World Vision
الرؤية العالمية

Projecting the impact of prolonged food insecurity and education interruption on economic growth in Lebanon.

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List of Acronyms

ADER	Average Dietary Energy Requirement
DES	Dietary Energy Supply
GDP	Gross Domestic Product
IPC	Integrated Food Security Phase Classification
MEHE	Ministry of Education and Higher Education
TOR	Terms of Reference
WVL	World Vision Lebanon
CEIC	China Economic Information Center
WFP	World Food Programme

Executive Summary

Lebanon's multifaceted challenges, including prolonged education disruptions and escalating food insecurity, have prompted World Vision Lebanon to commission Qualisus Consulting to conduct a research study aimed at comprehending the potential economic consequences of these intertwined crises. The core objective of this research is to gain insights into the potential economic implications of education disruptions and food insecurity in Lebanon. By unraveling these impacts, the study seeks to equip policymakers and stakeholders with valuable insights to advocate for proactive interventions and systemic reforms.

The research team employs a comprehensive methodology, encompassing a systematic scoping review of the literature to derive key insights and a decision tree predictive model analysis based on primary data from Lebanon. The scoping review explores the interconnections between disrupted education, food security, and their economic implications. The decision tree model scrutinizes correlations between variables like disrupted education, food security, and their effects on the Gross Domestic Product (GDP).

Key Findings:

- The scoping review findings indicate that a profound and substantial impact of interrupted education on the local and global economy, as well as the learning outcomes of students.

- Food insecurity in adults was associated with higher annual healthcare costs.

- Malnutrition during emergencies has significant economic consequences including increased healthcare costs, lost productivity, reduced educational attainment, and heightened social costs.

- Economic cost of malnutrition is higher in low-income countries and higher in women than men.

- The Average Protein Supply per capita is a significant predictor of national GDP per capita, emphasizing that good nutrition is integral to the nation's economic well-being.

- In Lebanon, higher Progression to Secondary School rates correlate with a more robust economic status, as reflected by the GDP per capita.

- Lebanon exhibits a trend where higher progression rates to secondary schools are associated with better overall economic performance.

- In Lebanon, a higher percentage of students repeating grades in primary school aligns with a reduced GDP per capita, indicating potential educational challenges that could impact economic growth.

- The Covid-19 pandemic and economic recession have further reinforced the connection between education, food security, and GDP.

Key Recommendations:

For Donors	For Policymakers
Invest in early childhood and primary education interventions to lay the essential foundations in education and increase the progression onto secondary education rates.	Advocate for multi-sectoral collaborations that acknowledge the interplay of education, food security, health, and economic well-being.
Invest in school feeding programmes	Strengthen the education-healthcare nexus. Enhance the synergy between education and healthcare by prioritizing cohesive policies and partnerships.
Invest in developing and implementing comprehensive policies to minimize interruptions to education	Advocate for collaborative research partnerships to address knowledge gaps concerning the intricate relationships between education, nutrition, and economic outcomes in Lebanon.
Invest in securing protein accessibility (a vital macro-nutrient) for vulnerable communities.	
Ensure access to safe water, sanitation, and essential micronutrients.	

Introduction

Lebanon faces a complex web of challenges including prolonged interruptions to schooling and escalating food insecurity. To gain a better understanding of the pressing economic implications of these interconnected crises, World Vision Lebanon (WVL) commissioned Qualisus Consulting to conduct research study titled "Projecting the Impact of Prolonged Food Insecurity and Interrupted Education on Economic Growth in Lebanon" aiming to shed light on the potential future burdens the nation may bear.

Lebanon continues to face a multifaceted crisis with devastating effects on education and food security. The country has the highest number of refugees per capita, with an estimated 1.5 million Syrian refugees (UNHCR, 2021). According to UN ESCWA, 74% of the population is living in poverty as of September 2021 (ESCWA, 2021). The refugee crisis, inflation, COVID-19, and the Beirut blast have placed tremendous stress on the country's infrastructure and economy. Inflation in Lebanon reached 154.8% in 2021 (Trading Economics, 2022), causing a severe devaluation of the local currency and a reduction in purchasing power. Both refugees and host communities are struggling to meet their basic needs due to the rapid increase in prices and unemployment rates fueled by COVID-19. The Integrated Food Security Phase Classification (IPC) of the World Food Programme approximates that a staggering 2.26 million individuals in Lebanon are suffering from acute levels of food insecurity, and an additional one million children have experienced interrupted education.

The imperative driving this research stems from the urgent necessity to comprehend the prospective economic ramifications that Lebanon could encounter as it grapples with the challenge of nurturing a generation bereft of essential skills and education while simultaneously contending with the exigencies of food insecurity. By unveiling potential impacts, this endeavour aims to equip policymakers and pertinent stakeholders with invaluable insights into the fiscal burdens that Lebanon may bear if prevailing trends persist, thus advocating for proactive interventions and systemic reforms.

Methods

To gain insights on the economic impact of the interconnected food and education crisis in Lebanon, the research team adopted a comprehensive methodological approach. This involved conducting a systematic scoping review aimed at charting the existing evidence concerning the interrelated impact and ensuing economic implications stemming from food insecurity and disruptions in education within the chosen geographic region. In parallel, an exhaustive search was conducted across reputable data repositories, including notable sources such as the World Bank and UNICEF, with a focus on identifying datasets integrating pertinent variables such as "Food Insecurity in Lebanon," "Interrupted Education in Lebanon," and "State Cost in Lebanon."

Subsequently, a decision tree model, a straightforward yet robust computational technique, was employed to analyze the gathered data. This model facilitated an exploration of the correlations between variables like disrupted education, food security fluctuations, and their subsequent effects on the region's Gross Domestic Product (GDP). By assessing various factors, the decision tree model identified the most influential elements for predicting potential outcomes.

Scoping review

The scoping review was conducted following the Arksey et al (2005) framework, with a primary aim of systematically mapping the existing evidence about the impact and cost of food insecurity and interrupted education on the state. The review methodology involved a systematic approach encompassing several steps (see Figure 1). Before commencing with the scoping review, the research team defined a set of operational definition (see Annex 1).
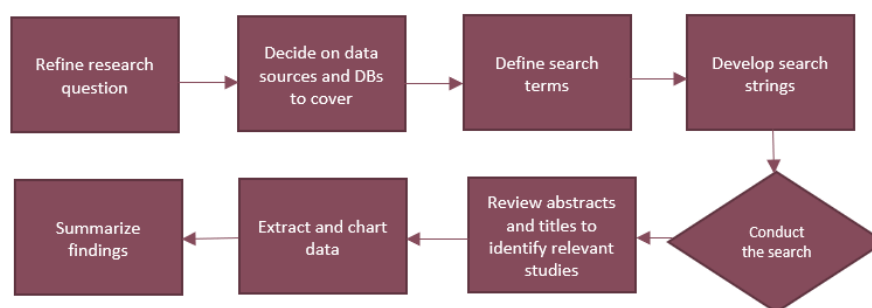

Figure 1 Scoping Review Process

The scoping review findings were utilized to refine the research question identified during the proposal stage. For example, the insights gained from the review process were instrumental in enhancing the definition of the variable "Impact and cost on state." More precise terms such as "Gross Domestic Product," "Economic Growth," and "Financial Impact" were identified through the review, allowing for a more comprehensive exploration of the topic, particularly in terms of its economic dimensions. To conduct the search, the research team utilized various databases[1], and to identify relevant studies, a series of research strings were constructed based on the identified terms (see Annex 2).

Search and Compilation of Quantitative Data

The objective was to identify datasets encompassing the variables "Food Insecurity," "Interrupted Education," and "State Cost." It was found that no single dataset contained all three variables in tandem. Consequently, the research team proceeded to download and amalgamate individual

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[1] PubMed, Relief web, Scopus, Education Resources Information Center (ERIC), World Bank eLibrary, OECD iLibrary, UNESCO Digital Library, Google Scholar, FAO Statistics Database, and Integrated Food Security Phase Classification (IPC) Global Database.

datasets for each variable, or in some instances, pairs of variables. Noteworthy datasets related to education, such as "Progression to Secondary School" from China Economic Information Center (CEIC), were incorporated, although some presented limitations in terms of data coverage. As a result, emphasis was placed on selecting consistently collected indicators featuring standardized definitions, thereby enhancing the overall quality of the compiled dataset. Outlined in Annex 3 is an overview of the 11 features or variables included in the dataset. In totality, the research team successfully identified a total of 54 datasets, from which 10 comprehensive features or variables were extracted, covering the period from 2000 to 2021. These constituted the foundational elements underpinning the subsequent development of the predictive model.

Statistical and Machine Learning Models

The research team utilized a machine learning technique known as the decision tree model to investigate the impact of education disruptions and food security fluctuations on GDP. The decision tree model offers several advantages, including high interpretability, simplicity, and the ability to model complex non-linear relationships accurately. This model operates by evaluating the range of available attributes and identifying the one most informative for the prediction target.

To gauge the effectiveness of the model, the research team employed 2-fold cross-validation and computed the coefficient of determination (R^2) of the prediction. With R^2 values, 1 denotes perfect prediction, 0 indicates random prediction and negative values represent worse predictions. Subsequently, the research team classified the features/variables according to their relevance in predicting GDP, retaining only the three most crucial ones from the initial eleven.

Nonetheless, decision tree models do not supply coefficients indicating the direction and magnitude of the association between GDP per capita and the included variables. To address this, the research team utilized a correlation matrix to visualize and quantify the linear association to the greatest extent possible.

Given the small sample size available, the linearity assumption is often not satisfied, necessitating a cautious interpretation of these correlation coefficients. The research team advises users to regard these correlation coefficients as suggestive of potential associations rather than as indications of causal effects. This cautious approach will help ensure the reliability and accuracy of the interpretations and recommendations based on the model's results.

Limitations

While the study provides valuable insights into the relationships between various factors and GDP per capita, it is essential to acknowledge its limitations. The primary limitation lies in the sample size. The dataset comprised only 18 data points (rows) and nine features (columns), which presents a challenge known as the "curse of dimensionality". With a high ratio of features to data points, the model may overfit the data, limiting its generalizability to new, unseen data.

Another crucial limitation to consider is the potential for omitted variable bias. Given the study's limited scope, the research team might have overlooked other relevant variables influencing GDP per capita, which could introduce bias into the estimates. This could potentially affect the interpretation and validity of the findings.

Furthermore, while the research team used decision tree models for their simplicity and interpretability, it's important to note that these models tend to have high variance and might not provide a globally optimal solution. Additionally, the fact that decision tree models do not provide coefficients limits the understanding of the direction and magnitude of the association between GDP per capita and the variables included in the model. The correlation matrix partly addressed this issue, but the small sample size constrained its utility, making it less reliable for inferring causal relationships.

Lastly, the generated model heavily relied on the assumption of linearity for some of the correlations. However, given the small sample size, these assumptions might not hold, and some relationships might be non-linear or even non-monotonic.

Despite these limitations, the study offers a pioneering look at the combined effect of education disruptions and food security on a state's economic health. However, future studies with larger datasets, more comprehensive feature sets, and advanced models are recommended to explore further and validate the findings.

Findings

The finding section is split into two interrelated sub-sections. The first sub-section provides a detailed overview of the scoping review findings, outlining the correlation between interrupted education and food insecurity on state. The second sub-section presents the findings of the predictive model, using the insight obtained from the scoping review.

Results of the Scoping Review

The scoping review was concluded, encompassing the identification of 543 reports and articles. From this corpus, a total of 46 reports and articles were retained and utilized to formulate the scoping review results. The main studies investigating the economic burden of learning losses and food insecurity on the state are summarized in Annex 4. While articles were found across different countries, it's vital to highlight the fact that no relevant articles were found related to Lebanon or the MENA context. Some articles related to prevalence were found and referred to, yet most of the informative articles were from the developed countries.

The scoping review findings indicate a profound and substantial impact of interrupted education on the local and global economy, as well as the learning outcomes of students. Economic effects, both locally and globally, have been significant. Hanushek et al., (2020) estimated a future reduction of 1.5% in annual GDP due to learning losses, a trend that could persist throughout the century. Jaume et al., (2019) quantified the cost of teacher strikes in Argentina between 2003 and 2015 at $2.34 billion in long-term annual earnings losses. Dorn et al. (2020) associated the learning crisis triggered by the pandemic with a potential loss of $110 billion in annual earnings for the US economy. They predicted this could translate to a GDP loss between $173 billion to $271 billion annually by 2040 due to lower levels of learning and increased dropouts.

Reading scores globally declined by 33%, equivalent to more than a year of schooling from 2016 to 2021, according to Jakubowsk et al. (2022), with an estimated economic consequence of a 0.68% reduction in global GDP growth. Cohen et al. (2022) projected a cost of $943 billion to the

global economy in 2030 alone due to the economic scarring effects of disrupted education. Moreover, Rosnick et al., (2021) associated learning loss from school closures with a reduction of 3.6% in GDP by 2050. However, they also argued for the potential of a high return on investment for extending the 2021-2022 school year, indicating a $16 return for each $1 invested over three decades. Fuchs-Schundeln et al. (2022) found that school closures during the COVID-19 pandemic reduced lifetime earnings of about 1.8% for affected children in the United States, with this loss larger for children from poorer families.

Regarding learning outcomes, Dorn et al. (2020) documented average learning losses of three months in mathematics and reading due to school closures and remote learning. These losses were higher for Black students and students from low-income families. Similarly, Jakubowsk et al., (2022) reported that schools with longer closures experienced larger learning losses, with lower-achieving students disproportionately affected.

In the long term, disparities in education distribution have a notable impact on economic growth, as shown by Castelló-Climent (2013). The study suggested a 0.53 percentage-point reduction in per capita GDP growth rates for every 0.1-point increase in the Gini coefficient, which measures inequality in education distribution. Other studies further support the positive correlation between education and economic growth. For instance, Reza et al. (2013) reported a 1.56% increase in output for a 1% increase in average education per worker in Indonesia.

These findings emphasize the profound impact of disrupted education on students' learning outcomes and the economy, highlighting the urgency of interventions to address learning losses and avoid further widening the achievement gap. The long-term consequences of interrupted education can be severe, affecting individual students and the broader economy. Therefore, mitigating these impacts is crucial for current and future generations.

The review also analyzed the economic implications of food insecurity and malnutrition, both of which were found to increase healthcare expenditures across different geographical locations and populations significantly.

A 2019 study by Berkowitz et al indicated that food insecurity in adults, at both state and county levels in the United States, was associated with higher annual healthcare costs, averaging an increase of $1,834. While the increase in healthcare costs for food-insecure children wasn't statistically significant, a slight positive association was observed. The study thus highlights the potential benefits of addressing food insecurity, including reducing healthcare expenditures.

Inciong et al. in 2022 estimated the economic burden of hospital malnutrition in 11 Asian countries, calculated to be approximately $30.1 billion annually. Most of this cost arises from an increased stay, especially in the ward and the ICU. Japan was found to bear the highest cost, followed by South Korea and Taiwan. The study emphasized early identification and management of malnutrition in hospitals through rigorous screening and monitoring. Although its focus was on hospital malnutrition, the findings indirectly underline the potential economic consequences of food insecurity.

A 2015 Bapen report estimated the annual cost of malnutrition in England to be around £19.6 billion, over 15% of the total public expenditure on health and social care. Half of this expenditure

was attributed to the elderly (>65 years). The report found that interventions such as nutritional support could lead to significant cost savings, especially in settings with a high prevalence of malnutrition, high hospital admission rates, and a large gap between current and desirable nutritional care. This underscores the value of implementing effective nutritional support measures to address food insecurity and its economic fallout.

A 2017 World Food Programme (WFP) report stressed the significant economic consequences of malnutrition during emergencies, including increased healthcare costs, lost productivity, reduced educational attainment, and heightened social costs. The report estimated the total cost of lost productivity for the analysis year to exceed US$2.5 billion in Ecuador and US$20 billion in Mexico, equal to 2.5% and 1.6% of GDP respectively. This cost would likely increase when indirect costs like reduced educational attainment are accounted for. The report concluded by calling for greater investment in preventing and treating acute malnutrition during emergencies.

Further findings by the WFP report highlighted that the economic cost of malnutrition was highest in low-income countries, higher for children than adults, and higher for women than men. The report suggested strategies to reduce these costs, including investing in early childhood nutrition, providing access to safe water and sanitation, promoting breastfeeding, and providing micronutrient supplements.

These findings collectively underline the significant economic consequences of food insecurity and malnutrition, underscoring the need for effective interventions and policy measures to address these issues. Given that the scoping review did not encompass data from Lebanon due to its absence, the research team along with WVL decided to construct a predictive model rooted in primary data from Lebanon. This approach aimed to grasp the implications of the food and education crisis on Lebanon's economic growth more comprehensively.

Predictive model

The insights derived from the scoping review were further complemented and enhanced by the predictive model. Four main variables stood out from the research team's statistical modelling and analysis exercise and are presented below.

Significance of Average Protein Supply per Capita

The decision tree model achieved an average performance score, also known as r-squared, of 81%. This score means that the model incorporates nine different factors and can predict 81% of the changes in a state's GDP per capita. This is a high level of predictive power, especially considering the small number of data points the research team had to work with. The most influential factors in predicting GDP per capita were identified as the Average Protein Supply per capita, the ratio of Imports to Total Merchandise Exports, and the Progression to Secondary School rates. The Average Protein Supply per capita stood out as the most significant variable, explaining approximately 95% of the variability in GDP per capita.

Impact of Progression to Secondary School

Looking at the correlation matrix, it's clear that education plays a significant role in influencing a state's GDP per capita. Among the education variables, Progression to Secondary School rates were notable, even though its impact on GDP per capita was less statistically significant compared to other variables such as Average Protein Supply per capita.

Positive Effect of Higher Progression Rate

The Progression to Secondary School rate, accounting for part of the remaining 5% variability in GDP, was positively correlated with GDP per capita, albeit not at a statistically significant level with a correlation coefficient (r) of 0.11. This correlation, while not statistically significant, introduces an intriguing dimension to the analysis. A trend emerges where higher progression rates to secondary school appear to coincide with a higher GDP per capita. This suggests that increased secondary school progression rates reflect more significant investments in human capital, which might translate into a more productive workforce, driving economic growth and leading to a higher GDP per capita. It's essential to emphasize that correlation doesn't equate to causation. While the correlation indicates that improving progression rates might uplift GDP per capita, it's also plausible that countries with a higher GDP invest more in education, causing higher progression rates. Further research is imperative to untangle these complex relationships.

Negative Impact of Grade Repetition in Primary School

Regarding the variable highlighting the percentage of students repeating a grade in primary school, a negative correlation coefficient of -0.6 (p-value 0.006) was documented. This suggests that a higher percentage of students repeating a grade aligns with a lower GDP per capita. Grade repetition might indicate inefficiencies in the education system and diminished educational outcomes for students, potentially culminating in a less productive workforce and a decreased GDP per capita in the long run. While the data doesn't provide definite causation, the findings underline the pivotal role of education and nutritional status in a nation's economic performance, advocating for investments in both sectors for potential positive economic outcomes.
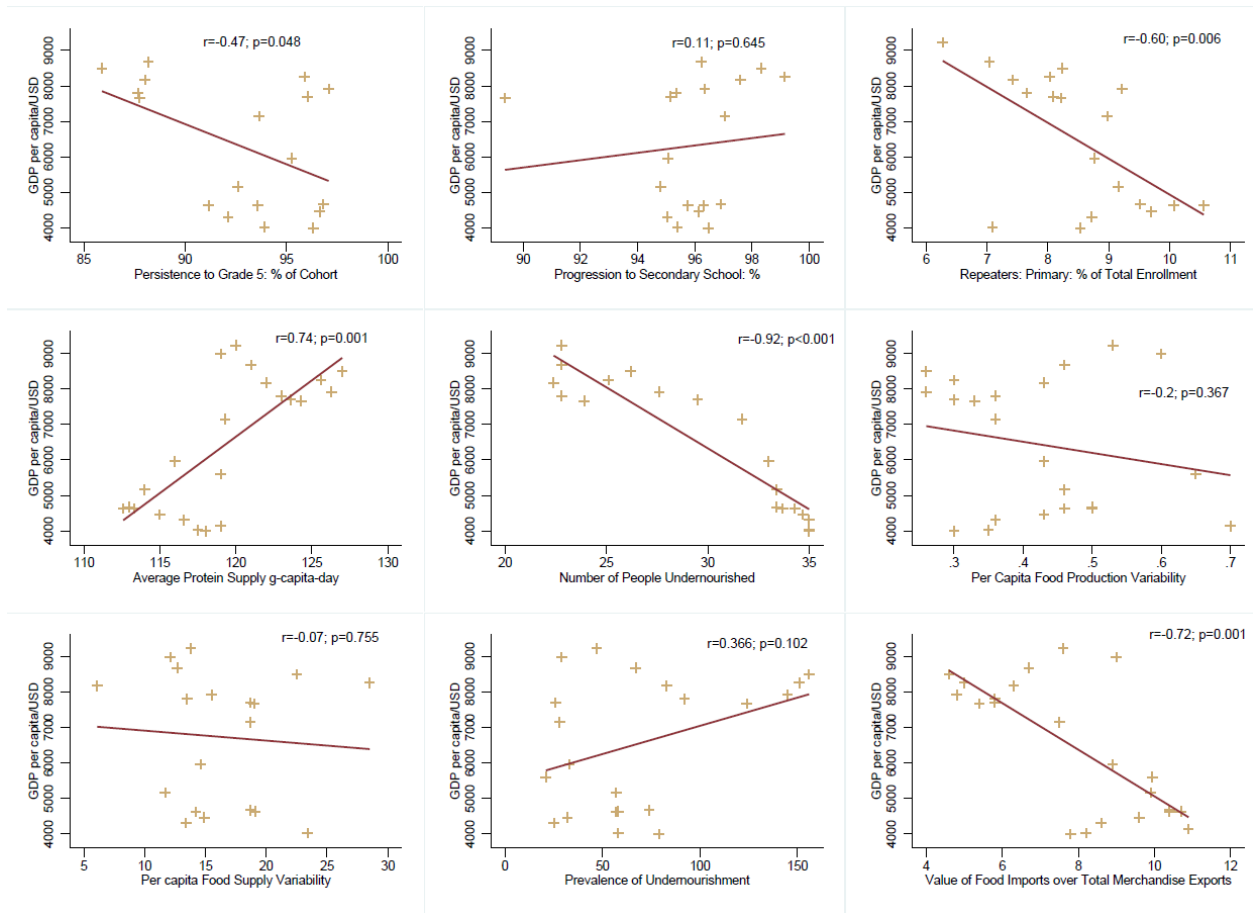
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Figure 2: Correlation matrix for average GDP per capita and each of the chosen predictive variables

Overall, the scoping review catalogued the profound ramifications of interrupted education on both learning outcomes and global economic consequences, complemented by a detailed exploration into the economic implications of food insecurity and malnutrition. The predictive model significantly bolsters these findings in Lebanon's context. With an r-squared of 81%, it identifies Average protein supply per capita as a notable influencer on Lebanon's GDP. . The model also flags the progression to secondary school rate as a notable influencer on a state's GDP per Capita. Together, the review and predictive model paint a comprehensive picture, underscoring the critical need for investments in education and nutrition to foster economic resilience and growth in Lebanon.

Discussion

In the discussion section, the research team combines insights from the scoping review and statistical modeling to illuminate their collective contribution to the primary objectives of the study. By synthesizing findings from these two approaches, a more comprehensive understanding emerges of the intricate links among disrupted education, food security, and GDP per capita, which are essential components for robust economies. The statistical model, boasting an 81% accuracy rate, underscores the significant influence of variables like Average Protein Supply per capita and Progression to Secondary School rates on GDP per capita. Supported by both qualitative descriptions and quantitative data, these findings unequivocally emphasize the pivotal role of addressing challenges in education and food security in promoting a thriving economy.

Food insecurity and GDP

As described in previous section, the methodology employed has led to the identification of the Average Protein Supply per capita to be the main variable with a significant influence on the GDP per capita. This metric measures the average protein availability in a population's daily consumption, serving as an essential barometer for gauging nutritional adequacy and overall food security within a region or nation.

On an individual level, adequate protein intake is fundamental for a plethora of bodily functions, from muscle and tissue repair to hormone synthesis and immune responses (FDA, 2021). This vital nutrient not only sustains the physiological well-being of individuals but also ensures their cognitive agility and overall vitality. Healthy individuals are generally more energetic, focused, and less prone to illnesses, leading to fewer workdays lost to sickness and greater efficiency when at work. On a wider level, it thus follows that a well-nourished population, bolstered by an adequate protein intake, is likely to exhibit higher work productivity, as stated in the scoping review (World Health Organization, 2023). Consequently, this enhanced productivity can bolster a nation's GDP, making protein supply not just a health metric, but a significant economic indicator.

Moreover, beyond the health of individuals, the Average Protein Supply per capita offers a window into the broader health of a society, both economically and agriculturally. Regions with consistent and ample protein supplies often have robust agricultural sectors, characterized by efficient farming practices, advanced livestock management, and effective food distribution networks (Food and Agriculture Organization of the United Nations, 2021). Such proficiency in agriculture often correlates with better infrastructure, research, and investment in farming technologies — hallmarks of economically thriving societies. Consequently, the Average Protein Supply per capita can encapsulate a society's overall wellness, its agricultural prowess, and its economic vitality, making it an invaluable metric in comprehensive socio-economic studies.

Bolstering a healthy society is not only indicative of higher productivity, but also entitles a lower healthcare cost. In the scoping review, the cost of healthcare is highlighted as a major factor impacting the overall economy (Berkowitz et al, 2019; Inciong et al, 2022; and Bapen, 2015). The overweighting cost of malnutrition is estimated in billions of dollars in the countries which these

studies focused on. Acknowledging the contextual difference between these countries and Lebanon, there is little doubt that the cost of malnutrition is also significant in the latter. Thus, it is fair to say that the reduction in malnutrition, which is associated with a healthcare cost, would decrease this cost and positively contribute to the overall economy.

In short, the strong associations observed between protein intake and the GDP per capita provide a valuable starting point for additional research, although they do not definitively establish causal relationships.

Interrupted education and GDP

Progression to Secondary School rate offers an intriguing insight into the relationship between education and GDP per capita. Even though the data does not show a strong, statistically significant link between the two, grade repetition in primary school and progression to secondary school have emerged as noteworthy factors when exploring their link to nation's GDP per capita.

Grade repetition, especially at primary school level, can be seen as a red flag in terms of the effectiveness and efficiency of an education system. When students are held back, it often points to potential issues such as inadequate teaching resources, outdated curricula, or other systemic issues that prevent students from progressing through their education smoothly. Such inefficiencies may result in students being less prepared and lacking crucial foundational knowledge, potentially leading to further educational challenges down the line (World Bank, 2018). Moreover, students who repeat grades can experience decreased self-esteem, a lack of motivation, and even develop a negative perception of the educational process. Such attitudes might impact their ability to progress to secondary school, and later pursue vocational training and/or higher education. The findings of this research in terms of the impact of Progression to Secondary School rates on the GDP per capita, is well supported by existing bodies of knowledge. Countries with more students moving on to secondary school generally have a higher GDP per capita (Roser & Ortiz-Ospina, 2016), and as such it is in the best interest of states and nations to ensure that students benefit from an adequate education system and support needed to ensure a progression across grades and levels.

This evidence points towards the idea that a nation investing in its educational system, especially in advancing students to higher levels of education, is also likely nurturing a more educated, skilled, and thus potentially more productive workforce. This educated workforce, in turn, can drive economic growth, leading to an increase in GDP per capita. The scoping review has clearly revealed a strong correlation between education and GDP, with interrupted education causing a significant decrease in global GDP (Jakubowsk et al., 2022; Cohen et al., 2022). Parallel to the modelling results, the scoping review provided in-depth evidence of interrupted education's broad implications on local and global economies and individual learning outcomes. The literature suggests both short-term and long-term economic burdens due to learning deficits, with predicted future GDP loss and significant annual earnings loss. These potential outcomes underscore the critical role of maintaining educational continuity and promoting educational equality to prevent widening achievement gaps and to sustain economic growth.

However, it's crucial to tread carefully when interpreting such findings. While the observed trend in this research study suggests a relationship between grade repetition and GDP per capita, it doesn't necessarily imply that grade repetition directly causes a decrease in GDP. Other underlying factors might be influencing both grade repetition and GDP. For example, a country facing economic hardships might also struggle to invest adequately in its education system, leading to both lower GDP and higher-grade repetition rates. The Covid-19 pandemic and the ensuing economic recession, cements this argument, with school closures causing a significant reduction in GDP (Fuchs-Schundeln et al., 2022). Lebanon, a country suffering from a plethora of such multifaceted crises, is undeniably struggling in this domain.

Recommendations

In alignment with the research's purpose and findings, the recommendation section is divided into two segments. The first segment provides recommendations for policymakers, while the second addresses donors' interests. This structure ensures helps enhance their relevance and potential impact of the provided recommendations for both stakeholders.

Recommendations for Policymakers

The purpose of the recommendations provided to policymakers is to guide towards strategic focuses for future policy elaboration, based on the evidence provided.

- **Advocate for multi-sectoral collaborations**: Recognizing the interconnectedness of education, food security, health, and economic outcomes, it is crucial to foster collaborations among different sectors. Collaboration should happen at policy level between different actors to address the complex challenges related to education, food security, and economic growth. Collaboration should also happen at the level of the implementation by ensuring multisectoral interventions to promote knowledge sharing, resource allocation, and coordinated efforts to achieve sustainable development goals.

- **Strengthen the education-healthcare nexus**. Recognizing the interlinkages between education and healthcare, actors should prioritize integrated policies and collaborations between the education and healthcare sectors. This includes establishing school health programs that focus on nutrition, health screenings, and mental health support for students. Collaboration between ministries, schools, healthcare providers, and NGOs can contribute to improved educational outcomes, reduced healthcare costs, and enhanced overall well-being.

- **Advocate for partnership and collaboration in research**: Given the identified gaps in knowledge, particularly in establishing causal relationships and deepening the understanding of the complex interplay between education, nutrition, and economic outcomes, it is crucial to foster partnerships for research and data collection related to food insecurity, disrupted education, and their economic implications in Lebanon. Collaborations between academic institutions, research organizations, and government agencies can help generate robust evidence and enable the generation of more evidence-

based information to inform policymaking and the development of effective interventions to address the identified challenges.

    a. Building on the quantitative modelling exercise, investment should be done in the development of forecasting models to assess the potential economic impact of prolonged food insecurity and disrupted education. These models can consider a range of factors, including GDP per capita, education indicators, and food security measures, to provide policymakers with a better understanding of the potential future burdens and inform policy decisions. Regular monitoring and updating of these models will enable timely interventions and adjustments to mitigate economic risks. Another way to support the research would be by encouraging the use of machine learning and AI in creating predictive models, which can assist programs in forecasting potential disruptions in education and food security, thereby enabling pre-emptive interventions.

    b. The above recommendation can be implemented in an efficient manner should the data be made available to facilitate more precise and comprehensive economic modelling. This may include efforts to share available data from relevant ministries, UN organisations and NGOs while abiding by data sharing agreement and confidentiality.

Recommendations for Donors

The purpose behind the recommendations targeted at donors is to provide them with precise guidance on the allocation of grants, rooted in the evidence obtained. This guidance aims to enhance the effectiveness and sustainability of interventions targeted at promoting Lebanon's economy and comprehensive welfare during the ongoing humanitarian crises.

Based on the above findings of the review, the following recommendations were developed:

- **Invest in early childhood and primary education interventions to lay the essential foundations in education and increase the progression onto secondary education rates.** Given the association identified earlier between educational disruption and GDP per capita, it is important to prioritize education and ensure its continuity, particularly during times of crisis or disruption. All actors involved, including the government, donors and organisations should allocate sufficient resources to support education systems, especially early childhood and primary education, including measures to mitigate learning losses, reduce dropouts, and promote educational equality. Emphasizing access to quality education, especially for disadvantaged groups, can contribute to improved learning outcomes and long-term economic growth. This is particularly true when addressing inequality in education distribution as findings showed that in the long term, disparities in education distribution have a notable impact on economic growth, as shown by Castelló-Climent (2013). The study suggested a 0.53 percentage-point reduction in per capita GDP growth rates for every 0.1-point increase in the Gini coefficient, which measures inequality in education distribution.

- **Invest in school feeding programmes,** as these have yielded high returns in terms of future productivity and health outcomes, more specifically in reducing learning losses and long-term economic consequences.

- **Invest in developing and implementing comprehensive policies to minimize interruptions to education**, such as robust e-learning infrastructures, tutor support programs, parental awareness raising on the importance of continuing education, and strategies to ensure the continuity of education in crises.

- **Invest in securing protein accessibility (a vital macro-nutrient) for vulnerable communities**. The observed correlation between per capita protein intake and GDP per capita underscores a vital consideration for nations, including Lebanon, emphasizing an urgent and strategic need for targeted investments. This goes beyond merely ensuring equitable access to protein, particularly among at-risk communities. The recommendation includes the allocation of direct funding to facilitate the availability of protein-rich sustenance and comprehensive nutritional support. Concurrently, it encourages fostering a holistic approach by investing in both the agrarian and infrastructural sectors to enhance and optimize protein supply chains within local markets.

  Emphasis must be placed on nurturing local production through supporting grassroots protein cultivation initiatives, offering training, and providing access to modern farming technologies. This strategy seeks to diminish reliance on external imports, thereby creating a self-sustaining and resilient protein provisioning framework. Furthermore, implementing educational programs to raise awareness about the importance of protein in the diet and the availability of locally produced protein sources can aid in driving consumer behaviour towards supporting local producers.

  In collaboration with both governmental and non-governmental organizations, this multifaceted approach promises to build a robust, sustainable protein supply chain that not only contributes to economic growth but also ensures that the nutritional needs of the most vulnerable populations are adequately and sustainably met.

- **Ensure access to safe water, sanitation, and essential micronutrients**: As highlighted in the findings the economic cost of malnutrition was highest in low-income countries, higher for children than adults, and higher for women than men. As such the findings suggest strategies to reduce these costs, including investing in early childhood nutrition, providing access to safe water and sanitation, promoting breastfeeding, and providing micronutrient supplements.

Conclusion

The evident interplay between nutrition, education, and economic prosperity in Lebanon presents a compelling case for multi-sectoral investments. Clear indicators highlight the pivotal role of nutrition and the long-term economic advantages of bolstering educational pathways. It is essential for stakeholders to unite and address these critical areas. By strengthening the foundational elements such as nutrition and optimizing educational outcomes, Lebanon can catalyze sustained economic growth and elevate the well-being of its citizens. The data not only

provides an understanding of the current scenario but also charts a strategic direction for Lebanon's progressive trajectory.

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