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The lockdowns and other precautions used to stop the virus' spread also impacted the world's agriculture and food supply networks, resulting in food shortages and price rises in some areas. The pandemic exacerbated already severe food insecurity in many regions of the world, particularly in underdeveloped countries where people already struggled to buy enough food. The lockdowns and economic slowdown brought on by the pandemic have made it harder for many people in these countries, many of whom depend on informal jobs like farming and street vending to live. As a result, hunger and malnutrition have increased in many parts of the world. According to preliminary data, the number of persons who experienced food insecurity surged during the COVID-19 pandemic and the ensuing mobility lockdowns in several regions of the world (Amare *et al.*, 2021; Bukari *et al.*, 2022) [4, 5]

For instance, it was estimated that a rise in COVID-19 or mobility lockdowns will lead to a 6–15 percentage point increase in household food insecurity in Nigeria (Amare, Abay, Tiberti *et al.*, 2021) ^[4]. Similar empirical information is also available for other developing nations, like Ghana, where an increase in the instrumented COVID-19 measure is connected to increases in poverty and food insecurity of 0.232 and 0.289 SD, respectively (Bukari, Aning-Agyei, Kyeremeh *et al.*, 2022) ^[5].

In a similar line, data on food crises around the world confirmed that populations that are food insecure are becoming more prevalent (Swinnen & McDermott, 2020; FSIN, 2022; FAO, IFAD, UNICEF, WFP & That, 2022) ^[6, 8, 7].

According to the 2022 Global Report on Food Crises (FSIN

and Global Network against Food Crises, 2022) published by FSIN and the Global Network against Food Crises, 151 million people were suffering from extreme food insecurity at the end of the year 2020. This number is 135 million lower than it was at the end of the year 2019. Since the year 2020, the number of people living in Nigeria who do not have access to food has increased. The level of food insecurity in Nigeria is depicted in Figure 1 using data from the 2022 Global Report on Food Crises (FSIN and Global Network against Food Crises, 2022). This report was produced by FSIN and the Global Network against Food Crises. There is no difference in population between sixteen of Nigeria's states and the country's Federal Capital Territory, which includes all 36 states.

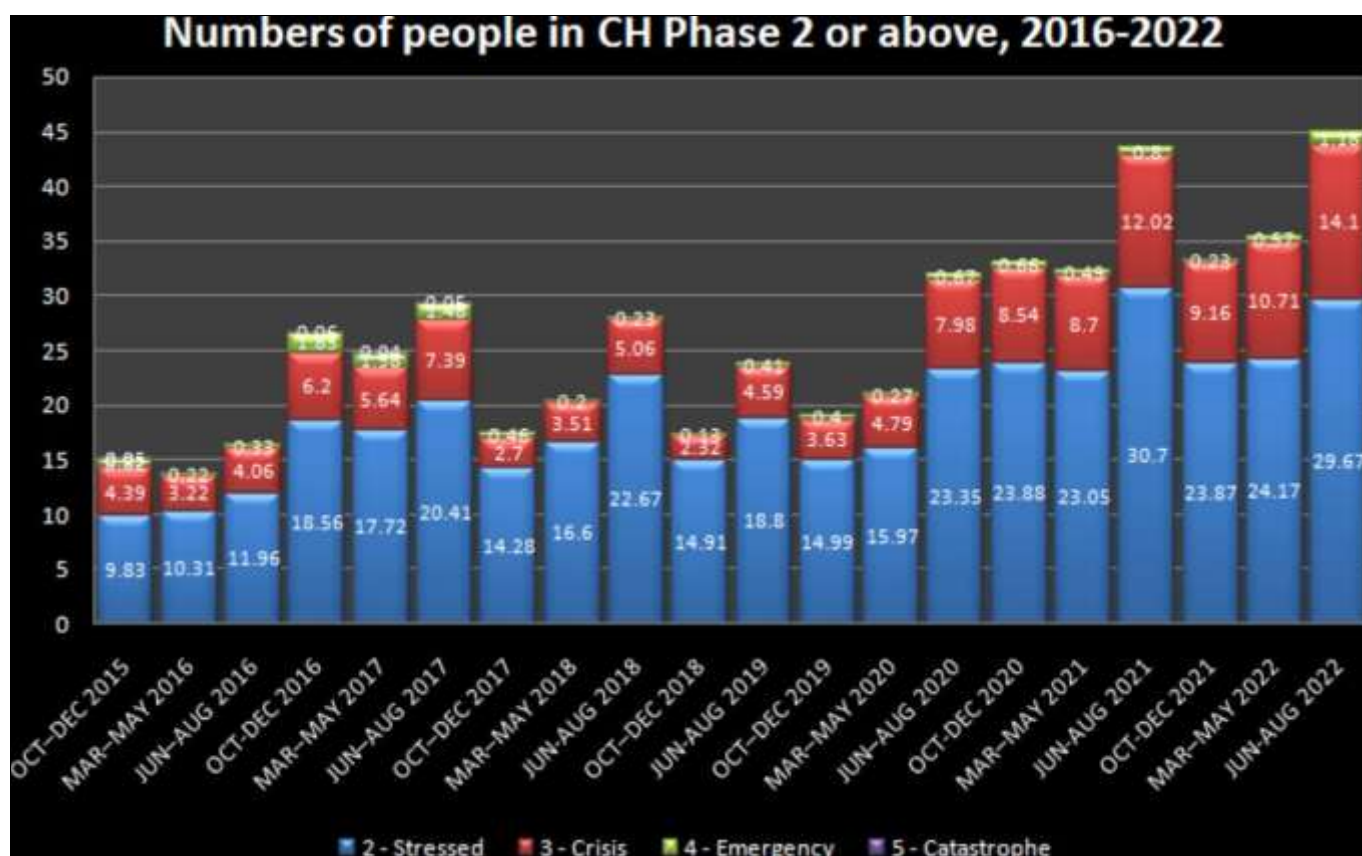


Fig 1: Number of people in Cadre Harmonisé (CH) phase 2 or above 2016-2022.

Before the pandemic's height, which fell between October and December 2019, 4.1 million persons in Nigeria were in CH phase 2 (crisis) or above. The value grew during 2020 and reached its maximum point in October–December when 9.2 million people were experiencing crisis-level situations. The COVID-19 pandemic has, in general, brought attention to the weakness of the world's food systems and the need for more durable and resilient ones that can resist disturbances and guarantee that everyone has access to enough wholesome food. Furthermore, it is undeniable that the protracted Ukrainian crisis makes it harder for nations to recover from the socioeconomic shocks caused by the pandemic (UNCTAD, 2022; World Bank, 2022) ^[9, 1]. Comparatively, to the epidemic era, the situation of global food insecurity has gotten worse due to the escalating inflation in many parts of the world. This necessitates immediate action from governments in food crisis-affected nations like Nigeria, where the Global Alliance for Food

Security (2022) predicted that as many as 19.45 million people would experience a crisis or worse (IPC/CH Phase 3 or above) as of June–August 2022.

Consequently, this study's primary focus is to decompose the link between food insecurity among household socio-economic factors and other factors that could affect food insecurity during the covid-19 pandemic in Nigeria.

2. Literature review

There are at least four ways that the coronavirus pandemic could impact the safety of household food supplies. First, viral infections or the fear of getting the virus could decrease activities that generate income. This holds for remittances as well as domestic and foreign revenue sources, including local sources. For instance, the pandemic is likely to reduce remittances, which have historically been proven to be crucial for preserving food security during food crises (Breisinger *et al.*, 2020; Diao & Mahrt, 2020; Obi *et*

al., 2020) ^[11, 14]. Second, restrictions put in place by the government to stop the pandemic's spread, including movement restrictions and lockdowns, are disrupting daily life and lowering household earnings (Abay *et al.*, 2020b; Arndt *et al.*, 2020; World Bank, 2020a) ^[12, 16 13]. Thirdly, the availability of food may be hampered by alterations in food systems and supplies (Hirvonen *et al.*, 2021b; Mahajan and Tomar, 2021) ^[17, 18]. Fourth, food price increases can be caused by disturbances in food systems and value chains, which limits the affordability of foods (Devereux *et al.*, 2020) ^[21]. For instance, preliminary research by Hirvonen *et al.* (2021b) ^[17] indicates that the pandemic caused considerable but variable rises in the cost of food (vegetables) in Ethiopia.

The coronavirus pandemic is still in its early stages, and comprehensive household survey data are not yet available, therefore empirical evidence on the extent of the impact it has had on the aforementioned processes is still lacking (World Bank, 2022) ^[1]. Nigeria is extremely vulnerable to financial shocks and food instability brought on by the pandemic's spread (Bukhari *et al.*, 2022) ^[5]. Furthermore, important economic activity, including local companies, is being disrupted by lockdowns and mobility restrictions at the federal, state, and local levels (World Bank, 2022b) ^[2]. These limitations have a direct impact on domestic food transportation and the availability of food. Food supply systems both domestically and internationally may be disrupted, food prices may be rising, and informal sector unemployment rates may be rising in Nigeria (GAIN, 2020) ^[19]. In particular, in poorer and more vulnerable households, all of these consequences are anticipated to have a considerable impact on food insecurity (Tendall *et al.*, 2015; Gilligan, 2020) ^[22, 20].

3. Data and Methodology

3.1 Data

Longitudinal data was publicly obtained from the World Bank publication of the 2020 covid-19 national longitudinal phone survey conducted across 36 states including the federal capital territory in Nigeria via <https://microdata.worldbank.org>. It is also secondary data because it was extracted from the World Bank Publication with a total household sample of 3958 collected using a purposive sampling technique based on the cleaning of the dataset by removing the missing values and outliers of the dataset.

3.2 Methodology

The quantitative research design was adopted in this research work and the method of analysis used is the summary statistics (using mean, standard deviation, frequency and percentage) and the quantile regression analysis.

3.2.1 Model specification

The model adopted for this study can be specified as functional equation below.

Food insecurity = f (socio-economic factors, any_work, ag_work, ext_work,).

3.3 Quantile regression

Quantile regression is used to model and decompose the link between a set of independent variables and the "quantiles" of an outcome (dependent) variable, most frequently the median. Quantile regression is a subset of linear regression that is employed when the linear regression's standard least squares assumptions are violated (i.e., linearity, homoscedasticity, normality, autocorrelation) and this makes it more robust than the ordinary linear regression. Meanwhile, appropriate quantile visualization will be carried out following the model estimate. The dependent variable is Food insecurity while the independent variables are socio-economic factors, any_work, ag_work, and ext_work. The socio-economic factors are sex, age, married, education, work, rural, finance and phone sample.

The generalized quantile regression model where the qth quantile can be expressed as;

$$Q_{(y)} = \alpha_q + \beta_{q,1}x_1 + \beta_{q,2}x_2 + \dots \beta_{q,n}x_n + \mu$$

Where the y_t is the response variable (Food insecurity) representing the response of different quantiles, $\beta_{q,1}$ to $\beta_{q,n}$ are the quantile coefficient estimates of the explanatory variables of x_1 to x_n and μ is the error term.

Quantile regression will enable decomposing using different quantiles of the model such as Q10, Q20, Q30, Q40, Q50, Q60, Q70 etc. based on applicable quantiles estimated. The decomposition by the quantiles forms different models which will be arranged in a table.

Table 1: Variable measurement

Variables	Description	Measurement
Socio-economic factors		
Sex	Male	Categorical
	Female	
Age	Age of the household in years	Continuous
Married	Individual married or not	Categorical
Education	Level of education	Categorical
Work	Working status (working or not)	Categorical
Rural	Rural or Urban Household	Categorical
Finance	Account from the financial institution	Categorical
Phone sample	Those with active phone or not	Categorical
Other variables		
Any._work	% of working adult working	Continuous
Ag._work	% of working adults working in agriculture	Continuous
Ext._work	% of working adults working in wage work	Continuous
Dependent variable		
Food insecurity	Food insecurity measure	Continuous

Source: World Bank

4. Results and Discussion

This section presents the results of the data analysis conducted using STATA version 17.0 and the discussion of the notable findings deduced from the interpretation of the results.

Table 2: Summary statistics

		Frequency	Percent	Mean	Std.Dev
Sex	Male	1955	49.4	1.51	0.500
	Female	2003	50.6	27.90	19.521
Age					
Married	No	2595	65.6	0.34	0.475
	Yes	1363	34.4		
Rural	Rural	1234	31.2	1.69	0.463
	Urban	2724	68.8		
Phone sample	No	1555	39.3	0.61	0.488
	Yes	2403	60.7		
Work	No	2381	60.2	0.40	0.490
	Yes	1577	39.8		
Education	None	1682	42.5	0.93	0.967
	Primary	1213	30.6		
	Secondary	738	18.6		
	Tertiary	325	8.2		
Finance	No	1910	48.3	0.52	0.500
	Yes	2048	51.7		

Source: Author's computation using STATA Software.

Table 2 shows that the male household in 1955 represented 49.4% while the female household in 2003 represented 50.6% which implies that we have more females than males in the household. The average age of the household in this study is about 28 years with a variability of about 20 years. The household that is not married is 2595 representing 65.6% while the unmarried is 1363 representing 34.4%. The household in the rural area is 1234 representing 31.2% while those in Urban are 2724 representing 68.8%. The household recorded without a phone is 1555 representing 39.3% while the household with the phone is 2403 representing 60.7%. The household working is 1577

representing 39.8% while the household not working is 2381 representing 60.2% which is very consistent with the current situation in Nigeria as there is a high level of unemployment. The household with no education is 1682 representing 42.5%, the ones with primary education are 1213 representing 30.6%, those with secondary education 738 representing 18.6% and those with tertiary education 325 representing 8.2%. Besides, the household with accounts from financial institutions in 2048 represented 51.7% while those without accounts from financial institutions in 1910 represent 48.3%.

Table 3: Quantile Regression

GDP	10 th Quantile	20 th Quantile	30 th Quantile	40 th Quantile	50 th Quantile	60 th Quantile	70 th Quantile
Sex	-0.005 (0.013)	0.000 (0.010)	-0.002 (0.011)	0.001 (0.010)	-0.007 (0.011)	-0.006 (0.010)	0.002 (0.011)
Age	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.001 (0.000)	0.001 (0.000)
Married	-0.004 (0.017)	-0.008 (0.013)	0.001 (0.014)	0.002 (0.013)	-0.007 (0.014)	-0.010 (0.013)	-0.019 (0.015)
Rural	-0.136** (0.015)	-0.114** (0.012)	-0.108** (0.013)	-0.114** (0.012)	-0.114** (0.013)	-0.116** (0.012)	-0.098** (0.014)
Phone Sample	-0.016 (0.013)	0.006 (0.010)	0.005 (0.011)	0.003 (0.010)	-0.006 (0.011)	0.003 (0.010)	0.004 (0.011)
Work	0.005 (0.015)	-0.003 (0.012)	-0.002 (0.013)	0.008 (0.012)	0.002 (0.013)	-0.002 (0.011)	-0.001 (0.013)
Education	-0.021** (0.007)	-0.018** (0.006)	-0.022** (0.006)	-0.022** (0.006)	-0.023** (0.006)	-0.019** (0.005)	-0.022** (0.006)
Finance	0.156** (0.015)	0.168** (0.011)	0.178** (0.012)	0.166** (0.011)	0.164** (0.012)	0.153** (0.011)	0.163** (0.012)
any_work	0.002** (0.000)	0.002** (0.000)	0.002** (0.000)	0.002** (0.000)	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)
ag_work	-0.001** (0.000)	-0.001** (0.000)	-0.001** (0.000)	-0.001** (0.000)	-0.001** (0.000)	-0.001** (0.000)	-0.001** (0.000)
ext_work	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)
Constant	4.973** (0.040)	5.013** (0.031)	5.079** (0.033)	5.158** (0.031)	5.246** (0.034)	5.313** (0.030)	5.330** (0.035)

Where the asterisk ** is 1% significant level while the Standard error in parenthesis.

Source: Author's computation using STATA Software.

Table 3 shows that the quantile regression decomposes the relationship between food insecurity and socio-economic factors as well as the other economic activity factors into seven models of seven quantiles. The results show that the coefficient estimates of the socio-economic factors such as rural and education have a negative significant contribution to food insecurity while finance that captures the household with accounts from financial institutions has a positive significant contribution to food insecurity in Nigeria which suggest that the higher the rural and educational level of the household, the lower will be the level of food insecurity and the more the household with accounts from financial institutions, the greater will be the food insecurity in

Nigeria.

Besides, the seven estimated quantiles also reveal that % of working adult working and % of working adults working in wage work has a positive significant contribution to food insecurity while the % of working adults working in agriculture have a negative significant contribution to food insecurity in Nigeria which indicate that the more the percentage of working adult working and percentage of working adults working in wage work, the more the food insecurity in Nigeria because they are locked down during that period and the higher the percentage of working adults working in agriculture, the lower will be the food insecurity during that the covid-19 pandemic.

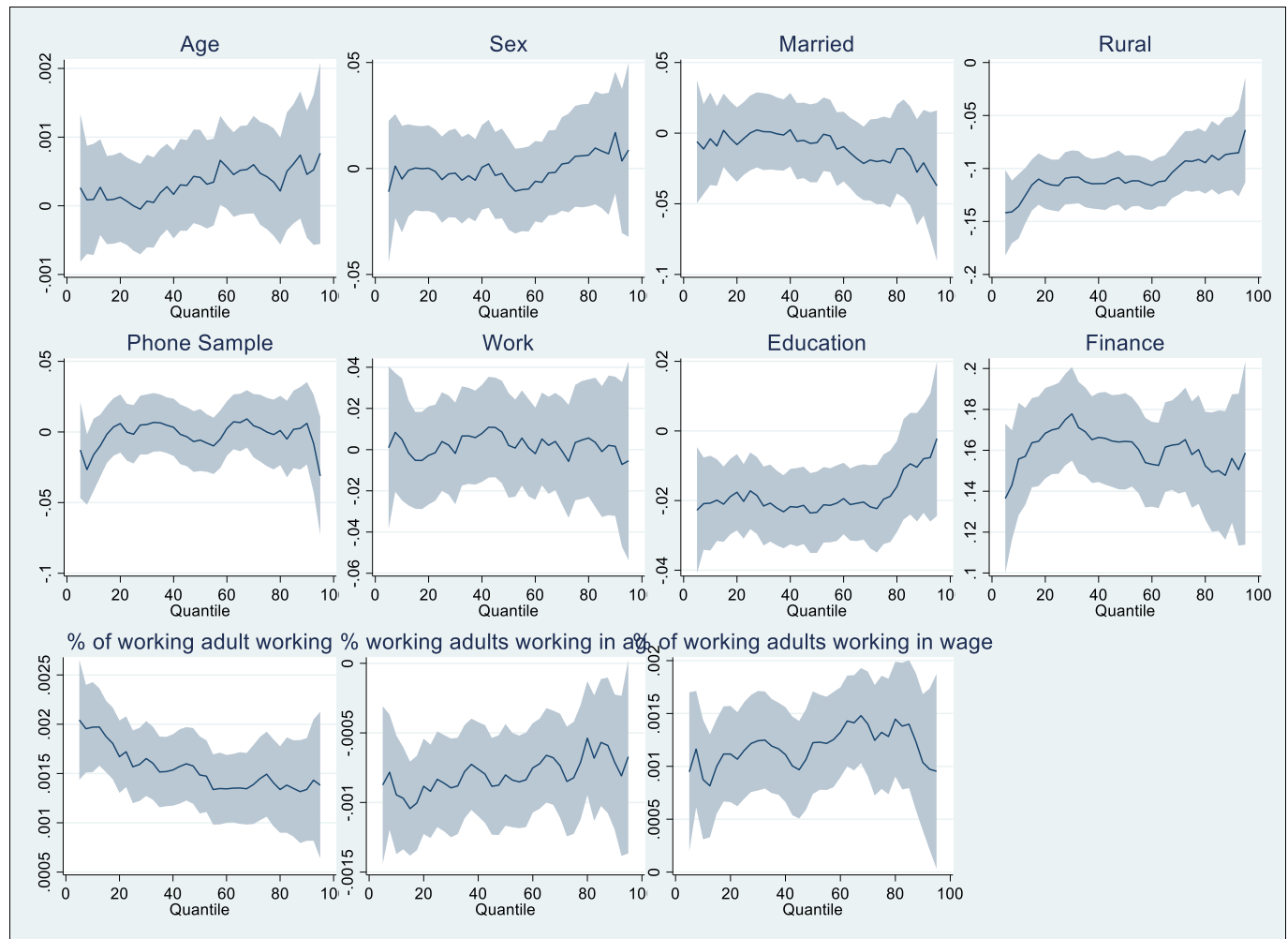


Fig 2: Quantile Regression coefficient estimate plot

Figure 2 demonstrated the stability of the fitted quantile regression model as we can see that the coefficient estimate of all the explanatory model in the above plot (see figure 2) fall between the 95% confidence interval.

4.1 Discussion of findings

In Table 2, the male household in 1955 represented 49.4% while the female household in 2003 represented 50.6% which implies that we have more females than males in the household. The average age of the household in this study is about 28 years with a variability of about 20 years. The household that is not married is 2595 representing 65.6% while the unmarried is 1363 representing 34.4%. The household in the rural area is 1234 representing 31.2% while those in Urban are 2724 representing 68.8%. The household recorded without a phone is 1555 representing 39.3% while the household with the phone is 2403 representing 60.7%. The household working is 1577 representing 39.8% while the household not working is 2381 representing 60.2% which is very consistent with the current situation in Nigeria as there is a high level of unemployment. The household with no education is 1682 representing 42.5%, the ones with primary education are 1213 representing 30.6%, those with secondary education 738 representing 18.6% and those with tertiary education 325 representing 8.2%. Besides, the household with accounts from financial institutions in 2048 represented 51.7% while those without accounts from financial institutions in 1910 represent 48.3%.

Table 3's findings, however, indicate that household finances, which are captured by accounts with financial institutions, have a positive significant contribution to food insecurity in Nigeria while rural and educational levels have a negative significant contribution. This suggests that the higher the level of rural and educational attainment of the household, the lower the level of food insecurity will be.

Additionally, the seven estimated quantiles show that the percentage of working adults working and the percentage of working adults engaged in wage work both significantly contribute to food insecurity in Nigeria while the percentage of working adults engaged in agriculture does not, indicating that the greater the percentage of working adults working and the greater the percentage of working adults engaged in wage work, the greater the level of food insecurity in Nigeria. The work of Obi *et al.* (2020a) ^[15], Breisinger *et al.* (2020) ^[11], as well as Diao and Mahit (2020) ^[14], all supported the idea that the impact of the COVID-19 pandemic reduces the necessity of sustaining food security during the food crisis as a result of the lockdown restrictions.

Abay *et al.* (2020b) ^[12] and Arndt *et al.* (2020) ^[13] have both found that the introduction of lockdown restrictions on movement in Nigeria and other countries of the world to stop the spread of the COVID-19 pandemic crippled livelihood activities and decreased household income.

5. Conclusion and policy implication

The main goal of this study is to dissect the relationship

between household demographics, including the percentage of working adults, the percentage of working adults engaged in wage work, and the percentage of working adults engaged in agriculture, and food insecurity. The quantile regression analysis reveals that some socioeconomic factors, such as rurality and education level, have a negative significant contribution to food insecurity in Nigeria, whereas households with financial institution accounts have a positive significant contribution.

The analysis's findings also indicate that the percentage of working adults engaged in agriculture makes a significant negative contribution to food insecurity, whereas the percentage of working adults engaged in wage work makes a significant positive contribution to food insecurity, suggesting that the greater the percentage of working adults engaged in wage work, the greater the food insecurity.

Therefore, the government must emphasise the significance of food security by making comprehensive investments in agriculture and providing adequate security to farmers to encourage more people to work in agriculture, which will help increase food availability, fight poverty and hunger, as well as combat food insecurity among Nigerian households.

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