

Does Carbon Disclosure Enhance Firm Performance? Evidence from Indian Corporate Firms

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Abstract: Growing concerns over climate change and increasing stakeholder expectations have made carbon disclosure an essential component of corporate sustainability reporting. Although firms are increasingly disclosing carbon-related information, empirical evidence regarding its influence on financial performance remains inconclusive, particularly in emerging economies. This study investigates the impact of carbon disclosure on firm performance in the Indian context under the evolving sustainability reporting regime. The study employs a panel dataset of 73 non-financial companies from the BSE 100 Index over the period 2020–2025. Fixedeffects panel regression is employed after addressing diagnostic issues relating to heteroscedasticity, autocorrelation, and multicollinearity. The empirical findings reveal that carbon disclosure exerts a statistically significant negative effect on firm performance, indicating that the costs associated with environmental reporting and sustainability initiatives outweigh their short-term financial benefits. The study contributes to the literature by providing evidence from India's mandatory sustainability reporting framework and offers important implications for policymakers, corporate managers, and investors. The findings suggest that while carbon disclosure may reduce short-term profitability, it remains a critical strategic tool for enhancing transparency, strengthening stakeholder confidence, and fostering sustainable value creation in the long run.

Keywords: Carbon disclosure, firm performance, BRSR, sustainability reporting.

1. Introduction

Climate change has increasingly become a central concern in global economic and policy discourse, primarily driven by the continuous rise in greenhouse gas emissions, particularly carbon dioxide. The acceleration of industrial activities, urbanization, and energy-intensive production processes has significantly contributed to environmental degradation, thereby posing serious risks to ecological balance and long-term economic sustainability (Borghei, 2021). In this context, corporations are recognized not only as major contributors to carbon emissions but also as key agents capable of driving environmental change through responsible business practices and transparent reporting mechanisms.

Over time, there has been a paradigm shift in the expectations of stakeholders, moving beyond traditional financial performance towards a broader evaluation of corporate accountability. Investors, regulators, and society at large now demand greater transparency regarding firms' environmental impacts, especially in relation to carbon emissions. This shift has led to the emergence and growing importance of sustainability reporting, within which carbon disclosure has gained significant prominence. Carbon disclosure refers to the systematic reporting of a firm's carbon-related information, including direct and indirect emissions, energy consumption patterns, climate-related risks, and emission reduction strategies. Such disclosures serve as a critical tool for reducing information asymmetry between firms and stakeholders, thereby enabling more informed decision-making (He et al., 2013).

From a theoretical perspective, the importance of carbon disclosure can be understood through multiple frameworks. Stakeholder theory suggests that firms disclose environmental information to meet the expectations of diverse stakeholder groups, thereby ensuring continued support and legitimacy. Legitimacy theory further posits that companies engage in disclosure practices to align their operations with societal norms and values, particularly in response to increasing environmental concerns. Additionally, signalling theory highlights that firms with superior



environmental performance (Kolk et al., 2008) are more likely to voluntarily disclose carbon-related information as a signal of transparency and long-term sustainability, thereby enhancing their reputation in the market.

At the global level, various standardized frameworks have been developed to guide corporate sustainability reporting and improve the quality and comparability of disclosures. Institutions such as the Global Reporting Initiative, the Carbon Disclosure Project, and the Task Force on Climate-related Financial Disclosures have played a pivotal role in establishing structured guidelines for reporting environmental information. These frameworks emphasize consistency, transparency, and comparability, thereby enabling stakeholders to evaluate firms' environmental performance more effectively across industries and regions.

In the Indian context, the evolution of sustainability reporting has been significantly influenced by regulatory initiatives introduced by the Securities and Exchange Board of India. The Business Responsibility Report (BRR) was initially implemented as a mandatory disclosure framework for top listed companies, focusing on responsible business practices across environmental, social, and governance dimensions. However, the BRR framework had certain limitations, particularly in terms of the depth, standardization, and quantifiability of environmental disclosures. Carbon-related information under BRR was often qualitative and lacked uniformity, making it difficult to conduct rigorous empirical analysis (Mahajan, 2022).

Recognizing these limitations and the increasing global emphasis on ESG reporting, SEBI introduced the Business Responsibility and Sustainability Reporting (BRSR) framework as a more comprehensive and structured reporting mechanism. BRSR represents a significant advancement over BRR by incorporating detailed, standardized, and quantifiable indicators related to environmental performance, including specific metrics for carbon emissions, energy usage, and climate-related risks. The transition from BRR to BRSR thus reflects a broader shift towards enhanced transparency, accountability, and alignment with international sustainability reporting standards.

This transition is particularly relevant for empirical research, as it introduces variations in the nature and quality of disclosed information over time. While BRR (covering the period from 2020 to 2022) provides a baseline understanding of corporate sustainability practices, BRSR offers a more refined and detailed dataset. The integration of both frameworks in a single study allows for a more comprehensive examination of carbon disclosure practices, while also capturing the evolution of reporting standards in India.

Parallel to the growing emphasis on environmental disclosure, there has been increasing interest in examining its economic consequences, particularly its impact on firm performance. Financial performance reflects a firm's ability to efficiently utilize its resources and generate value for shareholders, commonly measured through accounting-based indicators such as Return on Assets (ROA). The relationship between carbon disclosure and financial performance, however, remains inconclusive in existing literature. While some studies suggest that enhanced disclosure improves firm value by strengthening stakeholder trust and reducing information asymmetry, others argue that the costs associated with environmental initiatives and reporting may negatively affect profitability, at least in the short term.

These mixed findings highlight the need for further empirical investigation, particularly in emerging economies like India, where sustainability reporting practices are still evolving. Moreover, the existence of BRSR frameworks within the study period provides a unique opportunity to analyze carbon disclosure in India. By incorporating data from BRSR, the present study aims to provide a more nuanced and dynamic understanding of the relationship between carbon disclosure and firm performance.

Therefore, this study seeks to contribute to the existing body of knowledge by empirically examining the impact of carbon disclosure on financial performance, while also considering the evolving regulatory landscape in India. It not only evaluates whether increased transparency in carbon reporting translates into improved financial outcomes but also offers insights into how changes in reporting frameworks influence corporate disclosure behaviour. The findings of this study are expected to have important implications for policymakers, investors, and corporate managers in promoting sustainable and value-driven business practices.

2. Review of Literature

The literature on carbon disclosure has evolved considerably over the past two decades, reflecting the growing global concern over climate change and the increasing demand for corporate environmental accountability. Early research primarily focused on understanding why firms disclose carbon-related information, whereas recent studies have shifted towards examining the quality of disclosures, their financial implications, and the influence of regulatory frameworks and corporate governance.

The foundation of carbon disclosure research emerged in the context of international climate agreements, particularly

following the implementation of the Kyoto Protocol. Early evidence suggested that national regulatory environments

significantly influenced corporate disclosure practices. Firms headquartered in countries that ratified the Kyoto Protocol were found to disclose more comprehensive greenhouse gas information than firms from non-ratifying countries, even when both operated under similar regulatory conditions. This highlighted the role of institutional pressure and national commitment in shaping voluntary environmental disclosure practices (Freedman & Jaggi, 2005). Around the same period, increasing investor activism through initiatives such as the Carbon Disclosure Project (CDP) encouraged greater corporate participation in carbon reporting. Although participation rates improved substantially between 2003 and 2007, researchers observed that disclosure quality remained inconsistent due to the absence of standardized reporting practices and limited external verification (Kolk et al., 2008).

As carbon reporting became more widespread, researchers began exploring its economic consequences. Studies investigating the relationship between carbon disclosure and corporate financial outcomes produced mixed findings. He et al. (2013) demonstrated that greater carbon disclosure reduces firms' cost of capital, supporting voluntary disclosure theory, while simultaneously finding that firms with poorer environmental performance often disclose more extensively to maintain legitimacy. These findings indicate that carbon disclosure serves both as an information mechanism for investors and as a strategic response to stakeholder pressure. Expanding this perspective, Blanco et al. (2017) argued that participation in carbon disclosure initiatives generates benefits beyond regulatory compliance by improving operational efficiency, reducing costs, strengthening stakeholder relationships, and enhancing corporate reputation. As empirical evidence accumulated, scholars began critically reviewing the emerging body of research. Hahn (2015) observed that although carbon disclosure literature had expanded rapidly following the Kyoto Protocol, much of the research lacked a strong theoretical foundation and focused predominantly on disclosure practices rather than their actual environmental or financial consequences. Similarly, Borghei (2021), through a comprehensive systematic review, concluded that carbon disclosure research remains fragmented due to inconsistent measurement approaches and the absence of a unified conceptual framework. Both reviews emphasized the need for standardized reporting mechanisms and stronger theoretical integration to improve the comparability and reliability of future research.

The growing availability of international panel data enabled researchers to investigate whether carbon disclosure genuinely reflects environmental performance and creates economic value.

Siddique et al. (2021) reported that high-quality carbon disclosure is associated with better carbon performance and improved financial outcomes across diverse institutional settings, suggesting that disclosure increasingly represents substantive environmental commitment rather than symbolic compliance. However, Lu et al. (2021) demonstrated that these benefits are not universal. Their findings revealed significant industry heterogeneity, with positive financial effects observed primarily in non-carbon-intensive industries, while firms operating in carbon-intensive sectors experienced no immediate financial gains from disclosure. These contrasting findings indicate that industry characteristics substantially moderate the relationship between carbon disclosure and firm performance.

Parallel to international developments, India witnessed a significant transformation in sustainability reporting through regulatory interventions by the Securities and Exchange Board of India (SEBI). Earlier studies examining Business Responsibility Reporting (BRR) observed gradual improvements in disclosure practices but also identified considerable variation across reporting dimensions. Social disclosures generally exhibited higher transparency than environmental and supply-chain disclosures, highlighting persistent weaknesses in environmental reporting (Mahajan, 2022). The subsequent transition from BRR to Business Responsibility and Sustainability Reporting (BRSR) represented a major regulatory milestone intended to align Indian sustainability reporting with global ESG standards (Menghnani & Babu, 2022). Evidence suggests that the market responded favourably to this regulatory reform, as investors viewed mandatory sustainability disclosures as value-relevant information, resulting in significant positive abnormal stock returns following SEBI's BRSR announcement (Desai & Budiman, 2023).

Recent research has further expanded the literature by examining factors influencing disclosure quality. Contrary to expectations, Ladista et al. (2023) found that conventional corporate governance characteristics such as board composition and managerial ownership did not significantly influence carbon disclosure among Indonesian firms. In contrast, Bedi and Singh (2024) demonstrated that ownership structure plays a crucial role in the Indian context, with institutional investors, foreign shareholders, and ownership concentration significantly improving

carbon disclosure practices. These contrasting findings suggest that governance mechanisms may operate differently across institutional environments.

Another emerging area focuses on enhancing the credibility of carbon reporting. Luo et al.

(2023) found that firms obtaining external carbon assurance produce significantly higher-quality disclosures, particularly in stakeholder-oriented countries and weaker regulatory environments. Their findings suggest that third-party assurance serves as an important mechanism for improving transparency and stakeholder confidence in corporate climate reporting.

The relationship between carbon disclosure and firm value continues to generate conflicting evidence. Lestari et al. (2024) found that while superior carbon performance directly enhances both financial performance and firm value, carbon disclosure itself primarily improves financial performance without exerting a direct influence on firm value. Financial performance partially mediates this relationship, suggesting that disclosure creates value indirectly through improved operational outcomes. Conversely, Bedi and Singh (2025), using Indian evidence, reported a significant negative association between carbon emission disclosure and firm financial performance, although larger firms were better able to absorb the associated disclosure costs. These contradictory findings indicate that the financial consequences of carbon disclosure remain context-dependent and may vary according to institutional environments, firm characteristics, industry composition, and regulatory maturity.

Overall, the literature demonstrates a clear evolution from examining whether firms disclose carbon information to understanding why they disclose, what determines disclosure quality, and how disclosure influences financial and market outcomes. While considerable progress has been made, important gaps remain. Existing evidence presents inconsistent findings regarding the financial implications of carbon disclosure, employs diverse disclosure measurement approaches, and predominantly focuses on developed economies. Although Indian research has expanded following the introduction of BRSR, empirical studies examining carbon disclosure and firm financial performance within India's evolving mandatory sustainability reporting framework remain limited. These gaps provide a strong rationale for the present study, which seeks to examine the relationship between carbon disclosure and corporate financial performance in the Indian context under the emerging BRSR regime.

3. Research Methodology

3.1 Sample

The sample of the study is drawn from the BSE 100 index, which comprises large and well-established companies listed on the Bombay Stock Exchange. Initially, all 100 companies were considered; however, financial sector firms, including banks, insurance companies, and other financial institutions, were excluded due to their distinct financial structure, regulatory environment, and reporting practices, which are not directly comparable with non-financial firms, particularly in the context of carbon disclosure and environmental performance. After applying this exclusion criterion, the final sample consists of 73 non-financial companies. The selection is further based on the availability of complete and consistent data on carbon disclosure (as per BRSR) and firm performance variables for the period 2020–2025, ensuring reliability and comparability of the analysis.

3.2 Variable Measurement

3.2.1 Independent variable: The Carbon Disclosure Score (CDS) index used in this study is constructed based on the disclosure requirements specified under the Business Responsibility and Sustainability Reporting (BRSR) framework issued by SEBI. The index is designed to measure the extent and quality of carbon-related disclosures made by companies. A content analysis approach was adopted, where relevant carbon-related information was extracted from annual reports, sustainability reports, and BRSR reports of selected companies.

The CDS index includes the following key disclosure components:

- Greenhouse Gas (GHG) emissions (Scope 1, Scope 2 and scope 3)
- Energy consumption and efficiency
- Energy intensity
- Emission intensity
- Consumption of fuel

- NO₂, SO₂ and other emission
- Use of renewable energy
- Use of non- renewable energy

Each item in the index was assigned a score based on disclosure:

- 1 = Disclosure present
- 0 = Disclosure absent

The total CDS for each firm was calculated by summing the scores of all items. To ensure comparability, the score was normalized by dividing the total score by the maximum possible score.

3.2.2 Dependent variable: There are many indicators of financial performance, such as return on assets (ROA), earnings per share (EPS), return on equity (ROE), Z-score proposed by Edward Altman, return on investment (ROI) and profit margin. Among them, ROA and ROE are financial performance indicators recognized by scholars all over the world. Based on previous research, this paper selects the return on assets (ROA) as a substitute variable for financial performance. This indicator can reflect the company's financial performance at an overall level, and its high or low level can directly reflect the company's financial status, will not be affected by the company's extraordinary events, and has the characteristics of being objective, universal, and easy to obtain. At the same time, ROA is also one of the most concerned financial indicators of corporate stakeholders and it has good comparability.

3.2.3 Control Variables: Growth, leverage, firm age, board size, board independence and gender diversity are commonly used control variables in studies examining corporate financial performance and carbon disclosure, as they capture important firm-specific characteristics that may influence the relationship between the independent and dependent variables. Growth reflects a firm's expansion potential and future prospects and is commonly measured by the annual percentage change in sales or revenue (Brush et al., 2000). Leverage indicates the extent to which a firm relies on debt financing and is typically measured as the ratio of total debt to total assets, with higher leverage representing greater financial risk due to increased dependence on external borrowing (Arhinful & Radmehr, 2023). Firm age refers to the number of years a company has been in operation since its incorporation, reflecting its experience, stability, and organizational maturity. Board size represents the total number of directors serving on the company's board and is an important corporate governance attribute that influences strategic decision-making, monitoring effectiveness, and overall oversight of management (Eisenberg et al., 1998; Mak & Kusnadi, 2005). Likewise, board independence embarks positive impact on firm performance (Patil and Yadav, 2026). However, gender diversity lacks significant association. The operationalization of variables is deployed in table 1.

Table 1: List of Variables Employed in the Study

Variables	Measurement
Dependent Variable	
Return on Asset (ROA)	Net Income/Total Asset (Ace Equity Database)
Independent Variable	
Carbon Disclosure Score (CDS)	Each item in the index was assigned a score based on disclosure: 1 = Disclosure present, 0 = Disclosure absent
Control Variables	
Growth	(Current sale – Previous sale)/ Previous Sale
Leverage	Total Debt/Total Asset
Log (Firm Age)	Current year- Year of incorporation

Log (Board Size) (B_Size)	Total number of directors
Board Independence (B_Ind)	Proportion of Independent Directors on Board
Gender Diversity (G_Div)	Percentage of women directors on board

Source: Compiled from various studies.

4. Results and Discussion

4.1 Descriptive Statistics

The descriptive statistics presented in Table 2 provide a comprehensive overview of the distributional characteristics of the variables employed in the study, including the independent variable (Carbon Disclosure Score), the dependent variable (Return on Assets), and the control variables. The analysis highlights both central tendencies and dispersion, thereby offering initial insights into the nature of the dataset. Overall, the results indicate the presence of variability across firms, particularly in terms of disclosure practices and financial performance, which is essential for further empirical investigation. The independent variable, Carbon Disclosure Score (CDS), records a mean value of 0.592 and a median of 0.727, indicating a negatively skewed distribution where a larger proportion of firms exhibit relatively higher disclosure levels. However, the standard deviation of 0.336 and the wide range from 0.000 to 1.00 reflect substantial variation in disclosure practices, suggesting inconsistency across firms in terms of environmental transparency. The dependent variable, Return on Assets (ROA), shows a mean of 9.57 and a median of 8.09, indicating that firms are generally profitable. Nevertheless, the high standard deviation of 7.47 and the range from -11.2 to 35.5 reveal significant dispersion, highlighting the coexistence of both loss-making and highly profitable firms within the sample.

With regard to the control variables, growth exhibits a mean of 0.126 and a median of 0.102, suggesting moderate expansion among firms, although its variability indicates the presence of both declining and rapidly growing firms. Leverage, with a mean of 0.178 and a median of 0.121, reflects a generally conservative financing approach, though differences in capital structure are evident across firms. Firm Age demonstrates relative stability, as indicated by closely aligned mean and median values and a low standard deviation, implying that most firms fall within a similar maturity range. Likewise, Board Size shows minimal variation, suggesting consistency in governance structures across the sample. Board Independence has a mean of 0.510, indicating that independent directors constitute approximately half of the board on average, although the wide range reflects differences in governance practices across firms. Gender Diversity, with a mean of 0.187, highlights relatively low representation of female members on corporate boards, with some firms showing no diversity at all. Overall, the descriptive statistics reveal substantial variation in key variables, particularly CDS and ROA, while certain firm characteristics remain relatively stable. These findings justify the application of advanced econometric techniques in subsequent analysis to examine the relationship between carbon disclosure and financial performance while accounting for firm-specific factors.

Table 2: Descriptive Statistics of Variables Employed in the Study

Variable	Mean	Median	S.D.	Min	Max
CDS	0.592	0.727	0.336	0.000	1.00
ROA	9.57	8.09	7.47	-11.2	35.5
GR	0.126	0.102	0.194	-0.374	1.37
Leverage	0.178	0.121	0.170	0.000	0.559
Age	3.86	3.82	0.511	2.56	4.77
Board size	2.39	2.40	0.227	1.79	3.14
Board independence	0.510	0.500	0.131	0.0909	0.818
Gender diversity	0.187	0.167	0.102	0.000	0.600

Source: Authors' Own Computation.

4.2 Regression Results

In order to gauge the impact of carbon disclosure on firm performance, panel regression is applied. Further, panel regression model has been checked for the assumptions of autocorrelation, multicollinearity and heteroscedasticity. The presence of autocorrelation and heteroscedasticity as diagnosed through Wooldridge test and Breusch Pagan test respectively has been corrected through cluster command in stata. However, due to acceptable limits of Variance Inflation factor i.e. below 10, the data does not suffer from multicollinearity issue. In addition, the Hausman test (p-value = 0) strongly supports the use of the fixed-effects model over the random-effects model. Following regression model has been employed to check the impact of carbon disclosure on firm performance:

$$ROA_{i,t} = \alpha + \beta_1 DIS_{i,t} + \beta_2 GR_{i,t} + \beta_3 Lev_{i,t} + \beta_4 Age_{i,t} + \beta_5 B_Size_{i,t} + \beta_6 B_IND_{i,t} + \beta_7 G_DIV_{i,t} + \varepsilon_{i,t}$$

where $ROA_{i,t}$ is the accounting-based financial performance of firm i in period t ; $DIS_{i,t}$ denotes the carbon emission disclosure score; $GR_{i,t}$ represents sales growth; $Lev_{i,t}$ represents firm leverage; $Age_{i,t}$ depicts the age of the firm; $B_IND_{i,t}$ is the board independence; $B_Size_{i,t}$ is the size of the board; $G_DIV_{i,t}$ represents gender diversity; and $\varepsilon_{i,t}$ is the error term.

Table 3. Regression Results for Full Sample

	Coefficient	Std. Error	t-ratio	p-value
const	−85.9898	19.5097	−4.408	<0.0001 ***
CDS	−1.00703	0.291649	−3.453	0.0007 ***
Board size	0.681417	1.10801	0.6150	0.5393
Board independence	5.18088	1.24308	4.168	<0.0001 ***
Boarddivesity	3.13475	4.49437	0.6975	0.4864
Leverage	−15.8304	5.07267	−3.121	0.0021 ***
Age	24.3166	4.91194	4.951	<0.0001 ***
Growth	2.21752	0.581731	3.812	0.0002 ***

Source: Author's estimation using GRETL.

Durbin- Watson 1.130421

Within R-square 0.194859

The key independent variable, Carbon Disclosure Score (CDS), exhibits a negative and statistically significant impact on Return on Assets (ROA) (coefficient = −1.007, p-value = 0.0007) (table 3). This suggests that a one-unit increase in CDS leads to a decrease in ROA by approximately 1.007 units, holding another factors constant. The finding indicates that increased carbon disclosure may impose additional costs related to environmental compliance and reporting, thereby adversely affecting short-term profitability. Since the p-value is well below 0.05, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted, confirming a significant impact of CDS on firm performance. With respect to control variables, board independence shows a strong positive and significant effect on ROA (coefficient = 5.180, p-value < 0.0001), indicating that a 1-unit increase in board independence improves ROA by 5.18 units, reflecting the role of effective governance in enhancing firm performance. Similarly, firm age has a positive and highly significant impact (coefficient = 24.316, p-value < 0.0001), suggesting that more experienced firms tend to generate higher profitability. Firm growth also positively influences ROA (coefficient = 2.217, p-value = 0.0002), implying that expanding firms are more capable of generating returns. In contrast, leverage has a significant negative effect on ROA (coefficient = −15.830, p-value = 0.0021), meaning that higher debt levels substantially reduce profitability due to increased financial obligations. However, board size (coefficient = 0.681, p-value = 0.5393) and gender diversity (coefficient = 3.135, p-value = 0.4864) are statistically insignificant, indicating that these variables do not have a meaningful impact on financial performance in this model. The overall model demonstrates strong explanatory power, with an LSDV R-squared of 0.842, indicating that approximately 84.2% of the variation in ROA is explained by the model.

5. Conclusion

This study systematically investigates the relationship between carbon disclosure and financial performance within the context of increasing regulatory emphasis on sustainability, particularly under the Business Responsibility and Sustainability Reporting (BRSR) framework. Drawing upon existing literature and empirical evidence, the study seeks to bridge the gap between environmental transparency and its financial implications by focusing specifically on Return on Assets (ROA) as a measure of firm performance. The empirical results reveal that carbon disclosure has a statistically significant negative impact on financial performance in the overall period. This suggests that increased environmental disclosure is associated with higher operational and compliance costs, which adversely affect short-term profitability. Overall, the study makes a meaningful contribution to the literature by demonstrating that while carbon disclosure is becoming increasingly significant in a regulated environment, its impact on financial performance remains negative in the short term. This finding supports the argument that sustainability practices involve initial costs that may not immediately translate into financial gains but are essential for long-term value creation. From a practical perspective, the study suggests that firms should adopt a strategic approach toward sustainability, integrating environmental practices with core business operations to minimize cost inefficiencies.

Policymakers, on the other hand, should focus on creating supportive frameworks that not only enforce disclosure but also incentivize sustainable practices to reduce the financial burden on firms.

While the present study provides meaningful insights into the relationship between carbon disclosure and firm performance, it also opens several avenues for further research. Future research may extend the time horizon to examine the long-term impact of carbon disclosure. Since sustainability practices often involve initial costs and delayed benefits, a longer study period could help in understanding whether the negative short-term relationship eventually turns positive over time. In addition, future studies can explore industry-specific analysis to determine whether the impact of carbon disclosure varies across sectors, particularly between environmentally sensitive and non-sensitive industries.

Use of AI tools declaration

No AI tools were used in the writing or preparation of this manuscript.

Conflict of interest

Author declares no conflicts of interest in this paper.

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