindh Government "Malir Expressway" beginning from KPT Interchange (Qayyum Abad) to M9 Motorway, near DHA City. This proposed 39 KM Expressway is going to be the longest road planned to be constructed in the Urban Area of Karachi. This paper focuses on proposing an urban forest for the longest planned road and highlighting environmental impact based on a quantitative analysis. The first objective is described well in section 6, Proposed System Model. The second objective is completely based the data which has been generated and gathered with the help of questionnaire.

OVERVIEW OF MALIR EXPRESSWAY

With the help of available state-of-the-art studies and research articles, the feasibility of proposed model is depicted (Bradley & Bare, 2019). In the route of Malir Expressway, a 5 Kilometers long "Artificial or Treated Lake" is proposed. The lake is supposed to be surrounded by the urban forests along with its length, on both sides. The proposed features consist of a 2 KM long fishing area and 3 KM long boating and other water sports area as shown in the picture (proposed cross-section).

PROPOSED SYSTEM MODEL

The proposed system is to implemented in the Malir River bed in the lower tributary close to the fallout near the Shahrah-e-Faisal regioni where a river flows with treated water. This has enabled the river to be surrounded by dense and lush green urban forests and has some designated space for jogging and cycling along with fishing, boating, and other water sport Amenities.

This proposal relates to enhancing Malir River and its impact on the environmental factors associated with Malir Expressway. This coud be inhouse or a private public partnership. Construction of this recreational green area can provide mul-

tiple benefits (Cetin et al., 2018) . An urban forest can improve the quality of air and water, pollutants as well as carbon are eliminated from the air (Lukito, 2018). The recreational benefits that urban forests and green places can deliver are closely associated with their positive impact on the mental and physical health of the residents (Bertram & Larondelle, 2017). Moreover, it can provide healthy leisure time activities, people can develop fishing skills, can ride a bicycle or can jog along a beautiful track. Furthermore, food and relax (Jang-Hwan et al., 2020).

Quantitative Survey

A quantitative survey have been conducted, containing a population size of Karachi more than 15,000,000 (Schetke et al., 2016) having a confidence level of 95% and a margin error of 10%. The state-of-the-art studies reveals the beneficial facts and figures of such conducted surveys (Nesticò et al., 2019). Therefore, an effective survey of sample size of 96 was selected from the collected data, which

Figure 1: *3D Model of the proposed Malir Expressway Urban Forest and Recreational Zone. Here the recreational zones are detailed, which includes water recycling and usage in promoting greenery as well as entertainment (activities as well as food items), to be established on the lower banks of Malir River in Karachi.*

Table 1.
Recreational options

	Recreational options identified in Figure 1
A	Cycling/Jogging Track
B	River Water Purification System
C	Fish Farm
D	Fishing Area
E	Boating & Other Water Sports Area
F	Huts & Restaurants
G	Solar Power Station

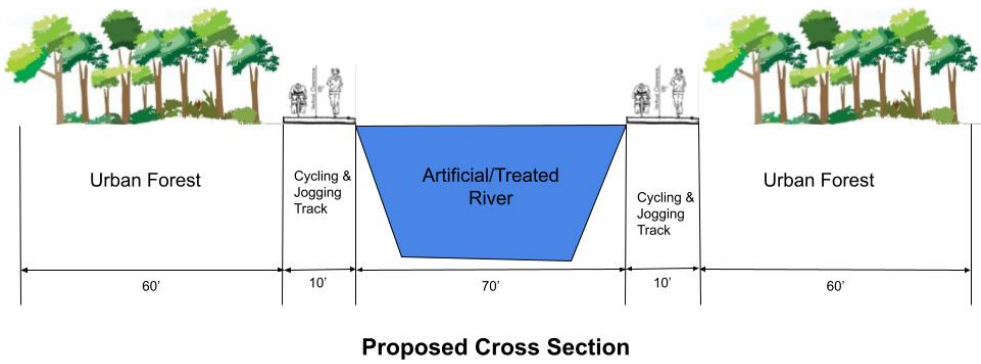

Figure 2: *Cross-section of the Urban Treated River, Jogging Track, and Urban Forest to giveperspective of reuse of the river banks*

is collected from mostly professionals and students residing in Karachi.

METHODOLOGY

An nstrumental questionnaire survey was sent to the participants during March 2021 to inquire about people's reactions to the recreational area as mentioned, expectations, and future requirements. The questionnaire was prepared using Google Forms (Raju & Harinarayana, 2016). This questionnaire consisted of three

attributes

Table 2.
Questionnaire attributes

No	Attribute	Details of Attribute
1	Personal Information	1. Age 2. Income 3. Location 4. Qualification
2	Quantitative Analysis	1. Strongly disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
3	Questions	Included in Appendix-1

No	Questionnaire Questions
1	How old are you?
2	What is your job status?
3	What would you say your income is (Rs.)?
4	What is your residential status?
5	Do you own a vehicle (Motorcycle/Car)?
6	Do you have any educational qualifications?
7	In which area of Karachi do you live?
8	I would pay more municipal taxes in order to build these places in Karachi?
9	I would like to see more green areas in Karachi
10	I use these spaces in my neighborhood to relax.
11	I use these green spaces in my neighborhood for recreation
12	These green spaces in my neighborhood contribute to my quality of life
13	I would love to spend my time in these places.
14	Do you like this idea?
15	How likely would you be willing to spend your leisure time in green places with your friends and family?
16	How do you prefer to have a new fishing place in your city?
17	What preference do you have for a water sports or boating place in Karachi?
18	Do you consider green recreational areas as being an important part of your everyday life?
19	Would you consider living in a place that is described in “Background” in Karachi?
20	How much can you pay to enter such place? (Rs.)
21	How often will you visit that place?

POSSIBILITIES AND THREATS OF IMPLEMENTATION

The possibilities of implementation of such proposed system in a large urban area depends legal requirements and available funds (Gundersen et al., 2019). The availability and possibility of funds depend upon the tax amount collection. The tax is directly proportional to income of the citizens. So, to confirm the feasibility and possibility of such valuable and worthy proposed system model a small data have been fetched from the collected data and shown in the form of Income graph in Figure 3 and Tax graph in Figure 4 .

Income Assessment for the Feasibility of Proposed System

Figure 3 shows the percentage of income of participants where the income is monthly gross as reported by the participants in the survey. The distribution reflects the amount for dwellers that are randomly chosen and the selection is based on random sampling. Here the Figure 3 reveals that participants with income between 25K till 85K constitute between 45 % of the respondents. Similarly, nearly a fifth of the respondents have not detailed any income source or amount.

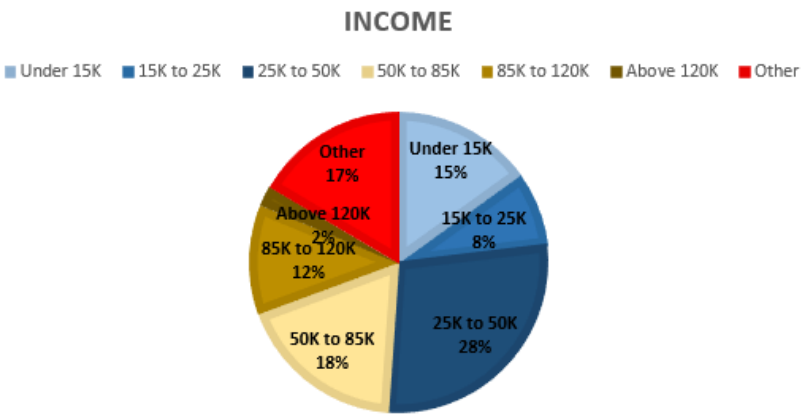

Figure 3: *Income distribution of participants*

Tax Assessment for the Feasibility of Proposed System

In order to implement such beneficial proposed systems, the citizens of Karachi have been asked about willing to pay more taxes in survey. The idea has been reflected through such studies (Sohn et al., 2020). So, it is an important finding and collected by reported responses. Out of 102 people, 61.8% people are willing to pay more taxes to build these places, as shown in Figure 4 the total

percentages of respondents agreed and strongly agreed to pay more taxes as defined by the last three bars.

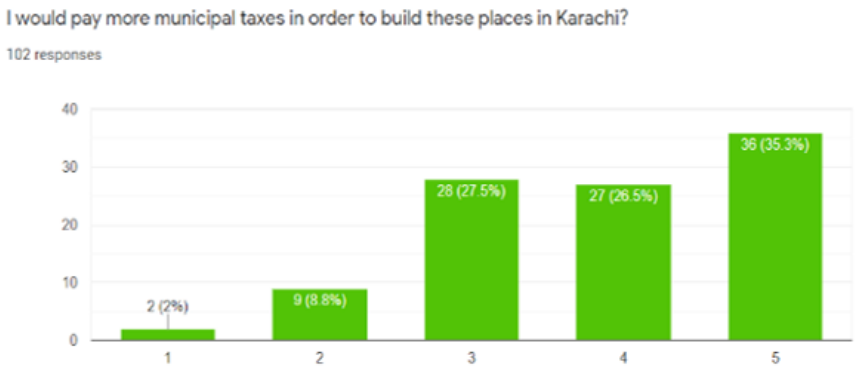

Figure 4: *Municipal taxes for the question related to tax payment to build better places in karachi*

Willingness to Pay entrance Fees to Assess for the Feasibility of Proposed System

Out of 107 people, 57% want to pay a visit once a week, 29% want to pay a visit once a month, and 14% want to pay a visit after months. The following data shows how much people can pay to enter this place.

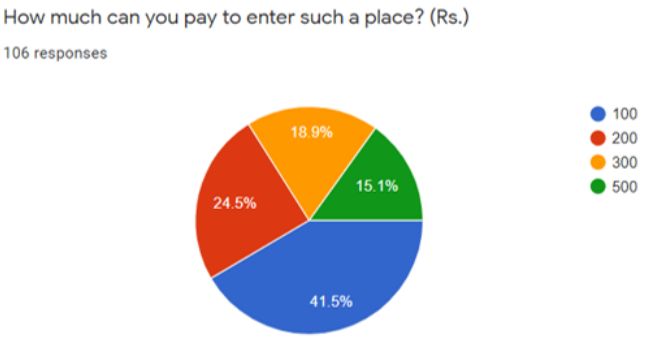

Figure 5: *Affordablity to access urban forest and recreational area in terms of PKR per entry for general facilities proposed for urban forest project.*

Preferences of Green Places for Assessment of the Feasibility of Proposed System

Out of 106, 94.3% of people consider the green recreational area as being an important part of their everyday life. While 76.6% of people consider living in such a place and 91 from 105 would like to see more green areas in Karachi. The identical study has been oobserved in the work of Andrea et al. (2020).

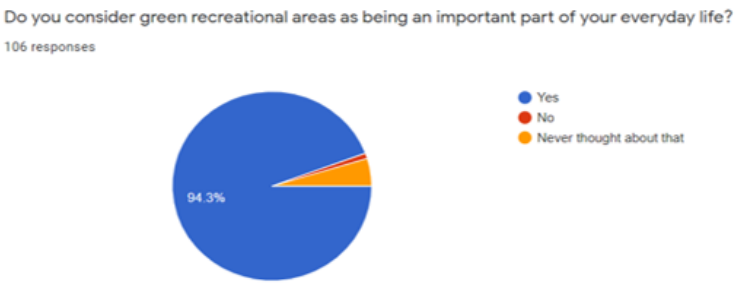

Figure 6: *Reviewof green recreational areas as important part of everyday lives*

Uses of Recreational Area to Assess the Feasibility of Proposed System

Ninety one out of 105 people says that they will use this place to relax, 77% of people would like to use these places for recreation (Hautamäki & Donner, 2021). This is confirmed by Figure 7 which states that 7.9% of respondents are neutral when asked to check whether they would be willing to spend leisure time in green places; 19.8% agree whereas 72.3% strongly agree to spend leisure time in green places with friends and family. This sums up to 91% (Sun et al., 2019), 84% of people want to have such a fishing place, and 91% of people prefer water sports/boating area in Karachi.

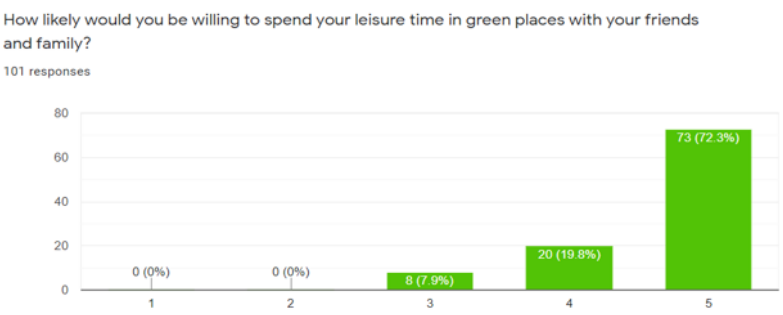

Figure 7: *Time management quantified in leisure hours response for anaverage Karachi family.*

RESULT ANALYSIS

A total of 112 responses were received in which 96.4% of people were educated and 4.6% were uneducated; 66.1% owns a vehicle while 33.9% travels via public transport; 47% works full time, 14% does not work or housewives; and 32% are students and 7% works part-time.

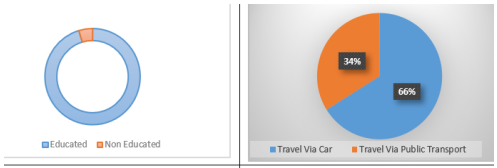

Figure 8: *Demographics of Respondents*

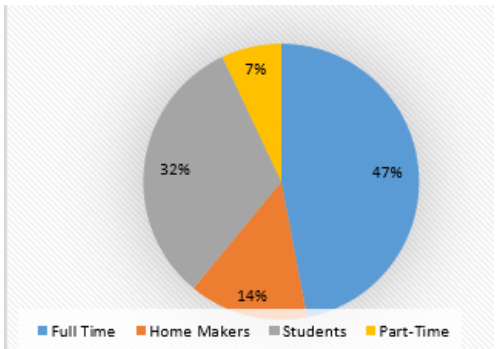

Figure 9: *Work Mode*

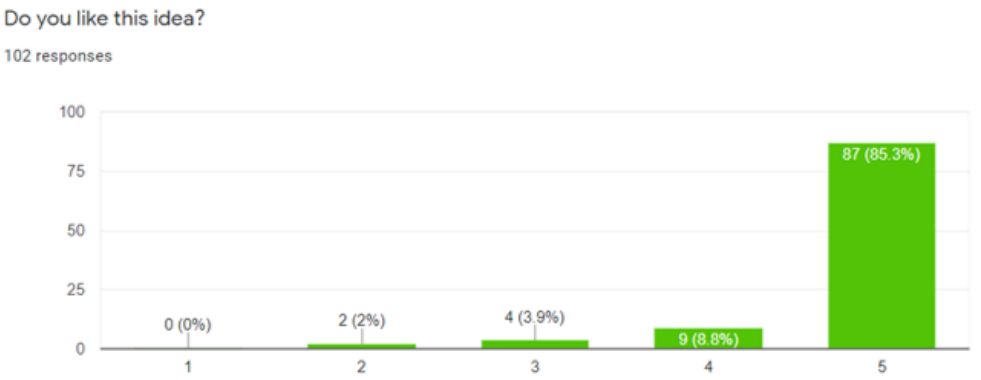

Figure 10: *Likeability of the idea related to public use of Malir River Bed Forestation drive.*

94.1% of people love this idea and want such a green place where they can enjoy multiple activities with their family and friends (Lee et al., 2021). This consists of people who have responded with agreement (8.8%) and strong agreement (85.3%) for likeability of the idea of Malir River Bed Forestation Drive.

CONCLUSION

This is the first known attempt on proposing a framework for implementing an urban forest spanning on both sides of the treated Malir River with facilities of multiple recreational activities in Karachi. This proposal will not only help fulfill the need of such recreational area but also to balance the negative environmental impact of Malir Expressway. To support this idea, a quantitative survey was conducted to check people's response. It was found that people are willing to pay more taxes for the construction of healthier green spaces besides willing to pay the required entrance fees. People come to know the importance of quality of life in post pandemic, so they really need more green recreational areas in Karachi. As predicted, the population of Karachi will grow along the M9 Motorway so this proposal can help to assess EIA report of Malir Expressway and other future projects. We propose the consideration of this project and recommend further ventures along arterial water flow channels within the urban areas of Sindh to SEPA and other authorities. To develop this project in future, a detailed on-site survey, cost estimation, and feasibility report should be carried out.

This research proposed model is a first known attempt on preserving forest and water habitat along the major artery connecting north to south of the largest city of Pakistan. The survey findings show that people are willing to pay up to Rs100 for a weekly visit with fishing and boating provisions. The same is proposed to Sindh Environmental Protection Agency (SEPA) and further work for a detailed technical management assessment based on the above guidelines is expected as a result of this publication. The study further suggests promoting water sports, exercising in green environment as well as potential advantage of locations for solar station and fish farm for sustainable development.

IMPLICATIONS

Future work can extend the concept of urban forest and add features like the fish diversity aquarium, and use disruptive technologies as a means to implement social positivity as well as cost as designs adapt to changing economic, technological and human resources management topics.

CONFLICT OF INTEREST STATEMENT

The authors have declared no conflict of interest.

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