Comparative Performance of Bangladeshi Mutual Funds During Covid-19 and Non-Covid-19 Periods: An Empirical Analysis of Risk and Risk-Adjusted Returns

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Abstract: Taking the perspectives of The Market Resilience Theory and Efficient Market Hypothesis (EMH), this study intends to compare the performance of Bangladeshi mutual funds between the Covid-19 and non-Covid-19 periods. The monthly data of twenty-seven mutual funds from January 2016 to December 2023 is used, and both univariate (paired samples t-test) and multivariate panel data analysis methods are performed. The 12-month rolling-window technique measures the risk parameters (beta and standard deviation) and risk-adjusted return parameters (Treynor and Sharpe ratios), which are used as the proxy for mutual fund performance measures. The result of the paired samples t-test indicates that the Covid-19 period exhibits statistically significantly higher risk and risk-adjusted returns than that of the non-Covid-19 period. Consequently, the results of the random effect model of panel data analysis show that Covid-19 epidemic appears to have a statistically significant impact on risk and risk-adjusted return metrics of mutual funds, where the effects of macroeconomic variables are controlled. These findings indicate that during the Covid-19 epidemic, mutual fund performance improved remarkably. This research helps mutual fund managers and investors understand performance shifts during Covid-19 and offers policymakers insights into how macroeconomic factors influenced mutual fund performance during economic disruptions. In addition, this empirical evidence extends the existing literature by highlighting the resilience of Bangladeshi mutual funds during the global turmoil.

Keywords: Covid-19, Mutual Funds, Performance, Risk-Adjusted Return, T-test, Risk, Bangladesh, Panel Data.

1. Introduction

The worldwide Covid-19 epidemic has created economic anxiety in global financial markets. To prevent the virus's spread, most cities around the world enforced stay-at-home orders, resulting in substantial losses in most commercial sectors (Alqadhib et al., 2022). This pandemic has also affected the capital market as Covid-19 has impacted most commercial sectors globally (Zahoor et al., 2024). Mutual funds are one of the fundamental instruments of the capital market; thus, identifying the impact of Bangladeshi mutual funds' performance

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in response to Covid-19 is crucial. The mutual fund market has undergone substantial restructuring in response to the Covid-19 pandemic, accompanied by notable changes in investor behavior, which collectively have influenced mutual fund performance (Tampakoudis et al., 2023; Divya et al., 2023). The impact of Covid-19 on the capital market is one of the most significant concerns for long-term sustainability and economic and financial progress (Hossain et al., 2021).

Covid-19 caused a drastic drop in stock markets in Asia, America, Africa, and Europe (Bahrini & Filfila, 2020). The effects of Covid-19 on the capital market led to different investors' investment decisions across various industries and countries (Pokhrel & Chhetri, 2021). The revenue of business organizations was reduced significantly due to Covid-19, which adversely affected the stock market. The capital market is the core of every country's economic development and has been influenced by Covid-19, as the pandemic widely affects on the global economy (Hossain et al., 2021; Bahrini & Filfila, 2020; Wagner, 2020; Chowdhury et al., 2022; Anjorin, 2020).

Covid-19 case first identified in Bangladesh on March 8, 2020, and continued until September 2021, affecting 2 million individuals and resulting in 30,000 deaths (Golder et al., 2022; Lytton & Ghosh, 2024). Productivity was reduced, and people became unemployed in Bangladesh due to Covid-19 (Chowdhury et al., 2022), which resulted in lessening economic indicators like GDP. Hossain et al. (2021) and Chowdhury et al. (2024) opined that the capital market of Bangladesh was significantly affected by the Covid-19 pandemic. Since mutual funds in Bangladesh are a component of the capital market, they are susceptible to the effects of Covid-19.

Previous research (Ahamed, 2021; Quader et al., 2024; Kabir et al., 2023) examined the impact of Covid-19 on different commercial sectors of Bangladesh, including the banking, tourism, garments, power, and energy sectors. However, research on the effect of Covid-19 on the risk and risk-adjusted returns of mutual funds in Bangladesh is scarce. Therefore, the purpose of this study is to investigate how Covid-19 affected the mutual fund performance of Bangladesh. The research objectives are - (i) to quantify the risk and risk-adjusted returns of mutual funds in Bangladesh during the Covid-19 and non-Covid-19 periods; (ii) to compare the mean of risk and risk-adjusted return measures between Covid-19 and non-Covid-19 periods in a univariate context; and (iii) to assess the impact of Covid-19 on risk and risk-adjusted returns in a multivariate framework, taking macroeconomic factors into account.

The remaining parts are organized into four distinct sections. A review of the literature and the formulation of hypotheses are included in Section 2. Section 3 explains the methodology, including details of the sample, data sources, computations producer of risk and risk-adjusted return of mutual funds, and data analysis methods. Then, Section 4 shows the descriptive statistics, correlation matrix, results, and discussion of regression analysis. After that, Section 5 consists of the conclusion, implication, limitations, and future research opportunities.

2. Literature Review

Researchers (Zahoor et al., 2024; Quader et al., 2024; Kabir et al., 2023; Kashem, 2022; Adenomon et al., 2022; Gherghina et al., 2021; Nugroho & Robiyanto, 2021; Golder et al., 2022; Miah et al., 2021; Ahamed, 2021; Hossain et al., 2021; Polemis & Soursou, 2020; Bash, 2020; Prabheesh et al., 2020) examined the potential impacts of Covid-19 on various aspects of financial markets across different countries, uncovering mixed evidence of its effects. The Covid-19 pandemic significantly affected the U.S. capital market, unlike previous infectious diseases, which had milder impacts (Yilmazkuday, 2020). Ashraf (2020) studied the impact of Covid-19 on 64 countries and found that the performance of the stock market and the Covid-19 pandemic are positively connected. Consequently, Yi et al. (2020) found that the Kenyan economy is facing a reduction in GDP, an increasing unemployment rate, and a destruction of the economy due to Covid-19. Additionally, Covid-19 epidemic and the volatility of gold returns have a positive relationship with the stock market (Nugroho & Robiyanto, 2021). Polemis and Soursou (2020) demonstrated that the Covid-19 epidemic positively impacts stock returns. Moreover, the risks of the capital market have increased due to Covid-19 (Chowdhury et al., 2022).

Conversely, Wagner (2020) identified that the S&P 500 and Dow Jones Industrial Average (DJIA) indices have flopped down significantly due to the coronavirus, resulting in a negative impact. Similarly, Kotishwar (2020) stated that there is a long-run adverse association of Covid-19 with the capital market indices. Thus, the stock return had a substantial adverse relationship with Covid-19 (Adenomon et al., 2022; Bash, 2020). Hasan et al. (2021) discovered an adverse correlation between Covid-19 and the stock return of energy sector companies. However, Gherghina et al. (2021) did not find any meaningful correlation between Covid-19 and the Bucharest Exchange Trading Index (BET) (Romanian capital market index).

Mutual fund performance depends on both company-specific factors and broad macroeconomic factors in addition to the effect of Covid-19. Hossain et al. (2021) stated that the activities of the capital market are also influenced by unavoidable Covid-19 and macroeconomic variables such as deposit rate, inflation rate, oil price, currency exchange rate, bank rate, interest rate of loan, and gold price. Interest rates are found to positively correlate with stock market performance (Ologunde et al., 2006). A favorable correlation between oil prices and stock returns during Covid-19 has also been observed for oil-importing countries (Prabheesh et al., 2020). Additionally, the exchange rate shows a substantial positive association with the performance of Bangladesh's capital market (Jahur et al., 2014). Hossain et al. (2021) performed a study on Bangladesh and identified that Covid-19 daily new confirmed cases, inflation rate, bank rate and deposit rate have a significant adverse relation with the Dhaka Stock Exchange (DSE). Interest rates and inflation rates have a substantial negative relationship with the performance of Bangladesh's capital market (Jahur

et al., 2014). However, Hossain (2020) identifies that inflation and interest rates do not significantly influence the firm's performance.

Previous studies like Hossain et al. (2021), Kashem (2022), Ahamed (2021), Golder et al. (2022), Gazi et al. (2022), and Miah et al. (2021) performed studies on Bangladesh to identify the effect of Covid-19 in different financial sectors of Bangladesh i.e. capital market, banking industry, etc. using data from pre-Covid, Covid-19 period and post-Covid period. There is a limited investigation in the context of Bangladesh examining the impact of Covid-19 on mutual funds' risk and risk-adjusted returns, particularly studies that account for the influence of broader macroeconomic parameters on these outcomes. Therefore, this research is designed to identify the influence of Covid-19 on the mutual fund performance measured by various risk and risk-adjusted return measures while controlling the influence of the macroeconomic parameters.

3. Hypotheses Development

The Market Resilience Theory and Capital Asset Pricing Model (CAPM) perspectives support that Covid-19 had no appreciable influence on mutual fund performance. The main factor influencing asset returns, according to CAPM, is systematic risk, often known as market risk (Sharpe, 1964). It is presumed that mutual funds were priced suitably for their systematic risk before the pandemic, meaning that their risk-adjusted returns ought to hold steady in the face of market fluctuations. Furthermore, financial markets are capable of absorbing shocks and returning to equilibrium, according to the Market Resilience Theory (Fama, 1998). Even if Covid-19 created some early turbulence, markets quickly reacted to the new information, and the returns and risk of mutual funds returned to normal. For instance, Liu et al. (2020) revealed that asset prices recovered quickly as a result of market resilience, indicating that the long-term effects on mutual fund performance were minimal. Adenomon et al. (2022) and Gherghina et al. (2021) reported no significant impact of Covid-19 on the risk and risk-adjusted returns of stock indices in Nigeria and Romania, respectively.

On the contrary, the perspective of the Efficient Market Hypothesis (EMH) indicates that prices in the capital markets reflect based on all publicly available information (Fama, 1970); thus, mutual fund performance during Covid-19 should reflect an efficient response to pandemic-related information. However, the great uncertainty surrounding the epidemic made market efficiency difficult, opening the door to price anomalies and increased volatility. Furthermore, according to behavioural finance theory, market inefficiencies may have resulted from investor irrationality motivated by fear and uncertainty, which raised fund risk and produced overreactions that affected their risk and return (Shiller, 2003; Mazur et al., 2020). Shankar et al. (2021) identified that the systematic risk of the capital market was influenced by Covid-19 pandemic. Liu et al. (2022) showed that the international stock markets faced higher risk during Covid-19. Consequently, by utilizing the Sortino, Treynor, Sharpe, and information ratios to assess the risk-adjusted performance of mutual funds during the Covid-19 period,

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Mirza et al. (2020) discovered that mutual funds fared better than comparable products. Maheen (2021) studied in India and found that Covid-19 significantly affected the mutual funds' performance. Alqadhib et al. (2022) studied Saudi Arabia utilizing panel data and discovered that Covid-19 had a significant favourable effect on mutual fund performance. Based on the above literature reviews, the following hypotheses are proposed for this study:

$H1_0$ = *No significant difference exists in risk of mutual funds between Covid-19 and non-Covid-19 periods.*

$H1_a$ = *A significant difference exists in the risk of mutual funds between Covid-19 and non-Covid-19 periods.*

$H2_0$ = *No significant difference exists in the risk-adjusted return of mutual funds between Covid-19 and non-Covid-19 periods.*

$H2_a$ = *A significant difference exists in the risk-adjusted return of mutual funds between Covid-19 and non-Covid-19 periods.*

4. Data and Methodology

4.1 Sample Selection and Data Sources

The research selects 27 conventional mutual funds listed on the Dhaka Stock Exchange (DSE) for a study period from January 2016 to December 2023. The Covid-19 period is defined as March 2020 to September 2021 (Golder et al., 2022; Lytton & Ghosh, 2024), while the non-Covid-19 periods are January 2016 to February 2020 and October 2021 to December 2023. The long-period data is utilized to assess the recovery impacts of Bangladeshi mutual funds, capturing pre-Covid trends, disruptions during Covid-19, and performance recovery in the post-Covid period. To generate a balanced data set, the conventional mutual funds (except Islamic mutual funds) that were inaugurated and listed in DSE before January 2016 are included in the sample to create a balanced panel because balanced data has fewer biases than imbalanced data and guarantees stability in data observations throughout time, improving the accuracy of econometric estimations (Baltagi, 2005).

The month-end closing price data of selected funds is collected from the Dhaka stock exchange and investing.com[1], and data on controlled variables are collected from the data bank of Bangladesh Bank[2] and World Bank[3] (following Hasan & Hasan, 2024; Hasan & Islam, 2023). In addition, monthly Covid-19 cases data are gathered from the Directorate General of Health Services in Bangladesh following Bangladesh Bank (2021). Next, the following formula is used to calculate the monthly returns from the mutual funds (Hasan, 2024):

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[1] https://www.investing.com/
[2] https://www.bb.org.bd/en/index.php
[3] https://www.worldbank.org/ext/en/home

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$$\bar{R}_{i,t} = ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \dots \dots \dots \dots \dots \dots (i)$$

Where, the natural logarithm is indicated by *ln*, a unit of fund indicated by *i*, *t* indicates time, $P_{i,t-1}$ indicates prior period data, $P_{i,t}$ indicates current period data and $\bar{R}_{i,t}$ shows the return of fund *i* at time *t*.

4.2 Variables Description

Various proxies are utilized to examine the impact of the Covid-19 epidemic on mutual fund performance. Risk measures and risk-adjusted return metrics serve as indicators of mutual fund performance. Monthly Covid-19 cases are used as a proxy for the Covid-19 pandemic. Additionally, this investigation controls several macroeconomic indicators, including the GDP growth rate, deposit rate, broad money supply, amount of exports, remittances flow, and amount of imports, to ascertain their influence on the mutual fund risk and risk-adjusted return during Covid-19. Here, the 12-month rolling-window method is applied to measure the risks (beta and standard deviation) and the other measurement of risk-adjusted return (Treynor ratio, Sharpe ratio) of mutual funds (following Hasan, 2024; Champagne, 2018). A summary of the variables is provided in Table 1.

Table 1: Variables Description

SL	Parameters	Definition/ Formula	References
		Risk and Risk-Adjusted Return Measures	
1.	Standard Deviation	The volatility of a mutual fund is quantified by the standard deviation, which indicates the extent to which returns deviate from the average return. Standard deviation is calculated using the below formula- $$SD_{i,t} = \sqrt{\frac{1}{t-1}\sum_{t=1}^{T}(r_{i,t} - \bar{r}_{i,t})^2}\,;$$ Where *SD* indicates standard deviation, *i* denotes the fund units*, t* denotes time, while *r* stands for monthly return and *r-* for mean return.	Humphrey & Lee (2011)
2.	Beta	The volatility of a portfolio relative to the market as a whole is measured by its beta, which shows how sensitive the portfolio is relative to changes in the market. The below formula is used to compute beta- $$(r_{i,t} - r_{f,t}) = \propto_{i,t} + \beta_{i,t}(r_{m,t} - r_{f,t}) + \varepsilon_{i,t};$$ where *r* indicates monthly return, *t* indicates times, the risk-free rate is indicated by *f*, *i* for the fund, *t* for time, β for beta, m for market, $\propto$ indicates constant term and ε stands for error.	Hoepner & Schopohl (2018)
3.	Sharpe Ratio	The Sharpe ratio calculates an investment's risk-adjusted return by comparing its excess return above the risk-free rate to its standard deviation.	Sharpe (1964)

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		The Sharpe ratio is determined using the following formula: $SharpeRatio(SR) = \frac{r_{i,t}-r_{f_{i,t}}}{\sigma_{i,t}}$;where r indicates monthly return, i indicates the fund, t indicates time, risk-free rate is indicated by f, and σ indicates standard deviation.	
4.	Treynor Ratio	The Treynor Ratio assesses risk-adjusted return by contrasting excess return over the risk-free rate with the beta, so measuring performance in relation to market risk. Treynor ratio is calculated using the below formula- $TreynorRatio(TR) = \frac{r_{i,t}-R_{f_{i,t}}}{\beta_{i,t}}$; where r represents the monthly return, i indicates the fund, t represents time, risk-free rate is denoted by f, and the systematic risk beta is denoted by β.	Mirza et al. (2020)
Macroeconomic Variables			
5.	Deposit Rate	The deposit rate indicates the interest rate that banks and other financial institutions provide investors or depositors for depositing into their accounts.	Hossain et al. (2021)
6.	GDP Growth Rate	The GDP (gross domestic product) growth rate of a nation is the percentage increase in GDP over a given period that reflects the health and performance of the economy. Using the EViews program, the proportional Denton method is applied to transform annual GDP data into monthly data (Baum et al., 2006).	Hussain (2017)
7.	Broad Money Supply	The term "broad money" refers to money in circulation as well as demand deposits, time deposits and savings held by corporations, people, and other monetary aggregates.	Hasan & Hasan (2024)
8.	Amount of Export	The money earned by exporting products or services from one nation to a foreign consumer is known as the amount of exports.	Jahur et al. (2014)
9.	Import Payment	An import payment is the sum paid for products and services that are bought from foreign countries.	Hasan (2024)
10.	Remittance	A remittance is a payment sent by an individual employed overseas to their relatives residing in their home country.	Hasan & Islam (2023)
Covid-19 Pandemic			
11.	Covid-19 cases	Monthly new infection in Bangladesh is treated as Covid-19 cases	Gherghina et al. (2021)

4.3 Econometrics Models of Data Analysis

The study used both univariate and multivariate data analysis techniques to investigate the impact of Covid-19 on mutual funds' performance. A paired T-test is applied to see whether the performance varies between Covid-19 and non-Covid-19 periods or not. Then, the panel data analysis model is utilized to examine the effect of Covid-19 on mutual fund performance in the multivariate setting where the influence of macroeconomic parameters is controlled. The following regression equation has been developed for the panel data analysis-

$$Performance_{i,t} = \beta_0 + \beta_1 Covid19_{i,t} + \beta_2 Controls_{i,t} + \varepsilon_{i,t} \ldots \ldots \ldots (i)$$

Where β denotes coefficients, *Covid19* denotes monthly Covid-19 cases. *Controls* denote the macroeconomic indicators (i.e., GDP growth and deposit rates, broad money supply, amount of exports, remittances and amount of import) which represent the controlled variables of the study, *t* denotes time and *i* denotes mutual funds, *Performance* denotes dependent variables, here 4 performance measures proxies have been utilized such as beta, standard deviation, Treynor and Sharpe Ratios and ε stands for the stochastic error term.

To conduct the data analysis, first, data is normalized using the 'Two-step data Normalization Method' where the 'fractional rank' in the first step, then the 'Inverse Documented Frequency (IDF)' to normalize the data (Templeton, 2011; Hasan et al., 2024). The normality of the data set is subsequently checked utilizing the Shapiro–Wilk test, which confirms that data is normally distributed. In addition, the multicollinearity, heteroscedasticity, autocorrelation, and cross-sectional correlation issues are checked by applying the Variance Inflation Factor (VIF), Breusch-Pagan/ Cook-Weisberg test, Durbin-Watson test, and Pesaran test, respectively to select the appropriate panel data analysis model.

5. Results and Discussions

5.1 Descriptive Statistics

Table 2 illustrates the descriptive statistics of risk measures, i.e., standard deviation and beta, the risk-adjusted return measures, i.e., Sharpe and Treynor ratios, and macroeconomic variables. Panels *A* and *B* of Table 2 confirm that mutual fund overall risk (standard deviation) and systematic risk (beta) are numerically greater during the Covid-19 period than they were during the non-Covid-19 period. This suggests that during the Covid-19 period, mutual funds are more exposed to risk than they are during the non-Covid-19 period. The Sharpe ratio, a risk-adjusted return measure, indicates that Covid-19 exhibits a numerically higher Sharpe ratio compared to the non-Covid-19 period. This suggests that mutual funds perform better during a crisis in the economy. However, the Treynor ratio is numerically lower during the Covid-19 time than it was during the non-Covid-19 period, indicating that systematic risk was higher during the Covid-19 times which reduces systematic risk-adjusted performance.

Additionally, this study includes several macroeconomic variables as controlled variables while examining the impact of Covid-19 on the performance of mutual

funds. Panel *D* shows the descriptive statistics of macroeconomic factors where the mean value of the monthly deposit rate is 4.81% and the monthly GDP growth rate is 6.36%. The average of exports and imports demonstrates that during the study period, there was a 1,394.68 million dollar monthly trade deficit in Bangladesh, which can be balanced by managing the monthly remittances of 14161.41 million dollars. Besides, broad money has the highest mean value, which is BDT 1659131 crore, and the volatility of broad money is BDT 280818.93 crore. Finally, panel E shows that, on average, 24360.62 people were affected by Covid-19 every month, and the highest number of monthly infections was on 31st August 2021.

Table 2: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Panel A: Risk and Risk-Adjusted Return Measures (Covid-19 Period)					
Standard Deviation	513	0.0941	0.0291	0.029	0.161
Beta	513	0.7285	0.4637	-0.769	1.855
Sharpe Ratio	513	-0.4344	1.2724	-3.048	3.079
Treynor Ratio	513	-0.1548	2.5502	-5.801	2.315
Panel B: Risk and Risk-Adjusted Return Measures (Non-Covid-19 Period)					
Standard Deviation	1,755	0.0631	0.0349	0	0.223
Beta	1,755	0.5850	0.7392	-8.703	5.239
Sharpe Ratio	1,755	-0.9455	1.3972	-21.671	3.071
Treynor Ratio	1,755	-0.0240	2.7270	-84.948	95.472
Panel C: Risk and Risk-Adjusted Return Measures (Total Period)					
Standard Deviation	2268	0.0701	0.0361	0	0.222
Beta	2268	0.6174	0.6892	-8.703	5.239
Sharpe Ratio	2268	-0.8298	1.3863	-21.671	3.079
Treynor Ratio	2268	-0.0535	2.6881	-84.948	95.472
Panel D: Macroeconomic Variables					
Deposit Rate	2268	4.8141	0.5354	3.97	5.71
Export	2268	3595.47	834.18	520.01	5365.19
Import	2268	4990.15	1114.04	2489.80	7706.40
Remittances	2268	14161.41	3690.89	6917.97	23284.87
Broad Money Supply	2268	1659131	280818.93	1143271	2127921
GDP Growth Rate	2268	6.3565	1.0438	3.45	7.88
Panel E: Covid-19 Cases					
Covid-19 Cases	2268	24360.62	57517.52	0	328902

Notes: This table shows the descriptive statistics for risk measures, risk-adjusted return measures, and macroeconomic factors of mutual funds using the monthly data between January 2017 and December 2023. Panel *A* shows the risk measures and risk-adjusted return measures for the Covid-19 period (March 2020 to September 2021), Panel *B* shows the risk measures and risk-adjusted return measures for the Non-Covid-19 period (January 2016 to February 2020 and October 2021 to December 2023), Panel *C* shows the risk measures and risk-adjusted return measures for the total study period and Panel *D* shows the description on macroeconomic factors. Here, the GDP growth rate is yearly data, which is transformed into monthly data by applying the *Dentonmq* method. Additionally, Panel E shows the monthly number of Covid-19 new cases.

5.2 Results of Mean Comparison Test (Paired T-test)

Mean difference analysis is performed to compare the performance of Bangladeshi mutual funds between the Covid-19 period and the non-Covid-19 period. The paired two-sample t-test is applied for the mean comparison using the normally distributed data following researchers like Berger and Zhou (2014). Table 3 below displays the results of the mean difference analysis -

Table 3: Mean Comparison of Mutual Fund Performance Between Covid-19 and Non-Covid-19 period

Variables	Mean		Difference of Mean
	During Covid-19	Non-Covid-19	
Panel A: Risk Measures			
Standard Deviation	0.0941	0.0631	0.0310*** (20.27)
Beta	0.7285	0.5850	0.1435*** (5.31)
Panel B: Risk-Adjusted Return Measures			
Sharpe Ratio	-0.4344	-0.9455	0.51109*** (7.82)
Treynor Ratio	-0.1548	-0.0241	-0.1307 (-1.006)
No. of Observation	513	1,755	-

*, **, *** indicate the level of significance at 10%, 5% and 1% level respectively.

Notes: This table shows the mean difference analysis of mutual funds' risk (Panel A) and risk-adjusted return (Panel B) between Covid-19 and non-Covid periods using the paired two-sample t-test. The data used in this study is from January 2017 to December 2023 and the t-test is performed assuming unequal variance following Levene's test.

Table 3 shows that, compared to the non-Covid-19 period, both the standard deviation and beta had significantly higher means during the Covid-19 period. This indicates that mutual funds faced greater risk during the pandemic, confirming hypothesis H1a. Additionally, the mean value of the Sharpe ratio, a measure of risk-adjusted return, is significantly higher during the Covid-19 period than in the non-Covid-19 period, supporting hypothesis H2a. The findings are aligned with the results of Golder et al. (2022), who found that during Covid-19 the risk of the stock market is higher and stock market performance is better than non-Covid-19 period. However, there is no statistically significant difference identified for the Treynor ratio during Covid-19 and non-Covid-19 periods. Overall results from the mean comparison test suggest that mutual fund risk and risk-adjusted return are substantially higher in the Covid-19 period than in the non-Covid-19 period.

5.3 Correlation Matrix

Table 4 is the correlation matrix, which shows the interrelation among the variables, i.e., dependent and dependent variables, dependent and independent variables, and independent variables. This correlation matrix confirms that risk measures (standard deviation and beta) have a statistically significant correlation with all macroeconomic parameters. Additionally, a statistically significant association exists between macroeconomic indicators and risk-adjusted return measures i.e. the Treynor and Sharpe ratios. Also, all macroeconomic variables have statistically significant relationships with each other. This correlation matrix primarily shows the macroeconomic variable's relationship with risk measures along with the risk-adjusted returns. This matrix also confirms that Covid-19 cases have a statistically significant relationship with risk and risk-adjusted return measures and macroeconomic variables. Furthermore, the correlation matrix also displays the multicollinearity issue between the independent variables. A multicollinearity issue is likely to arise if the correlation coefficient is higher than 0.80, but in this table, all variables have a coefficient value less than 0.80, which indicates no multicollinearity problem among the variables (Bohrnstedt & Carter, 1971).

Table 4: Correlation Matrix

	Standard Deviation	Beta	Sharpe Ratio	Treynor Ratio	Deposit Ratio	Export	Import	Remittance	Broad Money	GDP growth Rate	Covid-19
Std. Dev	1.00										
Beta	0.54***	1.00									
Sharpe Ratio	0.32***	0.19***	1.00								
Treynor Ratio	0.07***	-0.04***	0.48***	1.00							
Deposit Rate	-0.007	0.24***	-0.007	-0.021	1.00						
Export	-0.29***	-0.36***	-0.13***	0.04*	-0.53***	1.00					
Import	-0.12***	-0.29***	-0.009	0.07***	-0.58***	0.73***	1.00				
Remittance	-0.21***	-0.37***	-0.11***	0.05**	-0.39***	0.60***	0.41***	1.00			
Broad Money	-0.12***	-0.31***	-0.04*	-0.005	-0.61***	0.61***	0.65***	0.71***	1.00		
GDP Growth	0.14***	0.10***	0.11***	0.018	-0.19***	0.022	0.20***	-0.34***	-0.26***	1.00	
Covid Cases	0.30***	0.03*	0.16***	0.04*	-0.33***	0.005	0.08***	0.21***	0.28***	0.08***	1:00

The symbols ***, **, and * denote statistical significance for the variables at the 1%, 5%, and 10% levels, respectively.

Notes: The table represents the Pearson correlation matrix of risk and risk-adjusted return measures of 27 conventional mutual funds and 6 macroeconomic factors utilizing data from January 2017 to December 2023. Here, Covid-19 cases are considered as the proxy of the Covid-19 pandemic.

5.4 Results of Regression Analysis

Diagnostic tests were carried out on the panel data prior to selecting the appropriate data analysis model. The diagnostics test results suggest that data is normally distributed, and there were no problems with multicollinearity, heteroscedasticity, autocorrelation, or cross-sectional correlation. Following the

undisclosed results of the Hausman Test and the Breusch-Pagan Lagrange Multiplier Test, the random effects model is primarily selected for this study (Nguyen & Nguyen, 2019; Hasan et al., 2024). The results of the random effects model show that Covid-19 has a major impact on mutual fund risk and risk-adjusted returns (Table 5).

Table 5: Effect of Covid-19 on mutual fund performance
(Random effect model)

	Model - 1	Model - 2	Model - 3	Model - 4
	Standard Deviation (T-Value)	Beta (T-Value)	Sharpe Ratio (T-Value)	Treynor Ratio (T-Value)
Covid-19 Cases	0.000002***	0.000012***	0.000004***	0.000003*
	(14.30)	(4.96)	(6.73)	(2.38)
Deposit Rate	-0.004260*	0.141000***	0.071100	-0.040700
	(-2.48)	(4.06)	(0.92)	(-0.27)
Export	-0.000015***	-0.000092***	-0.000307***	-0.000169
	(-11.66)	(-3.48)	(-5.22)	(-1.46)
Import	0.000003**	-0.000056**	0.000142**	0.000452***
	(3.09)	(-2.71)	(3.08)	(4.98)
Remittance	-0.000001***	-0.000048***	-0.000028*	0.000101***
	(-4.06)	(-8.62)	(-2.27)	(4.09)
Broad Money	0.0000003	0.000001	0.000002	-0.000021***
	(0.68)	(1.43)	(1.17)	(-5.27)
GDP Growth Rate	0.001590*	0.041900**	0.098500**	-0.090400
	(1.99)	(2.59)	(2.72)	(-1.27)
Constant	0.12600***	0.71200*	-1.48800*	1.11700**
	(8.19)	(2.31)	(-2.17)	(2.82)
Adjusted R2	0.2344***	0.2089***	0.1230***	0.1003***
Chi2	984.07***	833.21***	451.85***	347.17***
Observation	2268	2268	2268	2268

*, **, *** indicate statistical significant at the 10%, 5%, and 1% level, respectively.

Notes: The results of the random effect model are shown in this table. In the column, Model-01 is the standard deviation, model-02 is the beta, model-03 is the Sharpe ratio and model-04 is the Treynor ratio. The monthly data will be utilized for 27 conventional mutual funds from 2017 to 2023. The row shows the independent variables, i.e., monthly Covid-19 cases, and control variables, i.e., macroeconomic variables.

Regression analysis results show that Covid-19 has a significant impact on the risk exposure of mutual funds, confirming hypothesis *H1a*. The standard deviation coefficient in Model 1 of Table 5, which is 0.000002 (t = 14.30, p < 0.001), indicates a statistically significant rise in total risk in line with the epidemic increases and vice-versa. The beta coefficient (β = 0.000012, t = 4.96, p

< 0.01) shows a statistically significant positive relationship with Covid-19 cases, suggesting that the systematic risk of mutual funds increases when Covid-19 cases increase and vice-versa.

These findings support the hypothesis that Covid-19 increased mutual fund risk exposure in terms of both systematic risk (beta) and total risk (standard deviation). The results of the positive impact of Covid-19 on mutual fund risk exposure are consistent with Hossain et al. (2021), Odhiambo et al. (2020), Rizwan et al. (2020), and Shankar et al. (2021). These findings highlight how Covid-19 increased unpredictability in mutual funds risk, complicating risk management. The increase in beta denotes heightened susceptibility to market fluctuations, posing difficulties for portfolio managers seeking to preserve stability and efficient diversification amidst economic turmoil. Additionally, macroeconomic factors, including deposit rate, imports, exports, remittances, and GDP growth rate, are revealed to have a statistically significant effect on the riskiness of mutual funds, and broad money supply does not have any statistically significant effect on the risk measures.

Consequently, the regression results show that Covid-19 cases significantly affect the risk-adjusted returns of mutual funds, which validates hypothesis *H2a*. In Models 3 and 4, both the risk-adjusted return measures, Sharp ratio ($\beta = 0.000004$, t = 6.73, p < 0.01) and Treynor ratio ($\beta = 0.000003$, t = 2.38, p < 0.10), exhibit a statistically significant positive relationship with Covid-19 cases. The results of Mirza et al. (2020), Maheen (2021), Alqadhib et al. (2022), Odhiambo et al. (2020), and Hossain (2020) are consistent with the effect of Covid-19 on mutual fund performance when returns are adjusted for risk. Additionally, the GDP growth rate, exports, imports, and remittances all have statistically significant effects on performance metrics for mutual funds, such as the Sharpe ratio. Subsequently, the broad macroeconomic determinants of import, remittance, and broad money supply exhibit statistically significant influence on the Treynor ratio.

5.5 Robustness Analysis

The results of the regression analysis utilizing the dynamic feasible generalized least squares (FGLS) model for panel data are shown in Table 6 as a part of the robustness analysis of the results derived from the random effects model. The results of the dynamic model substantially correspond with the results of the random effects model. The dynamic model further supports the statistically substantial effect of Covid-19 on mutual fund risk and risk-adjusted returns. Additionally, it highlights the considerable influence of the macroeconomic variables used as controlled factors on mutual funds' risk and risk-adjusted returns.

JUJBR   **Table 6: Impact of Covid-19 on mutual fund performance (FGLS Model)**

	Model - 1	Model - 2	Model - 3	Model - 4
	Standard Deviation (T-Value)	**Beta (T-Value)**	**Sharpe Ratio (T-Value)**	**Treynor Ratio (T-Value)**
Covid-19 Cases	0.000002***	0.000012***	0.000004***	0.000003*
	(13.20)	(4.78)	(6.74)	(2.38)
Deposit Rate	-0.004260*	0.141000***	0.071100	-0.040700
	(-2.31)	(3.91)	(0.92)	(-0.26)
Export	-0.000015***	-0.000092***	-0.000307***	-0.000169
	(-10.77)	(-3.35)	(-5.23)	(-1.45)
Import	0.000003**	-0.000056**	0.000142**	0.000452***
	(2.87)	(-2.60)	(3.09)	(4.97)
Remittance	-0.000001***	-0.000048***	-0.000028*	0.000101***
	(-3.73)	(-8.29)	(-2.27)	(4.08)
Broad Money	0.0000003	0.000001	0.000002	-0.000021***
	(0.60)	(1.37)	(1.17)	(-5.27)
GDP Growth Rate	0.001590*	0.041900**	0.098500**	-0.090400
	(1.83)	(2.49)	(2.73)	(-1.26)
Constant	0.12600***	0.71300*	-1.48800*	1.11700**
	(7.67)	(2.24)	(-2.17)	(2.70)
Chi2	582.81***	494.22***	152.39***	47.06***
Observation	2268	2268	2268	2268

The statistical significance is shown at the 10%, 5%, and 1% levels, respectively, by *, **, and ***.

Notes: The table presents the Feasible Generalized Least Square regression results, utilizing data from 27 conventional mutual funds between January 2017 and December 2023.

6. Conclusion

This study aims to evaluate the performance of Bangladeshi mutual funds during the Covid-19 period compared to the non-Covid-19 period. The analysis employs monthly closing data from 27 conventional mutual funds spanning January 2016 to December 2023. A 12-month rolling window method is used to calculate total risk, systematic risk, and the Sharpe and Treynor ratios, providing a comprehensive evaluation of mutual fund performance utilizing the before, during, and after data of the pandemic period. Both the univariate (paired t-test) and multivariate analysis (random effect model and Feasible Generalized Least Square Methods) confirm that the Covid-19 pandemic demonstrates significantly

higher risk and risk-adjusted returns of mutual funds compared to the non-Covid-19 period. Therefore, Covid-19 had a considerable impact on mutual funds by raising both risk indicators, such as standard deviation and beta, reflecting increased market volatility and changing investor behaviour. During the pandemic, the Sharpe ratio and Treynor ratio showed improved risk-adjusted returns and effective risk management. Furthermore, the mutual fund's risk was substantially influenced by all macroeconomic indicators, including the GDP growth rate, deposit rate, export, import, and remittance, during the Covid-19 period, except broad money supply. Moreover, mutual funds' risk-adjusted return was also impacted by macroeconomic variables during the Covid-19.

The study offers important new insights into the risk profiles and risk-adjusted returns of mutual funds, which helps to explain their dynamics during exceptional occurrences such as the Covid-19 pandemic. The results show that mutual funds were more volatile and sensitive to changes in the market, which put conventional risk management techniques to the test. Furthermore, the Treynor ratio and the Sharpe ratio indicate better risk-adjusted returns. The need for fund managers to create flexible strategies that improve portfolio resilience in times of crisis is highlighted by this dichotomy. This study enhances the literature by illustrating the connection between macroeconomic variables and mutual fund performance, aiding investors in making decisions during volatile periods.

The study was conducted with certain limitations, like other studies. The sample selection comprised solely 27 conventional mutual funds listed on the Dhaka Stock Exchange before January 2016, omitting Islamic and younger mutual funds, hence constraining the generalizability of the findings to the wider mutual fund market. The study utilized month-end closing prices of mutual funds and monthly Covid-19 cases that may inadequately reflect the dynamic effects of Covid-19 on mutual fund performance, given that investor behavior frequently varies and impacts mutual funds' performance over shorter timeframes. However, the lack of reliable data sources about the investor's attitudes during the periods restricts the inclusion of this variable in the data analysis.

Future research opportunities include examining the influence of Covid-19 on mutual funds using daily or weekly panel data and including both Islamic and newer funds, enabling more nuanced insights. The study period is limited to 2016 to 2023, but researchers can also increase the data period. Additionally, exploring other macroeconomic determinants like exchange rates, unemployment rates, and inflation would provide a comprehensive view. Researchers could also consider expanding the scope to include international mutual funds, enriching the analysis and facilitating cross-border comparisons, thereby contributing valuable insights into global investment strategies during crises.

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