

Strategic Portfolio Allocation: An Analytical Approach to Balancing Market and Style 23 Investments: A Case Study

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Abstract. This study explores optimal portfolio design by evaluating the risk-return dynamics of the Style 23 and Market portfolios, employing advanced statistical and analytical tools such as Sharpe ratio, regression analysis, cumulative returns, and Value at Risk (VaR). By examining both the entire and half-sample datasets, we developed a robust investment strategy that combines a 0.343 weight for Style 23 and a full weight for the Market Portfolio, demonstrating the benefits of diversification. The findings suggest that this strategy offers superior risk-adjusted returns compared to investing in a single portfolio, as losses in one can be mitigated by gains in the other. However, the analysis also identifies key challenges, including the impact of transaction costs and external factors like economic conditions, which can affect overall performance. These insights underscore the need for continuous strategy evaluation and adjustment. The study concludes that while the combined strategy provides a sound framework for portfolio management, ongoing refinements and adaptability are essential to navigate evolving market landscapes effectively.

Keywords: Portfolio Optimization; Risk-Return Trade-off; Sharpe Ratio; Value at Risk; Asset Allocation; Transaction Costs.

1. Introduction

In today's complex and volatile financial markets, investors are continuously seeking strategies that balance risk and return to achieve optimal portfolio performance. The dynamic nature of market conditions, characterized by economic uncertainties and rapid shifts in asset valuations, necessitates a more sophisticated approach to portfolio management [1]. Traditional investment strategies often fall short in addressing the intricacies of market fluctuations, underscoring the need for advanced techniques that enhance risk-adjusted returns [2]. This study focuses on optimizing portfolio design by evaluating the performance of two distinct portfolios: the Market Portfolio, which broadly reflects overall market trends, and the Style 23 Portfolio, known for its targeted investment strategies that exploit specific market inefficiencies [3]. Through the application of advanced statistical and analytical tools—including Sharpe ratio analysis, regression modeling, cumulative returns, and Value at Risk (VaR)—this research aims to construct a robust investment strategy that effectively combines these portfolios. The primary objective is to determine an optimal blend of the Market and Style 23 portfolios that maximizes returns while managing risk exposure. By analyzing both entire sample and half-sample datasets, the study identifies a strategic allocation that leverages the benefits of diversification, demonstrating how combining different asset classes can offset losses and enhance overall portfolio performance. This research highlights the potential of a 0.343 weight in Style 23 combined with a full weight in the Market Portfolio, offering superior returns for each unit of risk compared to single-portfolio investments.

However, the study also addresses the challenges posed by transaction costs and external market factors that can impact the effectiveness of the strategy. These factors underscore the importance of ongoing evaluation and adaptability in investment strategies. The findings suggest that while the proposed strategy offers a sound framework for managing risk and enhancing returns, continuous

adjustments are crucial to navigating the evolving financial landscape. This research contributes to the field of portfolio management by providing actionable insights into how investors can optimize their asset allocations to achieve better outcomes in uncertain market environments [2-3]. By integrating sophisticated analytical techniques and addressing real-world challenges, this study offers a comprehensive approach to refining investment strategies for enhanced risk management and return optimization.

2. Methodology

2.1 Description of the Portfolios Analyzed: Market and Style 23

2.1.1 Market Portfolio

The Market Portfolio encompasses a wide range of asset classes, including equities, fixed income, and commodities. Designed to reflect overall market trends, it serves as a benchmark for evaluating portfolio performance by replicating major market indices [4]. This portfolio offers insights into general market movements and provides a baseline for comparing more specialized strategies.

2.1.2 Style 23 Portfolio

The Style 23 Portfolio focuses on targeted investment strategies, such as value or growth investing, or specific sectors like technology or healthcare. By utilizing advanced approaches such as long-short positions, this portfolio capitalizes on market anomalies and sector-specific opportunities. While this approach can yield higher returns, it carries additional risks and demands in-depth analysis of specific economic trends [5].

2.2 Analytical Framework and Tools Used

2.2.1 Quantitative Analysis Approaches

Performance Metrics Calculation: Key indicators such as Sharpe ratio, beta, and alpha were calculated to assess the risk-adjusted returns of the portfolios. These metrics provide a clear picture of how each portfolio performs relative to its risk, aiding in the comparison of the Style 23 and Market portfolios [2,5].

Monte Carlo Simulations: Monte Carlo simulations were used to estimate potential future portfolio performance under different market conditions [6]. By simulating thousands of scenarios based on probability distributions, this technique helps assess how resilient each portfolio is under varying levels of uncertainty.

Optimization Techniques: Portfolio optimization was conducted using Excel Solver and other advanced tools to determine the ideal asset allocation that maximizes returns for a given level of risk [7]. This method allowed us to fine-tune the balance between the Market Portfolio and Style 23, ensuring the most efficient asset mix.

2.2.2 Qualitative Analysis Methods

Market Condition Review: The analysis included a review of both current and historical market conditions, examining economic indicators, sector performance, and geopolitical events. These factors informed the portfolio strategy, allowing adjustments to be made in response to broader market influences.

Risk Management Evaluation: A thorough risk assessment was conducted, examining both systemic risks affecting the entire market and specific risks tied to the Style 23 portfolio. This evaluation enabled the identification of vulnerabilities and the development of mitigation strategies to improve portfolio resilience [8].

2.2.3 Tools Utilized

Microsoft Excel: Excel was utilized extensively for data entry, financial modeling, and statistical analysis. Its capacity for managing large datasets and generating visual representations of data made it a critical tool throughout the analysis.

Statistical Software Packages (R and Python): Advanced statistical analysis, including Monte Carlo simulations and regression modeling, was carried out using specialized software packages such as R and Python [9]. These tools provided a more sophisticated platform for financial modeling, allowing for precise and in-depth analysis.

Financial and Economic Databases: The analysis relied on data sourced from reputable financial and economic databases. These databases provided the essential market data and indicators needed for both quantitative and qualitative assessments, ensuring the analysis was grounded in reliable and up-to-date information.

3. Performance Metrics and Return Analysis

3.1 Cumulative Returns

Cumulative returns measure the total change in an investment's value over a given period, reflecting the compounded effect of all gains and losses. This metric is crucial in assessing the long-term growth potential of an investment, providing investors with insights into how their portfolios have performed over time [10]. The comparative analysis of cumulative returns between the Market and Style 23 portfolios reveals distinct performance patterns, as shown in **Figure 1**.

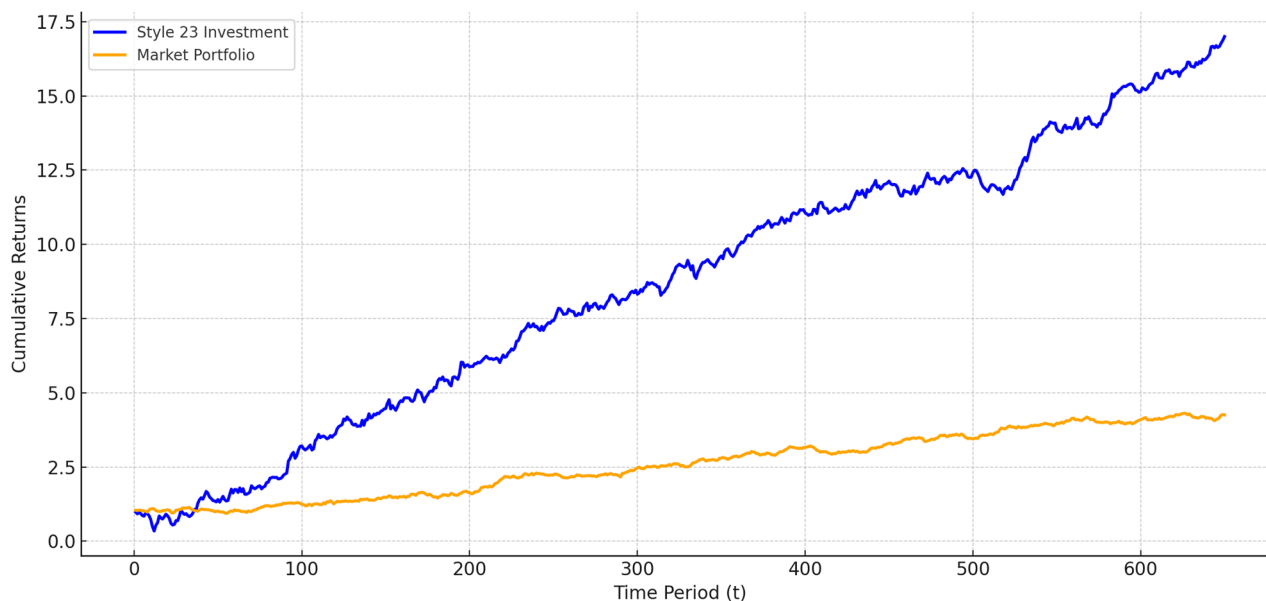


Figure 1. Cumulative Returns Comparison of Style 23 and Market Portfolio Over Time

Figure above illustrates that the Style 23 portfolio (blue line) significantly outperforms the Market Portfolio (orange line) over the observed period. The Style 23 portfolio shows a steady and substantial upward trend, culminating in a final cumulative return of 15.61, compared to the Market Portfolio's much flatter curve with a final return of 1.23. This performance divergence begins around time $t=57$, highlighting the effectiveness of the Style 23 portfolio's targeted investment strategies, which capitalize on market inefficiencies and sector opportunities not captured by broader market indices. The consistently higher trajectory of the Style 23 portfolio underscores its ability to generate superior returns through more aggressive and selective investment approaches [11]. However, the Style 23 portfolio's higher returns are accompanied by increased volatility, as seen in the more pronounced

fluctuations in its performance curve. This suggests that while Style 23 offers greater growth potential, it also exposes investors to higher short-term risks compared to the more stable Market Portfolio. For investors, this trade-off emphasizes the importance of aligning their investment choices with their risk tolerance and long-term objectives.

3.2 Sharpe Ratio Analysis

The Sharpe ratio measures the risk-adjusted return of a portfolio by dividing the average return by the standard deviation of the portfolio's returns. It indicates how much excess return an investor receives for each unit of risk taken, making it a valuable metric for comparing the performance of different investments [12].

Table 1. Sharpe Ratio Evaluation of Style 23 and Market Portfolio

	Style 23	Market Portfolio
Average Return	0.0240	0.0019
Standard Deviation	0.1186	0.0477
Sharpe Ratio	0.2024	0.0396

The table above presents the Sharpe ratios, average returns, and standard deviations for the Style 23 and Market Portfolios. From the data, the Sharpe ratio of the Style 23 portfolio is 0.2024, significantly higher than the Market Portfolio's Sharpe ratio of 0.0396. This indicates that Style 23 provides a much better risk-adjusted return, suggesting it is a more efficient choice for investors seeking higher returns per unit of risk [13].

However, the higher standard deviation of Style 23 (0.1186) also indicates greater volatility, implying that while the portfolio offers superior returns, it comes with increased risk. Investors must consider this trade-off, as the higher Sharpe ratio does not eliminate the potential for larger drawdowns compared to the more stable Market Portfolio. This evaluation highlights that although the Style 23 portfolio delivers higher risk-adjusted performance, its suitability will depend on the investor's risk tolerance and preference for stability versus growth potential [14].

4. Risk Management and Portfolio Optimization

4.1 Value at Risk (VaR)

4.1.1 Overview of the VaR Metric and Its Role in Risk Assessment

Value at Risk (VaR) is a widely used risk management tool that estimates the maximum potential loss of a portfolio over a specified time period at a given confidence level, such as 95% [15]. VaR provides investors with a quantifiable measure of the potential downside risk, helping them assess whether they can bear the financial distress associated with their investment choices. It plays a crucial role in risk management by informing decisions on portfolio allocations, risk exposures, and capital requirements.

4.1.2 Analysis of the VaR Figures for Both Portfolios

The table below presents the VaR95 figures for the Style 23 and Market Portfolios:

Table 2. Value at Risk (VaR) Evaluation of Style 23 and Market Portfolio

	Style 23	Market Portfolio
VaR95	0.1635	0.0799

From the data, the VaR95 of the Style 23 portfolio is 0.1635, which is approximately double the VaR95 of the Market Portfolio at 0.0799. This indicates that the maximum potential loss for Style 23

at a 95% confidence level is significantly higher, reflecting the increased risk associated with its more aggressive investment strategy. Investors with a low risk tolerance may prefer the Market Portfolio due to its lower potential maximum loss, aligning better with conservative risk preferences [16]. However, the higher VaR of Style 23 also highlights its potential for greater returns, appealing to investors willing to accept more risk for higher gains. It is important to note that while VaR is useful for assessing risk, it does not account for all aspects of market risk and should be complemented with other risk management tools for comprehensive decision-making [17].

4.2 Optimal Portfolio Construction

4.2.1 Techniques for Determining Optimal Portfolio Weights Using Risk Aversion Coefficients

The risk aversion coefficient reflects an investor's tolerance for risk, with higher values indicating a stronger preference for minimizing risk. In this analysis, a risk aversion coefficient of 5 was used, representing a moderately risk-averse investor. The goal is to minimize portfolio risk by effectively blending the Market Portfolio (which traditionally has a weight summing to 1) with the Style 23 portfolio (a long-short strategy with weights summing to 0). This approach balances general market exposure with the specific risk-return characteristics of the Style 23 investments.

4.2.2 Utilization of Optimization Tools (e.g., Solver) to Blend the Style 23 and Market Portfolio

To achieve the optimal mix of the Market Portfolio and Style 23, Solver was used to determine the appropriate weights that maximize the portfolio's expected utility while adhering to the constraints set by the investor's risk aversion. The optimization problem uses the following formula:

$$\text{Maximize } E(W^T R) - \frac{\gamma}{2} \text{Var}(W^T R) \text{ subject to } \sum(w) = 1 \quad (1)$$

The expected return of the portfolio (r_{prp}) can be calculated using the following formula:

$$r_p = \sum_{t=1}^n r_{it} w_{it} \quad (2)$$

In this equation, r_{it} represents the return of asset i in the portfolio at time t , and w_{it} denotes the portfolio weights, which are the fractions that the investor allocates to each asset i at time t . This formula helps in computing the total expected return based on individual asset contributions and their respective weights.

4.2.2.1 Optimal Portfolio Weight Calculation

Based on Solver results using the first half of the data ($t = 1$ to $t = 325$), the optimal weights were determined to be 0.459 for Style 23 and 1 for the Market Portfolio. This combination was tested on the second half of the observations and found to generate a higher Sharpe ratio and expected return, reinforcing its suitability given the specified risk aversion level. The detailed results are presented in Table 3.

Table 3. Optimal Portfolio Weight and Performance Metrics for Style 23 and Market Portfolio

	Value (First Half)	Value (Full Sample)
Weight of Style 23	0.4590	0.3430
Weight of Market Portfolio	1	1
Expected Return	0.0162	0.0101
Volatility (Standard Deviation)	0.0770	0.0673
Sharpe Ratio	0.2097	0.1503

4.2.2.2 Implications of the Analysis

The results from **Table 3** indicate that the strategy derived from the first half of observations delivers superior performance, evidenced by a higher expected return (0.0162) and a higher Sharpe ratio (0.2097) compared to the full sample. The volatility is also slightly higher in the first half (0.0770) than in the full sample (0.0673), suggesting a marginally increased risk in exchange for greater returns. The reduction in the weight of Style 23 from 0.4590 in the first half to 0.3430 in the full sample suggests that as the dataset expands, the overall risk associated with the Style 23 portfolio increases, prompting a reallocation towards the less risky Market Portfolio. This adjustment demonstrates a key insight into the optimal risk-return trade-off, highlighting that the full sample's broader risk necessitates a more conservative approach [18].

Investors might prefer the strategy from the first half observations due to its higher Sharpe ratio, indicating better risk-adjusted returns [19]. Moreover, focusing on the first half minimizes the impact of estimation errors that might arise from the variability in larger, more complex datasets, particularly for portfolios like Style 23 that include multiple assets. This approach aligns with maintaining optimal portfolio performance under specified risk preferences, making it an attractive option for risk-averse investors seeking balanced yet profitable investment strategies.

5. Advanced Portfolio Strategies

5.1 Influence of Transaction Costs

Transaction costs refer to the fees and expenses incurred when changing the weights assigned to assets in a portfolio [20-21]. These costs can significantly impact portfolio performance by reducing net returns, especially when frequent adjustments or rebalancing are required. In the context of the Style 23 and Market Portfolio combination, transaction costs become particularly relevant when modifying the allocation towards the riskier Style 23 portfolio, as each adjustment generates an associated fee. Transaction costs were incorporated into the utility function of the portfolio using the formula:

$$\text{Utility of Portfolio} = \text{Expected Return} - \frac{5}{2} \times \text{Variance} - \text{Transaction Cost} \quad (3)$$

The transaction cost is modelled as a function of the weight assigned to Style 23, reflecting the direct impact of this cost on overall portfolio performance. As a result, the optimal decision variables were recalculated, resulting in adjusted weights of 0.346 for Style 23 and 1 for the Market Portfolio, compared to the previous weights of 0.459 and 1, respectively.

5.1.1 Adjustments in Portfolio Weights Due to Transaction Costs

The incorporation of transaction costs led to a reduction in the weight of Style 23 by 0.113 (0.459 - 0.346), indicating that investors would reduce their exposure to the riskier Style 23 portfolio as transaction costs rise. This adjustment aligns with a more conservative allocation, reflecting the need to offset the cost of rebalancing and preserve net returns.

Table 4. Impact of Transaction Costs on Key Performance Metrics of the Portfolio

	Without Transaction Cost	With Transaction Cost
Expected Return	0.0162	0.0126
Volatility (Standard Deviation)	0.0770	0.0671
Sharpe Ratio	0.2097	0.1875
Utility of Portfolio	0.0089	0.0063

As shown in **Table 4**, the inclusion of transaction costs lowers the expected return, standard deviation, Sharpe ratio, and utility of the portfolio. This outcome highlights the trade-off investors

face: while reducing the allocation to the riskier portfolio (Style 23) decreases overall risk and volatility, it also diminishes potential returns. Therefore, transaction costs must be carefully considered when developing an investment strategy, as they can significantly alter optimal weight allocations and overall portfolio performance (Schachermayer, 2004).

5.1.2 Strategic Implications

The observed decrease in portfolio metrics suggests that strategies heavily weighted towards high-risk components like Style 23 may become less appealing when transaction costs are factored in. Investors are likely to shift towards more stable allocations, prioritizing cost management alongside return optimization. Furthermore, the impact of transaction costs becomes evident when applying the first-half strategy to the second-half samples; all key factors—returns, risk, volatility, and Sharpe ratio—show a downward adjustment, emphasizing the critical influence of transaction costs on portfolio strategy decisions [21].

5.2 Sensitivity and Regression Analysis

Regression analysis is employed to understand the factors influencing portfolio returns, with a specific focus on the Fama and French three-factor model [22]. This model extends the Capital Asset Pricing Model (CAPM) by adding size and value factors, offering a deeper insight into the drivers of portfolio performance. By analyzing the sensitivity of the portfolio to market movements, size-related factors, and value versus growth dynamics, investors can make informed decisions on strategic adjustments to optimize returns [23].

5.2.1 Utilizing Fama and French Three-Factor Model to Estimate Returns

Using the optimal strategy of combining 0.343 weight of Style 23 and 1 of the Market Portfolio, a parametric portfolio was constructed and regressed against the three factors of the Fama and French model: market excess return, SMB (small minus big), and HML (high minus low). The regression outputs provide valuable insights into the portfolio's behavior under different market conditions.

Table 5. Regression Summary Output of Portfolio Performance with Fama and French Three-Factor Model

	Intercept	Market Portfolio	Small Minus Big (SMB)	High Minus Low (HML)
Coefficient	0.0081	1.1173	0.0512	-0.0563
Standard Error	0.0016	0.0348	0.0536	0.0574
t Stat	5.0566	32.0947	0.9540	-0.9793
P-value	0.0000	0.0000	0.3405	0.3278
Lower 95%	0.0049	1.0489	-0.0542	-0.1691
Upper 95%	0.0112	1.1856	0.1566	0.0565

The table above shows that the intercept (alpha) is 0.0081, suggesting a positive risk-adjusted return that exceeds the expected return purely driven by market exposure. This implies the strategy delivers additional returns beyond what would be attributed to market factors alone. The market portfolio coefficient (beta) of 1.1173 indicates a strong correlation with market returns, meaning the portfolio's performance is highly sensitive to market movements. This is expected due to the significant weight of the market portfolio in the strategy. The coefficients for the SMB and HML factors are 0.0512 and -0.0563, respectively, indicating minor sensitivity to size-related and value versus growth factors. However, their p-values above 0.05 suggest that these factors do not significantly affect the strategy's returns. Thus, while the market factor remains a crucial driver, the impact of size and value characteristics appears limited, reinforcing that the portfolio's performance is predominantly shaped by market conditions rather than other smaller factors [24].

5.2.2 Strategic Implications

Given the high sensitivity to the market factor and the statistical insignificance of the size and value factors, investors focusing on a strategy that optimally combines Style 23 and the Market Portfolio should prioritize monitoring market conditions. The strong market exposure underscores the importance of aligning the portfolio with broader market trends while recognizing that adjustments based on size or value dynamics may have less impact.

5.3 Strategic Adjustments in Adverse Market Conditions

5.3.1 Analysis of Portfolio Behavior During Periods of Significant Market Downturns or Low Returns

During extreme market conditions, such as periods of significant downturns or low returns, the performance of a portfolio heavily invested in the market portfolio can suffer dramatically [25]. From the data provided, the 20 periods with the lowest returns in the market portfolio highlight the vulnerability of a strategy overly reliant on market movements. Since the optimal strategy combines the market portfolio with Style 23, negative returns in the market portfolio will adversely affect the overall portfolio performance. Investors should carefully examine these low-return periods and evaluate the impact on their overall investment. For instance, significant negative returns observed during specific periods (e.g., $t=201, 159, 577$) demonstrate scenarios where both the market and Style 23 portfolios incurred losses. These findings emphasize the importance of diversifying to reduce exposure to adverse market conditions.

5.3.2 Strategies for Reallocating Weights in Style 23 and the Market Portfolio to Mitigate Losses and Capitalize on Market Recoveries

To mitigate losses during these downturns, strategic reallocation between Style 23 and the Market Portfolio is essential. For example, when the market portfolio shows negative returns, increasing the weight of Style 23, particularly during periods when it performs positively (e.g., $t=503$), can help offset market losses. This flexible approach allows investors to capitalize on the unique characteristics of Style 23, which often behave differently than broader market trends. However, investors should remain cautious as both portfolios might simultaneously experience losses during certain extreme periods. A careful analysis of these dates, especially those marked by significant losses, is crucial to understand the conditions that lead to simultaneous downturns and to develop strategies to navigate through them [26].

5.3.3 Performance Evaluation Under Varying Market Conditions

In response to recent performance evaluations, it is important to communicate that the strategy implemented over the past six months has undergone extensive sensitivity testing, ensuring that it is designed to provide stable returns with low volatility under normal conditions. While current market conditions may have led to underperformance, these short-term results do not necessarily reflect the overall quality of the strategy. External factors, such as sudden market shifts and economic activities outside the company's control, can temporarily impact returns. To address any concerns, it is essential to present relevant analysis documents that highlight the rigorous evaluations supporting the strategy. Emphasizing that the strategy is robust but currently facing an unusual market environment can help manage expectations about short-term performance [10,21]. Additional analysis should be conducted to identify specific causes of losses, estimate recovery timelines, and develop immediate actions to minimize further losses. Clear communication with stakeholders, along with a commitment to resolving performance issues promptly, will reinforce confidence in the strategy's long-term potential.

6. Conclusion

This report provides a comprehensive analysis of portfolio investment strategies using statistical and analytical tools such as Sharpe ratio evaluation, regression analysis, cumulative returns, and

Value at Risk (VaR). Through these methods, we developed an optimized investment strategy for investors, which combines a weight of 0.343 for Style 23 and 1 for the Market Portfolio. This approach capitalizes on diversification benefits, offering higher risk-adjusted returns compared to investing in a single portfolio. By offsetting losses in one portfolio with gains in another, the strategy provides a balanced path to improved performance.

Despite its strengths, the strategy faces certain challenges. Transaction costs, for instance, can significantly alter portfolio weights and overall performance, necessitating careful consideration of cost management. Additionally, external factors such as market conditions and economic changes can influence outcomes, highlighting the importance of ongoing strategy evaluation. Future analyses should focus on refining the strategy further by examining additional risk factors and conducting deeper assessments of external influences. To achieve optimal performance, the strategy requires continual adjustments and close monitoring to ensure it remains responsive to evolving market conditions and investor needs. This adaptable approach will help maintain the strategy's robustness and effectiveness in diverse financial landscapes.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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