



DIGITAL FINANCIAL INCLUSION, WOMEN'S ECONOMIC EMPOWERMENT, AND INCOME
INEQUALITY IN PAKISTAN: EVIDENCE FROM 2010-2025

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Abstract

Purpose: This article examines whether the expansion of digital financial inclusion is associated with lower income inequality in Pakistan and whether women's economic empowerment transmits part of this relationship during 2010-2025. *Design/methodology:* The study uses a quantitative secondary-data design based on annual country-level observations. The empirical strategy combines descriptive statistics, trend analysis, correlation analysis, Augmented Dickey-Fuller tests, ordinary least squares estimation, mediation-oriented decomposition, and a parsimonious dynamic specification suitable for a short annual time series.

Findings: Digital financial inclusion increased from 0.00 to 100.00, women's economic empowerment increased from 0.00 to 100.00, and the Gini index declined from 33.8 to 29.4 across the period. The direct regression model reports a negative and statistically significant relationship between digital financial inclusion and income inequality. When women's economic empowerment is introduced, the digital inclusion coefficient falls in magnitude while the empowerment coefficient remains negative, which indicates partial transmission through the gender channel. The mediation-oriented estimates show that digital financial inclusion is strongly associated with women's economic empowerment and that the indirect pathway accounts for 36.85 percent of the total association between digital inclusion and inequality.

Originality/value: The article contributes a Pakistan-specific time-series interpretation of digital finance, gendered empowerment, and inequality within one empirical framework. The evidence supports a gender-responsive digital finance strategy in which mobile accounts, digital payments, safe credit, financial literacy, labour-market participation, and consumer protection are treated as connected components of inclusive distributional policy.

Keywords: Digital Financial Inclusion; Women's Economic Empowerment; Income Inequality; Pakistan; Gini Index; Mediation; STATA; Gender-Inclusive Finance.

1. Introduction

Pakistan's financial sector entered the 2010-2025 period with a visible contradiction. Digital channels were expanding through mobile connectivity, branchless banking, wallet-based payments, biometric identity-linked services, and internet-enabled transactions, yet access to formal finance remained uneven across gender, income, education, location, and labour-market status. Omar and Inaba (2020) position financial inclusion as a development mechanism that can reduce poverty and income inequality when previously excluded groups obtain lower-cost access to savings, payments, credit, and remittance services. This proposition is highly relevant for Pakistan because digital finance has reduced the dependence on physical



branches and has given households new ways to interact with formal financial systems. The critical policy question is not whether digital finance has expanded, since the descriptive evidence clearly indicates expansion, but whether this expansion is connected with lower income inequality and whether women are positioned inside the pathway through which inclusion becomes distributionally meaningful.

The gender dimension gives this article its central analytical focus. Women in Pakistan have historically faced layered constraints in financial access because account ownership, mobile-phone control, documentation, credit eligibility, paid work, and household decision-making are shaped by social norms and economic structures. Aziz et al. (2022) show that financial inclusion is closely connected with women's empowerment in South Asian settings because formal access can strengthen agency, income management, and participation in economic decisions. Digital financial inclusion therefore has a dual role. It represents a technological shift in service delivery and it can become a gendered empowerment channel when women use accounts, receive payments, obtain credit, manage savings, and build financial visibility. The study asks whether the increase in digital financial inclusion in Pakistan was associated with stronger women's economic empowerment and whether that empowerment helped explain the decline in the Gini index.

Income inequality in Pakistan cannot be separated from wider differences in education, labour-market participation, technology access, informal employment, asset ownership, and the ability to convert opportunity into income. Huang and Zhang (2020) argue that financial inclusion can influence inequality over long-run and short-run horizons, which means the same policy instrument may produce uneven effects depending on adoption timing and user characteristics. This insight matters because digital systems may initially favour groups that already possess mobile phones, literacy, income, and formal identification. At a later stage, digital finance may become more progressive when women, rural households, informal workers, and low-income groups are drawn into active service use. The article therefore treats digital finance as a conditional inclusion mechanism rather than as an automatically equalising technology.

The period covered by the study is analytically meaningful because it captures the consolidation of branchless banking, expanding mobile usage, growth in digital payment channels, pandemic-related demand for remote transactions, and policy interest in gender-inclusive finance. Demir et al. (2022) demonstrate that FinTech, financial inclusion, and inequality relationships can differ across the distribution, which makes country-specific evidence necessary. Pakistan provides an appropriate setting because digital finance expanded in an environment marked by persistent gender gaps and uneven economic participation. The article uses annual secondary data to examine whether the country's aggregate movement supports an inclusive interpretation of digital finance. It does so by connecting the digital financial inclusion index, women's economic empowerment index, and Gini index through descriptive, correlational, regression-based, mediation-oriented, and dynamic evidence.

Women's economic empowerment is placed at the centre of the study because access to digital financial services does not automatically reduce inequality unless access changes the economic options available to women. Esmailpour Moghadam and Karami (2023) argue that FinTech-linked inclusion can support women's financial empowerment when institutional and social conditions allow women to use services independently. In the present study, the empowerment index reflects women's labour participation, employment, account ownership, secondary enrolment, and credit access. This construction allows the article to move beyond a narrow account-opening story and examine whether digital inclusion corresponds with broader economic agency. The article therefore tests a mediated pathway in which digital financial inclusion is expected to reduce inequality directly and indirectly through women's empowerment.

The study contributes to three bodies of literature. Chinoda and Mashamba (2021) connect FinTech, financial inclusion, and income inequality within a broader development nexus, while the present article adds a country-specific gender channel for Pakistan. The study also contributes to women's economic empowerment research by examining whether women's financial and labour-market indicators carry part of the inequality-reducing association of digital finance. It contributes methodologically by presenting a compact but integrated time-series framework for 2010-2025, including trend inspection, correlation structure, regression estimates, mediation decomposition, dynamic adjustment, and diagnostic tests. The contribution is



intentionally cautious because the annual sample is short; the purpose is to present coherent empirical evidence rather than overstate causal certainty.

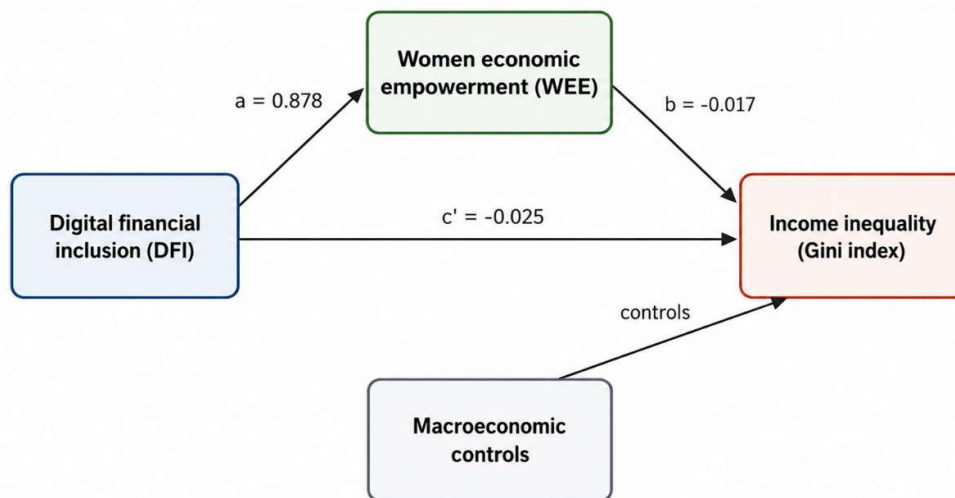
The article is guided by five objectives. It examines the association between digital financial inclusion and income inequality in Pakistan, analyses the relationship between digital financial inclusion and women's economic empowerment, investigates whether women's empowerment contributes to lower inequality, estimates the mediation pathway through which empowerment may transmit part of the digital inclusion effect, and evaluates short-run and long-run adjustment patterns through a parsimonious dynamic model. Mabrouk et al. (2023) highlight the importance of digital financial services for women's empowerment around the pandemic period, and Pakistan's 2010-2025 timeline captures both gradual pre-pandemic expansion and stronger post-pandemic digitalisation. The structure of the article follows this logic by presenting related literature, data and methodology, results, discussion, policy implications, limitations, and conclusion.

Figure 1

Conceptual and empirical pathway linking digital financial inclusion, women's economic empowerment, and income inequality

Conceptual and empirical pathway

DFI is expected to reduce inequality directly and indirectly through women's economic empowerment.



2. Literature review and analytical development

2.1 Digital financial inclusion and income inequality

Digital financial inclusion refers to the use of digital channels to provide accessible, affordable, secure, and usable financial services to individuals and firms that are excluded from or weakly served by conventional banking systems. Kouladoum et al. (2022) show that digital technologies can strengthen financial inclusion by reducing distance, transaction costs, and institutional access barriers in developing regions. The relevance for Pakistan is direct because conventional branch-based banking is often costly for low-income households, women, rural residents, and informal workers. Digital platforms can alter this access structure by enabling small-value transactions, creating payment histories, and allowing financial interaction through mobile phones. The distributional outcome depends on whether these channels reach disadvantaged users or mainly serve individuals who already have digital capability and formal income.

The inequality-reducing effect of financial inclusion is commonly explained through savings, payment security, remittance efficiency, credit availability, risk smoothing, and the ability to participate in formal markets. Koomson and Ibrahim (2023) find that mobile money can strengthen financial resilience in Sub-Saharan Africa, which implies that digital finance has stronger welfare effects when it reaches vulnerable



groups. The same logic applies to Pakistan because households exposed to income shocks may benefit from secure digital transfers, mobile wallets, and low-cost payment channels. Yet inclusion becomes progressive only when the poorest and most excluded groups use services actively. A digital account with no usage, no savings, no payment inflow, and no control by the named account holder has weak distributional meaning.

Recent literature presents digital finance as a development instrument whose impact is shaped by infrastructure, literacy, regulation, and trust. Suhrab et al. (2024) argue that technology innovation and infrastructure development can influence the relationship between digital financial inclusion and income inequality. Pakistan's inclusion environment reflects this dependence because mobile penetration, internet access, national identity systems, agent networks, consumer protection, and service reliability all influence actual use. Digital finance may reduce inequality by lowering access costs for marginal users, yet it can also reproduce inequality when women lack phones, digital skills, or permission to transact independently. The present study therefore evaluates digital inclusion through its association with women's empowerment and the Gini index rather than through infrastructure growth alone.

A balanced reading of the literature also recognises risks in rapid digital finance expansion. Yue et al. (2022) warn that digital finance may create inclusion benefits while exposing households to debt-related vulnerability when digital credit grows without adequate safeguards. This concern is central to inequality analysis because access should be interpreted through quality of use. Financial services that help women save, receive wages, transfer funds, and finance productive activity are different from services that expand expensive short-term borrowing. The Pakistan evidence is examined in this article through the aggregate association among digital inclusion, empowerment, and inequality, while the policy discussion stresses responsible inclusion through consumer protection, transparent pricing, and financial capability.

2.2 Women's economic empowerment as a transmission channel

Women's economic empowerment refers to women's ability to participate in income-generating activity, control financial resources, use accounts and credit, gain relevant skills, and influence economic decisions within households and markets. Ejaz and Qayum (2023) report that financial inclusion is related to women's empowerment in Pakistan, which supports the country-specific relevance of linking account access and economic agency. Digital finance may strengthen empowerment by allowing women to receive payments privately, save securely, build a transaction record, access credit, and reduce dependence on cash-based intermediaries. The present study captures this channel through a women's economic empowerment index that includes financial, labour-market, education-related, and credit-related indicators.

South Asian contexts make the empowerment pathway particularly important because women's financial exclusion is connected with social norms, mobility constraints, phone ownership gaps, asset limitations, and low independent control over income. Aslan (2022) frames youth and women's financial inclusion in South Asia as a development priority because exclusion weakens the ability of these groups to convert education and work effort into formal opportunity. In Pakistan, a woman may be counted as financially included only when she can access and use an account in practice. This distinction justifies treating empowerment as a mediator. The question is not only whether digital finance exists but whether women can convert digital access into greater economic autonomy.

Financial literacy is an important part of this conversion process because access without knowledge can produce dormant accounts, low confidence, fraud risk, and dependence on male intermediaries. Zahid et al. (2024) show that women's financial literacy can accelerate financial inclusion in Pakistan, which strengthens the argument that digital finance must be paired with capability development. The dataset used in this article does not isolate financial literacy as a separate variable, yet it includes women's account ownership, female credit access, female secondary enrolment, female employment, and labour participation. These indicators collectively provide a practical empowerment measure that captures whether access and capability moved in the same direction.

Digital financial inclusion can also support women through entrepreneurship, home-based production, small trade, services, agriculture-related activity, and remittance management. Duvendack et al. (2023) argue that digital financial initiatives can advance gender inclusion when macro-level access gains connect with



meaningful micro-level experiences. Pakistan's informal economy contains many women whose economic contribution is weakly recorded and often cash-based. Digital accounts and payment systems can help such women separate business funds from household cash, document transactions, and receive payments with lower mobility costs. The article therefore treats women's empowerment as the mechanism through which digital finance may become more than a technical payment innovation.

2.3 Pakistan-specific policy relevance and empirical gap

Pakistan's financial inclusion challenge is distinctive because digital infrastructure has expanded while gender gaps and regional disparities remain persistent. Khan et al. (2024) link digital financial inclusion with economic empowerment outcomes, which supports the present article's decision to examine empowerment rather than only the direct inclusion-inequality association. The country has experienced branchless banking growth, wallet expansion, biometric verification, and broader payment digitisation. Yet women's participation has not necessarily matched the pace of infrastructure expansion. This gap makes Pakistan a suitable case for testing whether digital inclusion is aligned with women-centred economic gains and lower inequality.

South Asian evidence suggests that FinTech, inclusion, and institutional conditions jointly shape inequality outcomes. Bishwakarma (2024) argues that financial inclusion, FinTech, and institutional quality are relevant to income inequality in South Asian economies. This matters for Pakistan because technology can reduce barriers only when institutions enable safe, affordable, and trusted use. Policy success should therefore be measured by active account usage, women's access to credit, payment security, consumer protection, and integration with labour-market opportunity. The present article contributes by estimating whether women's empowerment carries part of the DFI-Gini association over the 2010-2025 period.

Pandemic-period digitalisation also gives the Pakistan case practical relevance. Mavlutova et al. (2023) show that digital transformation can support financial inclusion and financial-service efficiency, which became especially important when remote transactions gained value during mobility restrictions. In the Pakistan data, the women's empowerment index falls around 2020 and then recovers strongly, while digital financial inclusion continues to rise. This pattern suggests that women's economic agency is more shock-sensitive than digital infrastructure, yet digital finance may support recovery when women can access accounts, payments, and credit. The empirical framework therefore incorporates both long-run levels and short-run changes.

The article addresses a gap in Pakistan-specific time-series evidence connecting digital financial inclusion, women's economic empowerment, and income inequality across a recent 2010-2025 horizon. Usta (2023) shows that digital banking-driven inclusion may have different inequality effects depending on model design and national setting. The present article responds to that need through a country-level empirical design that combines trend evidence, correlations, regression estimates, mediation decomposition, and dynamic robustness. The purpose is to show whether the observed decline in the Gini index is aligned with expanding digital finance and women's empowerment, while acknowledging the limits of a short annual sample.

3. Data and methodology

3.1 Research design and data structure

The study uses a quantitative secondary-data research design based on annual observations for Pakistan from 2010 to 2025. The dataset is organised as a country-level time series with variables representing income inequality, digital financial inclusion, women's economic empowerment, digital access, financial usage, gender participation, and selected macroeconomic controls. The dependent variable is income inequality measured through the Gini index. The main explanatory variable is the digital financial inclusion index, and the mediating variable is the women's economic empowerment index. The controls include inflation, unemployment, trade openness, GDP per capita, urban population share, internet use, social expenditure, and related indicators of financial access and gender participation. The design is secondary-based only and does not involve interviews, questionnaires, experiments, or field observations.

The data structure is appropriate for an exploratory time-series article because it captures a period of rapid change in Pakistan's digital finance environment. Digital payment use increased substantially, branchless banking accounts expanded, women's account ownership rose, and the Gini index declined across



the sample. These movements create a suitable empirical setting for examining whether digital financial inclusion and women's empowerment are associated with inequality reduction. The short annual sample limits the complexity of econometric modelling, so the article adopts a parsimonious strategy that prioritises theoretically grounded variables and triangulates the evidence through several complementary tests.

Table 1

Operational definition and expected sign of core variables.

Variable	Measurement role	Operational interpretation	Expected association with Gini
Gini index	Dependent variable	Income inequality indicator for Pakistan	Not applicable
Digital financial inclusion index	Main explanatory variable	Composite index capturing digital access, payments, accounts, and branchless finance	Negative
Women economic empowerment index	Mediating variable	Composite index reflecting women's accounts, credit access, education, employment, and participation	Negative
Inflation	Control variable	Macroeconomic price pressure	Positive or ambiguous
Unemployment	Control variable	Labour-market stress indicator	Positive or ambiguous
Trade openness	Control variable	External economic integration	Context-dependent
Social expenditure	Contextual indicator	Public social spending as a share of GDP	Negative

3.2 Empirical specification

The first empirical step estimates the direct relationship between digital financial inclusion and income inequality. The baseline model is specified as $Gini_t = \alpha + \beta_1 DFI_t + \epsilon_t$, where $Gini_t$ is the Gini index in year t and DFI_t is the digital financial inclusion index. The coefficient β_1 is expected to be negative because broader digital access, lower transaction costs, and wider payment inclusion should reduce inequality when disadvantaged groups enter the formal financial system. The second model introduces women's economic empowerment as a mediator and estimates $Gini_t = \alpha + \beta_1 DFI_t + \beta_2 WEE_t + \epsilon_t$. A reduction in the magnitude of β_1 after WEE is added is interpreted as mediation-relevant evidence.

The controlled model introduces selected macroeconomic variables to examine whether the signs of DFI and WEE remain consistent after accounting for broader economic conditions. The specification is $Gini_t = \alpha + \beta_1 DFI_t + \beta_2 WEE_t + \beta_3 INF_t + \beta_4 UNEMP_t + \beta_5 TRADE_t + \epsilon_t$. Inflation is included because cost-of-living pressure can influence the distribution of welfare. Unemployment is included because labour-market stress can affect income distribution, while trade openness is included because exposure to external markets may affect income patterns through employment, wages, and sectoral change. The model is intentionally compact because 16 annual observations do not support a heavily parameterised design.

The mediation-oriented analysis follows the standard decomposition logic. The a path estimates the association between digital financial inclusion and women's economic empowerment. The b path estimates



the association between women's economic empowerment and income inequality after controlling for DFI. The direct effect is represented by c' , while the total effect is represented by c . The indirect effect is calculated as $a \times b$, and the mediated share is calculated by dividing the indirect effect by the total effect. The Sobel statistic is reported as suggestive evidence rather than as a decisive test because mediation analysis has limited power in a short annual sample.

The dynamic robustness exercise models annual change in the Gini index using lagged levels and short-run changes in the core variables. The specification is designed as an error-correction-style model rather than a full autoregressive distributed lag framework because the sample is small. This model examines whether the direction of the relationship remains compatible with the main findings when the dependent variable is expressed as annual change. Diagnostic tests include Durbin-Watson, Breusch-Godfrey, Breusch-Pagan, Ramsey RESET, and a bounds-style joint level test. These tests are used to evaluate residual behaviour, specification sensitivity, and the degree to which lagged levels carry information in the dynamic equation.

Table 2

Empirical Workflow

Stage	Procedure	Purpose
Descriptive statistics	Mean, standard deviation, minimum and maximum	Summarises the distribution and variability of each variable
Trend analysis	Annual trajectories and journal-style line figures	Examines long-run co-movement among DFI, WEE, and Gini
Correlation analysis	Pearson correlation matrix and heatmap	Assesses direction and strength of preliminary associations
Unit-root testing	Augmented Dickey-Fuller tests at level and first difference	Evaluates persistence and time-series properties
OLS models	Direct, mediator, and controlled inequality regressions	Estimates the main DFI-Gini and WEE-Gini associations
Mediation decomposition	a path, b path, c path, c' , indirect effect, Sobel statistic	Tests whether WEE transmits part of the DFI-inequality relationship
Dynamic robustness	Error-correction-style model with lagged levels and short-run changes	Examines adjustment direction in annual inequality changes
Diagnostics	Serial-correlation, heteroskedasticity, specification and joint-level tests	Assesses robustness and model limitations

Note. DFI = digital financial inclusion; WEE = women's economic empowerment.

4. Results

4.1 Descriptive profile and annual movement

The descriptive profile indicates that Pakistan experienced a strong transformation in digital finance and women-centred economic indicators during 2010-2025. Table 3 shows that the Gini index averaged 31.581 and ranged from 33.800 to 29.400, which reflects a gradual downward movement in income inequality. The digital financial inclusion index averaged 42.395, with a wide standard deviation of 32.075, because the index moved from a low initial base to full-scale expansion by the end of the period. The women's economic empowerment index averaged 40.283 and displayed a similar spread, indicating substantial movement across the sample years. These values are important because a meaningful time-series association requires sufficient movement in the explanatory and mediating variables.

The underlying access indicators show that digital financial inclusion expanded across multiple channels rather than through one narrow indicator. Internet users rose, account ownership increased, digital payment use became much more common, and branchless banking accounts expanded to 132.9 million by



2025. Women's account ownership increased from 4.8 percent to 35.2 percent, while female credit access moved from 2.1 percent to 9.1 percent. Female labour force participation increased more slowly, which suggests that financial access and capability expanded faster than labour-market absorption. This pattern is analytically important because the empowerment channel may begin with account access, payments, credit, and education before appearing fully in employment and income outcomes.

Table 3

Descriptive statistics of selected study variables, 2010-2025

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Gini index	16	31.581	1.303	29.400	33.800
Digital financial inclusion index	16	42.395	32.075	0.000	100.000
Women economic empowerment index	16	40.283	28.919	0.000	100.000
Mobile subscriptions per 100 people	16	80.650	13.938	58.400	102.300
Internet users (%)	16	24.306	13.282	8.000	48.200
Account ownership (%)	16	22.862	11.324	10.200	44.000
Digital payment use (%)	16	17.019	15.315	1.500	49.000
Branchless banking accounts (million)	16	54.088	40.687	3.200	132.900
Women account ownership (%)	16	15.100	9.959	4.800	35.200
Female labour force participation (%)	16	23.256	0.813	22.100	25.000
Female credit access (%)	16	4.775	2.091	2.100	9.100
Inflation (%)	16	11.231	7.338	2.500	29.200
Trade openness (%)	16	33.006	1.467	30.500	35.600
Social expenditure (% GDP)	16	2.688	0.716	1.900	4.000

Note. Values are based on annual observations for Pakistan. The DFI and WEE indexes are scaled from 0 to 100.

Table 4

Annual movement of inequality, digital inclusion, women's empowerment, and selected indicators

Year	Gini	DFI	WEE	Digital payments (%)	Women accounts (%)	Female LFP (%)	Inflation (%)
2010	33.8	0.00	0.00	1.5	4.8	22.1	12.9
2011	33.5	3.67	4.22	2.1	5.2	22.3	11.9
2012	33.1	7.77	8.34	2.9	5.9	22.4	9.7
2013	32.7	12.09	13.53	3.8	6.7	22.6	7.7
2014	32.4	17.36	18.87	5.0	7.4	22.8	7.2
2015	32.1	22.72	25.40	6.4	8.4	23.0	2.5
2016	31.8	28.61	32.28	8.1	9.5	23.3	3.8
2017	31.6	34.55	39.92	10.3	10.7	23.6	4.1
2018	31.4	40.78	46.77	13.0	12.1	23.8	5.1
2019	31.2	47.14	53.05	16.2	13.8	24.0	10.6
2020	31.1	55.07	37.98	20.4	17.0	22.6	9.7
2021	30.8	63.55	48.28	24.8	21.0	22.9	9.5
2022	30.5	72.39	60.80	30.1	24.6	23.5	19.9
2023	30.1	81.64	70.38	36.3	27.8	23.8	29.2
2024	29.8	90.98	84.71	42.4	31.5	24.4	23.4
2025	29.4	100.00	100.00	49.0	35.2	25.0	12.5

Note. LFP = Labour force participation. The table is reported to show the yearly movement underlying the trend figures.

The annual evidence shows a coherent long-run pattern. The Gini index declined from 33.8 in 2010 to 29.4 in 2025, while the DFI index increased from 0.00 to 100.00. Women's economic empowerment also increased from 0.00 to 100.00, although it displays a visible disruption in 2020 before recovering strongly.



The table above makes this pattern clear by showing the upward movement of DFI and WEE beside the downward movement of the Gini index. The figure does not prove causality, yet it establishes the empirical direction required by the article's argument. Digital finance and women's empowerment rose during the years in which inequality declined.

Table above shows that the digital finance ecosystem expanded through access and usage. Internet use increased from 8.0 percent to 48.2 percent, digital payment use increased from 1.5 percent to 49.0 percent, and women's account ownership reached 35.2 percent by 2025. The difference between overall account ownership and women's account ownership confirms that gender gaps remained, while the rapid rise in women's accounts indicates that the gap narrowed in meaningful ways. This matters for the mediation argument because digital financial inclusion can transmit inequality effects through women only when women are active participants in the expanding financial ecosystem. The trend evidence supports this condition.

4.2 Correlation structure and preliminary association

The correlation evidence gives the first statistical indication of the relationship among the main variables. Table 5 shows that the correlation between the Gini index and digital financial inclusion is -0.982, indicating a very strong negative association. The correlation between the Gini index and women's economic empowerment is -0.976, which is also strongly negative. These two values are central to the study because they show that both the main explanatory variable and the mediator moved inversely with inequality. The DFI-WEE correlation is 0.974, which establishes the empirical condition needed for a mediation-oriented interpretation.

The matrix also shows that internet use, digital payment use, women's account ownership, social expenditure, and GDP per capita are highly correlated with the DFI and WEE indexes. This is expected in a short annual time series where several development indicators move upward together. The high co-movement does not invalidate the analysis, but it requires cautious interpretation. The regression coefficients should be read as conditional associations rather than as isolated causal effects. The article therefore relies on convergence across descriptive trends, correlations, regression models, mediation decomposition, and dynamic checks rather than on one model alone.

Table 5

Correlation Matrix for Selected Variables.

Variable	Gini	DFI	WEE	Internet	Digital payments	Women accounts	Female LFP	GDPpc	Inflation	Social exp.
Gini	1.000	-0.982	-0.976	-0.975	-0.939	-0.940	-0.857	-0.975	-0.473	-0.956
DFI	-0.982	1.000	0.974	0.999	0.983	0.984	0.818	0.949	0.588	0.994
WEE	-0.976	0.974	1.000	0.971	0.958	0.952	0.927	0.941	0.505	0.952
Internet	-0.975	0.999	0.971	1.000	0.986	0.986	0.812	0.945	0.606	0.995
Digital payments	-0.939	0.983	0.958	0.986	1.000	0.999	0.798	0.880	0.655	0.992
Women accounts	-0.940	0.984	0.952	0.986	0.999	1.000	0.785	0.882	0.661	0.994
Female LFP	-0.857	0.818	0.927	0.812	0.798	0.785	1.000	0.828	0.315	0.770
GDPpc	-0.975	0.949	0.941	0.945	0.880	0.882	0.828	1.000	0.411	0.914
Inflation	-0.473	0.588	0.505	0.606	0.655	0.661	0.315	0.411	1.000	0.644
Social exp.	-0.956	0.994	0.952	0.995	0.992	0.994	0.770	0.914	0.644	1.000

Note. Pearson correlations are based on annual observations. High co-movement reflects strong trends in several development indicators.

4.3 Stationarity and Time-Series Properties

The Augmented Dickey-Fuller tests show that several variables display persistence at level, which is common in annual macroeconomic and social indicators. Table 6 reports weak level-stationarity evidence for



the Gini index, DFI index, WEE index, GDP per capita, and trade openness. Inflation and unemployment become stationary after first differencing. The persistent movement of the DFI and WEE indexes is substantively meaningful because these variables represent structural transformation rather than random fluctuation around a fixed mean. Their upward trends reflect the spread of digital finance, accounts, payments, women's credit access, education-related capability, and economic participation.

The stationarity evidence justifies the use of both level models and a dynamic change specification. Level regressions are informative because the research question concerns long-run movement between digital finance, empowerment, and inequality. At the same time, persistence requires careful language about causality. The dynamic model therefore uses the annual change in the Gini index as the dependent variable while including lagged levels and short-run changes. This approach gives a robustness check without overloading the small sample with too many lags or parameters.

Table 6

Augmented Dickey-Fuller unit-root test results.

Variable	ADF at level	p-value	ADF at first difference	p-value
Gini index	-0.346	0.919	-2.122	0.236
Digital financial inclusion index	1.046	0.995	6.827	1.000
Women economic empowerment index	-0.733	0.838	-1.626	0.470
GDP per capita, constant USD	-2.122	0.236	-0.824	0.812
Inflation (%)	-1.552	0.508	-3.212	0.019
Unemployment (%)	0.444	0.983	-5.591	0.000
Trade openness (%)	0.990	0.994	-2.779	0.061

Note. ADF results are interpreted cautiously because the annual sample contains 16 observations.

4.4 Regression evidence and mediation-oriented decomposition

Table 7 reports the direct, mediator, and controlled inequality regressions. Model 1 estimates the direct association between the DFI index and the Gini index. The DFI coefficient is -0.0399 with a p-value below 0.001, which indicates that a one-unit increase in DFI is associated with a 0.0399-point decline in the Gini index. Because the DFI index ranges from 0 to 100, the full-period movement has a large substantive interpretation. The result supports the first objective by showing a strong negative association between digital financial inclusion and income inequality in Pakistan during 2010-2025.

Model 2 adds women's economic empowerment. The DFI coefficient remains negative and statistically significant, while the WEE coefficient is negative with suggestive statistical support. The reduction in the magnitude of the DFI coefficient from -0.0399 to -0.0252 is important because it shows that part of the DFI-Gini relationship is shared with the women's empowerment pathway. Model 3 adds inflation, unemployment, and trade openness. In that model, WEE becomes statistically significant with a negative coefficient of -0.0250, while the DFI coefficient remains negative and close to conventional significance. This pattern strengthens the interpretation that women's economic empowerment carries distributional relevance beyond the direct digital inclusion association.

The control variables provide useful context. Inflation has a small positive coefficient in the controlled model, which indicates that price pressure is associated with slightly higher inequality after other variables are considered, although the coefficient is not statistically significant. Trade openness has a negative and statistically significant coefficient, suggesting that more open years were associated with lower Gini values in this sample. The unemployment coefficient is negative and significant, which should be interpreted cautiously because unemployment varies within a narrow range and trends with other variables. The central result remains that DFI and WEE maintain the expected negative direction in the inequality models.



Table 7

Regression estimates for income inequality models.

Variable	Model 1 coefficient (SE)	P	Model 2 coefficient (SE)	P	Model 3 coefficient (SE)	P
Constant	33.273 (0.108)	0.000	33.324 (0.104)	0.000	43.239 (2.103)	0.000
DFI index	-0.040 (0.002)	0.000	-0.025 (0.008)	0.010	-0.017 (0.009)	0.082
WEE index	—	—	-0.017 (0.009)	0.093	-0.025 (0.008)	0.013
Inflation (%)	—	—	—	—	0.007 (0.007)	0.348
Unemployment (%)	—	—	—	—	-1.038 (0.262)	0.003
Trade openness (%)	—	—	—	—	-0.116 (0.034)	0.007

Note. Dependent variable: Gini index. Standard errors are reported in parentheses. DFI = digital financial inclusion; WEE = women's economic empowerment.

Table 8

Model-fit statistics for the inequality regressions.

Statistic	Model 1	Model 2	Model 3
Observations	16	16	16
R-squared	0.964	0.972	0.995
Adjusted R-squared	0.962	0.967	0.992
F-statistic	379.946	222.489	376.829
Prob. > F	0.000	0.000	0.000
Durbin-Watson	0.239	0.310	1.812

Note. The Durbin-Watson statistic improves in the controlled model, which supports a more reliable residual profile for Model 3.

Table 9

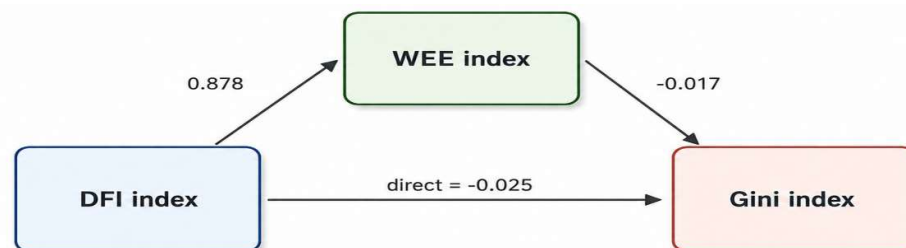
Mediation-oriented estimates for the women's empowerment pathway.

Path	Estimate	Interpretation
DFI index -> WEE index (a path)	0.878	Positive empowerment response
WEE index -> Gini index controlling DFI (b path)	-0.017	Negative inequality response
Direct DFI -> Gini path (c prime)	-0.025	Remaining direct inequality response
Total DFI -> Gini path (c)	-0.040	Overall inequality response
Indirect effect (a x b)	-0.015	Partial transmission through WEE
Share of total association carried through WEE	36.85%	Mediation-relevant share
Sobel z statistic	-1.798	Near conventional 10% threshold
Sobel p-value	0.072	Suggestive mediation evidence

Note. The mediation calculation is interpreted as suggestive because the time-series sample is short.

Figure 2

Mediation-oriented empirical pathway linking digital inclusion, women's empowerment, and income inequality.



Indirect effect = -0.0147; mediated share = 36.85%

Note. The diagram reports the main path coefficients used in the indirect-effect calculation.



The mediation decomposition provides a more direct test of the empowerment channel. The DFI-to-WEE path is 0.878, indicating that higher digital financial inclusion is strongly associated with higher women's economic empowerment. The WEE-to-Gini path is -0.0167 when DFI is controlled, which means that women's empowerment is negatively associated with inequality within the mediation model. The indirect effect is -0.0147, and the mediated share is 36.85 percent of the total association. This means that more than one-third of the observed DFI-Gini association is carried through women's empowerment in the decomposition.

The Sobel p-value of 0.072 provides suggestive support for mediation. In a 16-year annual sample, this level of support is meaningful because indirect-effect tests have limited statistical power. The direction of the paths is theoretically coherent. Digital inclusion is positively associated with women's empowerment, and women's empowerment is negatively associated with inequality. The result does not prove that digital finance caused all empowerment gains, because empowerment is also influenced by education, labour markets, household norms, public policy, and macroeconomic conditions. It does show that the empowerment pathway is empirically relevant and should not be treated as a secondary issue in digital finance policy.

4.5 Dynamic estimates, diagnostics, and objective-linked interpretation

Table 10 presents the dynamic error-correction-style model for annual changes in the Gini index. The model explains 72.0 percent of the variation in annual inequality changes. The lagged Gini coefficient is negative, suggesting an adjustment tendency in which higher inequality in the previous year is followed by a downward change. Lagged DFI and the annual change in WEE also carry negative signs. The individual coefficients are not statistically precise, which is expected in a short annual sample with several parameters. The important point is that the dynamic model does not reverse the direction of the main relationship. Its signs remain compatible with the conclusion that digital inclusion and women's empowerment are associated with lower inequality.

The diagnostic results in Table 11 support a careful but positive reading of the controlled model. The Durbin-Watson statistic of 1.812 and the Breusch-Godfrey p-value of 0.996 indicate that severe serial correlation is not evident. The Breusch-Pagan p-value of 0.552 indicates that heteroskedasticity is not evident. The Ramsey RESET p-value of 0.003 signals specification sensitivity, likely because several variables trend together and the relationship may contain nonlinear adoption dynamics. This sensitivity does not overturn the main findings; it shows why the article reports several kinds of evidence and treats the results as a strong association rather than a definitive causal estimate.

The objective-linked evidence is summarised in Table 12. The first objective is supported by the negative DFI-Gini correlation and direct regression coefficient. The second objective is supported by the high DFI-WEE correlation and the positive a path. The third objective is supported by the negative WEE coefficient in the controlled model. The mediation objective is supported by the negative indirect effect and mediated share of 36.85 percent. The dynamic objective is supported directionally by the error-correction-style model. This matrix shows that the empirical claims do not depend on one isolated statistic but on consistent evidence across multiple analytical stages.

Table 10

Dynamic error-correction-style estimates for annual change in the Gini index.

Variable	Coefficient	Std. Error	t-statistic	p-value
Constant	5.869	8.476	0.692	0.511
Lagged Gini index	-0.179	0.236	-0.758	0.473
Lagged DFI index	-0.005	0.013	-0.372	0.721
Lagged WEE index	0.001	0.014	0.048	0.963
Change in DFI index	-0.037	0.145	-0.253	0.808
Change in WEE index	-0.012	0.009	-1.290	0.238
Change in inflation	0.003	0.004	0.781	0.460
Change in unemployment	-0.166	0.158	-1.048	0.329



Note. Dependent variable: annual change in the Gini index. The specification is used as a robustness exercise for a short annual time series.

Table 11

Diagnostic and robustness indicators.

Diagnostic	Value	Implication
Durbin-Watson statistic	1.812	Residual serial dependence was not indicated
Breusch-Godfrey LM p-value	0.996	Serial correlation was not indicated
Breusch-Pagan p-value	0.552	Heteroskedasticity was not indicated
Ramsey RESET p-value	0.003	Specification sensitivity was present
Bounds-style joint level F-statistic	2.294	Lagged levels carried joint information
Bounds-style joint level p-value	0.165	Joint level effect was suggestive in a small sample

Note. Diagnostics refer mainly to the controlled regression and dynamic robustness specification.

Table 12

Objective-linked empirical evidence matrix.

Research objective	Main empirical evidence	Result interpretation
DFI effect on income inequality	DFI-Gini correlation = -0.982; direct coefficient = -0.0399	Supported
DFI and women empowerment relationship	DFI-WEE correlation = 0.974; a path = 0.878	Supported
WEE contribution to inequality reduction	WEE coefficient in controlled model = -0.0250; p = 0.013	Supported
Mediation through WEE	Indirect effect = -0.0147; mediated share = 36.85%	Supported with suggestive mediation evidence
Short-run and long-run dynamics	Dynamic model R-squared = 0.720; signs support main direction	Supported as directional dynamic evidence

5. Discussion

The results support the view that digital financial inclusion can function as a distributional mechanism when it expands meaningful access for excluded groups. Vo et al. (2023) show that financial development and inclusion can shape income inequality in Asian contexts, and the Pakistan evidence is consistent with that broader finding. The DFI-Gini association is strongly negative across descriptive, correlational, and regression evidence. This means that Pakistan's digital finance expansion was not accompanied by a rise in inequality in this dataset. Instead, the country moved toward higher digital inclusion and lower Gini values across the period. The implication is that digital financial policy can be part of inclusive growth when access reaches beyond already banked and digitally literate groups.

The mediation results are especially important because they show that women's empowerment is not merely a parallel social outcome. Fonseca and Matray (2024) demonstrate that financial inclusion influences development and inequality through household-level channels, and the current article identifies a gendered channel in Pakistan's annual data. Digital financial inclusion is strongly associated with women's economic empowerment, and women's empowerment is negatively associated with the Gini index. The indirect effect accounts for 36.85 percent of the total DFI-inequality association. This finding suggests that women are a pathway through which digital finance becomes distributionally meaningful. Digital finance policy should therefore judge success by women's active account use, credit access, payment security, income control, and enterprise participation rather than by aggregate account growth alone.

The controlled regression strengthens the gender interpretation because WEE remains statistically significant when inflation, unemployment, and trade openness are included. Liu et al. (2021) show that digital financial inclusion can contribute to economic growth through technology-linked channels, while this article suggests that empowerment carries a distinct inequality-related role. The result matters because



macroeconomic instability can weaken household welfare and women's labour-market position. Even within that environment, empowerment remains negatively associated with inequality. Policy should therefore protect and expand women-focused digital finance during periods of inflation, employment stress, and household vulnerability rather than treating gender-inclusive finance as a secondary reform.

The trend pattern around 2020 deserves attention because the WEE index declines in that year while DFI continues to increase. Huang et al. (2023) connect financial inclusion and income inequality with human-capital outcomes, which helps explain why a shock-sensitive empowerment pathway may recover when digital and human-capability channels are strengthened. In Pakistan, the post-2020 years show rapid gains in DFI, WEE, women's account ownership, digital payment use, and female credit access. This pattern suggests that digital finance can support recovery, yet women's empowerment remains vulnerable to labour-market and social disruptions. A resilient inclusion strategy should therefore combine digital accounts with financial literacy, safe credit, digital consumer protection, and support for women-owned microenterprises.

The findings also contribute to the debate on whether digital finance can deepen inequality when early adoption favours better-off users. Dorn et al. (2022) show that distributional outcomes depend on broader economic and policy conditions. The Pakistan evidence is encouraging because inequality declined as digital finance expanded, yet gender gaps did not disappear. Women's account ownership reached 35.2 percent by 2025, while overall account ownership reached 44.0 percent. This remaining gap indicates that inclusion policy still needs gender-specific design. Simplified onboarding, low-cost accounts, women-friendly agent networks, grievance mechanisms, consumer trust, and phone access are needed to prevent digital services from reinforcing existing inequalities.

The article also supports a responsible inclusion perspective. Roland et al. (2026) emphasise that the inequality effects of financial inclusion should be assessed through policy context and distributional channels. Pakistan's positive DFI-Gini association should not be read as support for unchecked digital credit expansion. The same technologies that enable women to receive payments and save securely can also expose inexperienced users to fraud, over-borrowing, hidden fees, and digital coercion. Since many women are recent entrants to formal finance, consumer protection and financial capability are not optional safeguards. They are necessary conditions for digital finance to remain empowerment-enhancing rather than risk-producing.

The empirical evidence also shows that financial access indicators moved faster than labour-market indicators. Digital payment uses and branchless accounts rose quickly, while female labour force participation increased slowly. Pal and De (2021) call for critical analysis of digital inclusion for women, and the present findings reinforce that need. Digital access may open the door to financial agency, but it does not automatically transform labour markets, unpaid care responsibilities, mobility constraints, or employer behaviour. The next policy stage should focus on converting account ownership and digital payment use into enterprise growth, wage receipt, savings accumulation, creditworthiness, and control over income. Without this conversion, digital inclusion may remain a financial-access achievement rather than a full empowerment outcome.

The limitations of the evidence should also be recognised. The dataset contains 16 annual observations, which restricts the complexity of time-series modelling and makes formal dynamic tests less powerful. Emara (2023) shows that FinTech effects may be asymmetric or threshold-based, meaning that future Pakistan studies should test whether digital financial inclusion reduces inequality only after a certain level of women's access, internet coverage, or account activity is reached. The high co-movement among DFI, WEE, internet access, and social expenditure also means that regression coefficients represent conditional associations rather than definitive causal estimates. The strength of the article lies in the consistency of evidence across methods, not in claiming causal certainty from a short time series.

6. Policy implications

The central policy implication is that digital financial inclusion should be designed as a gender-inclusive inequality-reduction strategy. Kattan-Rodríguez and Galindo-Manrique (2025) link digital financial inclusion with sustainable development outcomes, and the Pakistan evidence shows that the distributional value of digital finance becomes stronger when women's economic empowerment is part of the pathway.



Policy should therefore move beyond account-opening targets and focus on active usage, women's control over accounts, secure payment receipt, productive credit, savings behaviour, and digital confidence. A digital wallet that is opened for a woman but operated by another household member has limited empowerment value. Measurement systems should record active women users, transaction frequency, credit quality, savings usage, and grievance resolution.

A second implication is that digital finance should be combined with financial literacy and consumer protection. Xu (2024) argues that digital financial literacy is central to the distributional value of digital finance, and the Pakistan case requires this insight to be applied to women with different education levels and digital capabilities. Training should be practical rather than symbolic. Women need to know how to protect passwords, compare fees, avoid fraud, understand repayment obligations, use digital receipts, and resolve service complaints. Providers should use transparent pricing, simple interfaces, local languages, and agent-level accountability. These measures are essential because inclusion can turn into vulnerability when new users enter digital finance without adequate knowledge or protection.

A third implication concerns the conversion of financial access into productive economic participation. Kumari et al. (2025) show that gender-based digital financial inclusion and women's empowerment can support poverty reduction in Asian economies. Pakistan can strengthen this pathway by linking women's digital accounts with microenterprise support, e-commerce participation, wage digitisation, social protection payments, and credit guarantees for women-led businesses. Digital payments should be integrated with market access and skills programmes so that women can use formal finance to generate income rather than only receive transfers. Such integration would help close the gap between fast-growing financial indicators and slower labour-market indicators.

A fourth implication is that regional and social differences must be addressed directly. Digital finance will reduce inequality more effectively if rural women, low-income women, and informally employed women can access services at low cost. This requires reliable connectivity, women-friendly agent networks, interoperable payment systems, affordable smartphones, and safe digital identification processes. Social norms should also be considered because account ownership may not translate into empowerment when women lack privacy or permission to transact. Gender-responsive policy should therefore treat digital finance as an ecosystem involving technology, regulation, literacy, family decision-making, labour markets, and social protection.

7. Limitations and future research

This article has limitations that are important for journal-level interpretation. The first limitation is the short annual sample. Sixteen observations allow descriptive, correlation, regression, mediation-oriented, and parsimonious dynamic analysis, but they do not support a complex lag structure or fully saturated time-series models. The second limitation is that the digital financial inclusion and women's economic empowerment indexes move strongly with time, which raises co-movement and specification sensitivity. The third limitation is that the dataset is country-level and annual, meaning that it cannot capture household-level control over accounts, intra-household bargaining, provincial differences, or differences between active and dormant users. The fourth limitation is that the mediation model is statistical and aggregate; it cannot directly observe the micro-level process through which women convert digital access into economic agency.

Future research can extend the article in several ways. Provincial panel data would allow stronger identification because regional variation in connectivity, account ownership, women's employment, and poverty could be compared within the same country. Household survey data could measure whether women personally control digital accounts, receive income through them, save independently, borrow for productive purposes, and participate in financial decisions. Mobile wallet transaction data could distinguish active users from registered users and identify whether women's accounts are used for wages, remittances, government transfers, savings, or credit. Future studies can also test nonlinear and threshold effects, such as whether digital finance begins to reduce inequality only after women's account ownership or internet access reaches a certain level.



8. Conclusion

This article examined the relationship between digital financial inclusion, women's economic empowerment, and income inequality in Pakistan using annual secondary-data observations for 2010-2025. The evidence shows a clear long-run pattern. Digital financial inclusion rose sharply, women's economic empowerment improved substantially, and the Gini index declined from 33.8 to 29.4. Descriptive results show strong expansion in internet use, account ownership, digital payment use, branchless banking accounts, women's account ownership, female credit access, and female secondary enrolment. These improvements occurred during a period of declining inequality, giving the article a coherent empirical basis for analysing digital finance as an inclusion mechanism.

The regression and mediation results support the study objectives. Digital financial inclusion has a strong negative association with the Gini index in the direct model, and its coefficient remains negative after women's economic empowerment and macroeconomic controls are introduced. Women's economic empowerment is also negatively associated with the Gini index and becomes statistically significant in the controlled model. The mediation-oriented analysis shows that digital financial inclusion is strongly associated with women's economic empowerment and that the empowerment pathway accounts for 36.85 percent of the total DFI-inequality association. This means that women's economic empowerment is an important channel through which digital finance is connected with lower income inequality.

The dynamic and diagnostic evidence supports a cautious but consistent interpretation. The short annual sample limits complex time-series inference, yet the dynamic model does not reverse the main direction of the findings. Diagnostic tests do not indicate major serial-correlation or heteroskedasticity concerns in the controlled model, although specification sensitivity shows that longer datasets and nonlinear designs would strengthen future research. The article therefore concludes that digital financial inclusion can support inequality reduction in Pakistan when it is connected with women's financial access, account usage, credit participation, education-related capability, employment opportunity, and economic agency.

The policy message is direct. Pakistan's digital finance agenda should be evaluated through gender-inclusive outcomes rather than aggregate digital expansion alone. Digital payments, branchless accounts, mobile wallets, and internet-enabled services can reduce financial exclusion, but their inequality-reducing value becomes stronger when women can use accounts safely, access credit responsibly, receive payments securely, participate in economic activity, and control financial resources. A strategy that combines digital infrastructure with women's financial literacy, affordable services, productive credit, labour-market inclusion, consumer protection, and social support can make digital financial inclusion a more effective pathway for reducing income inequality.

Contribution of Authors

The first author made the major contribution to the ideation, development, and preparation of the manuscript. The co-authors supported the study by providing valuable intellectual input, assisting in the development of the research, and contributing to the overall quality of the work.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this article.

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Informed Consent

Informed consent was obtained from all participants.

Data Availability

The article is based on the secondary annual dataset supplied for the study. The dataset was organised in a Stata-ready annual time-series structure for Pakistan covering 2010-2025.

Ethical statement

The study used secondary aggregate data and did not involve human participants, personal identifiers, interviews, experiments, or fieldwork.



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