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Article

Effect of synergy between provider and consumer quality of healthcare on child health in Kenya

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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

EFFECT OF SYNERGY BETWEEN PROVIDER AND CONSUMER QUALITY OF HEALTHCARE ON CHILD HEALTH IN Kenya

Isabella Jebiwott Kiplagat^{1,2}, Mercy G Mugo², and Martine O. Oleche²,

Abstract: Besides access to health services, quality of health care is recognized as a key element in putting an end to preventable childhood illnesses. While the quality of health care and its effects on health is often assessed at the facility level, consumers of health care are co-producers of quality health care since they are capable of using their knowledge and resources to enhance their own health and that of their children. Using the 2014 Kenya Demographic Health Survey data, this study sought to examine the interaction effect of the provider and consumer quality of health care on child health as measured by child weight-for-age (WAZ). Controlling for potential endogeneity, the results of the Two-Stage-Residual-Inclusion model show that the coefficient of the interaction between provider quality of health care as indicated by a dispensary, a health center and a private clinic and consumer quality of healthcare index was positive and significant. This suggests that consumer quality of health care enhances child health given the

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Isabella Jebiwott Kiplagat is a PhD Candidate at University of Nairobi. She is also a Senior Economist at The National Treasury and Planning, Kenya. Her interests include child and maternal health, healthcare financing, social identity and public sector related issues. The current paper contributes to the wider knowledge in the field of health economics.

Specifically, it provides insights into theoretical and empirical evidence on health production. Mercy G Mugo, PhD, is a Senior Lecturer at the Department of Economics and Development Studies, University of Nairobi. Her research interests include economic evaluation of healthcare programs, child and maternal health, reproductive health, healthcare financing as well as economic growth and poverty-related studies.

Martine O. Oleche is a Senior Lecturer in the Department of Economics and Development Studies, University of Nairobi. His main teaching courses are Health Economics; Development Economics; Welfare Economics; Economic Policy Analysis and Planning; and Quantitative Methods. His areas of research include; health valuations, healthcare financing, economic growth, poverty and labor markets.

PUBLIC INTEREST STATEMENT

Many children below the age of five years continue to die in Sub-Saharan Africa due to preventable and treatable childhood illnesses. The key question here is: can combined effort between healthcare providers and consumers make a difference? It is on this basis that the authors of this research paper seek to investigate whether an interaction between quality of health care at the health facility and at family level results in better child health outcomes. The findings revealed that besides the well-known health effects of child characteristics and socioeconomic status, healthcare provider-consumer synergy in provision of quality health care leads to improved child health status. It is thus recommended that a simultaneous attention be paid to provider side quality of health care and household level quality of health care.

provider quality of health care. Policies targeted at addressing quality of health care should thus focus on simultaneously improving both supply and demand side quality of health care. Other variables that were key in influencing child nutritional status include; child sex and sex, twin birth and belonging to a higher wealth index.

Subjects: African Studies; Economics; Maternal and Child Health

Keywords: Quality of healthcare; child health; synergistic effect; co-production; Kenya

1. Introduction

Quality of health care is a key driver for improved population health outcomes in the developing countries (WHO, 2007). Indeed, it is posited that increased access to health care is insufficient where care is of poor quality (Leslie et al., 2017; Peabody et al., 2006). This perhaps explains the inclusion of “access to quality essential healthcare services” as one of the targets toward achievement of the health-related Sustainable Development Goal (SDG)-goal 3, which seeks to ensure healthy lives and promote well-being for all ages (Akachi & Kruk, 2017; UN General Assembly, 2015). As a country, Kenya continuously endeavors to achieve better population health indicators through the provision of high-quality health care (Ministry of Medical Services and Ministry of Public Health and Sanitation, 2014).

Previous empirical works show that provision of quality health care is associated with increased utilization of health care (Gage et al., 2018; Lépine & Nestour, 2013; Muriithi, 2013). This largely explains the phenomena of bypassing behavior by households when seeking healthcare services (Ocholla et al., 2020; Aggrey & Appiah, 2014; Leonard et al., 2002). Other studies document the link between improved provider quality of health care and better health outcomes (Battleman et al., 2002; Houck et al., 2004; Lavy, 1995; Meehan et al., 1997). Notably, these studies are inclined to health effects of the supply side quality of health care including availability of infrastructure, medical services, medical equipment and drugs.

Some actions at the household level including timeliness in seeking health care and provision of appropriate care during illness episodes fall within the purview of definition of quality health care (Donabedian, 1988; WHO, 2006). The link between such actions and health outcomes is extensively examined in the existing literature. Studies, for instance, show that appropriate and timely health-seeking behaviour (Gebreegziabher et al., 2016; Spivak et al., 2018) as well as implementation of simple recommended preventive and treatment recommendations (Brown et al., 1995, 2009; Munos et al., 2010) result in better health outcomes.

Fundamentally, existing quality of healthcare-related studies appear to be focusing on separate effects of supply and demand side indicators of healthcare quality on health outcomes. Yet, healthcare services, just like any other service are co-produced (Batalden et al., 2015). The concept of co-production entails an active involvement of service users in the process of service provision (Realpe & Wallace, 2010). This resonates with the argument in health economics that production of health care is unique from other goods in that, consumers (patients) are involved in both its production and consumption (Mwabu, 2007). Thus, efficacy in production of health requires combined effort between healthcare providers and consumers. In an environment where majority of child deaths is as a result of preventable illnesses, more research is necessary to establish if some form of complementarity between provider and consumer quality of health care will improve health outcomes.

This study seeks to address the existing knowledge gap by exploring the synergistic effects of provider and consumer quality of health care on child health in Kenya. Specifically, this study first models theoretically the interaction effect of healthcare provider and user quality of health care on health outcomes. Based on the theoretical model, empirical evidence on effect of this interaction on child

health as indicated by child nutritional status is then examined. Child health indicators and especially those relating to children aged below five years provide a good assessment of the overall health status of the whole population (Mugo, 2012). Moreover, children in Kenya still die from preventable childhood illnesses, top in the list being, pneumonia (15%), diarrhea (9%) and malaria (7%; Knbs & Nacc.) These illnesses could be alleviated through implementation of simple effective interventions not only at the healthcare facility level but also at the community/family level (WHO/UNICEF, 2013).

1.1. The concept of quality of health care

The concept of quality is difficult to define because of its subjective and intangible nature. The concept is even more difficult when applied to health care given its distinctive characteristics (Mosadeghrad, 2014). Furthermore, healthcare providers, patients, leaders and other stakeholders may have differing perspectives on healthcare quality, thus leading to varied definitions (Levine et al., 2012; Pilgrimienė & Buciuniene, 2008).

Efforts to operationalize existing definitions of quality of health care (Brownson & Petitti, 2006) have culminated into two commonly used approaches to its measurement. The first systematic approach was proposed by Donabedian (1988). It proposes three dimensions of assessment of quality namely, structure of the healthcare system, the process of care and outcomes of care. *Structure* denotes attributes of the settings in which care takes place including geographical location and accessibility to services. *Process* quality assesses whether what is known to be good medical or healthcare practice is applied or not. Processes comprise patient's activities including timeliness in seeking care and adherence to treatment regime as well as the practitioner's competence, patient-centered activities in making diagnostic tests, technical communication and recommending correct treatment. *Outcomes* are impacts of health care on individuals such as restoration of function, mortality and patient satisfaction.

The second approach entails the assessment of patient's perspective based on their experiences with healthcare services. The patient's perspective is embodied in outcomes, such as perception of symptoms, functional status and satisfaction with outcomes and processes of care (Katz & Sangha, 1997). Patient's satisfaction with a number of dimensions of care including personal aspects of care, technical quality of care, access to and availability of care, physical setting and efficacy is normally subjectively assessed to establish quality of healthcare provision (Cleary & McNeil, 1988).

2. Literature review: overview of health production models

Becker (1965) laid the theoretical foundation for the study of health production. In this model, a household is assumed to produce and consume a vector of commodities which are associated with different activities undertaken by the household including leisure, from which utility is derived and maximized subject to the budget constraint and time. Based on Becker's model, Grossman (1972) modelled a household health production function, where households combine various inputs (purchased goods and services and knowledge) and their time to produce health. The stock of health is valued either as a consumption commodity where health enters utility function directly or as an investment commodity since health determines the time available for market and non-market activities and affects the length of one's lifetime.

Rosenzweig and Shultz (1983) model the behavior of mothers as inputs in the production of child health demonstrating the relationship between behavioral inputs and output which is the newborn's health production function. The model embeds health production function in a utility maximizing framework and distinguishes among the various goods (health related and health neutral goods) that affect the utility function. Mwabu (2007) adopts the approach by Rosenzweig and Shultz (1983) and develops a health production function for low-income countries.

Lavy and Germain (1994) model theoretically the utility maximization model as a function of individual's health, quality of care and other consumption goods. In this model, individuals choose between a finite number of alternatives that include self-treatment and treatment by various healthcare providers. Each healthcare provider offers an anticipated improvement in health for a specific price. From this view, there exists a household production function conditional on the quality of provider and on the characteristics of the household.

A common feature in the foregoing health production models is that they adopt a Cobb–Douglas production function, since they relate inputs to the production of health care at the household or individual level thus assuming substitutability of inputs. Still, models incorporating the supply side inputs, for instance, the role of healthcare providers in improving health outcomes (Lavy & Germain, 1994) fail to suggest complementarity between the inputs and more specifically the interdependency between the supply and demand side quality of health care in the production of health outcomes. Even when possible interactions are suggested (Mwabu, 2007; Fuchs, 1982), the synergy between the demand side and the supply side in contributing to improved health outcomes is not demonstrated. Hence, an attempt to model the provider and consumer interaction in production of health in this paper.

3. Methodology

3.1. Theoretical framework

The initial structure of the theoretical model employed resembles the classic health production models where the utility maximization problem is a function of health and consumption of other goods (Mwabu, 2007; Rosenzweig & Shultz, 1983). The utility function is expressed in equation (1).

$$U = U(C, H) \quad (1)$$

Where C is a set of health and non-health-related consumption goods and H is health status, in this case, child health status.

Following Lavy and Germain (1994), a quality of healthcare variable is introduced into the health production function. This model is modified to include a consumer quality of healthcare measure in addition to provider quality of health care. Naturally, improvement in health status is an outcome of an interaction between healthcare providers and consumers in the production of quality health care. As an illustration, while provider quality of healthcare indicators such as, availability of modern infrastructure, qualified personnel and medicines are important in improving health outcomes, they cannot be effective if a healthcare consumer does not take the initiative to visit the facility in a timely manner or even fails to comply with treatment advice. On the other hand, the latter, would be futile if quality health care is lacking in a health facility.

To capture the provider-consumer interdependency, the study employs a generalized Leontief production function proposed by Diewert (1971). Under certain circumstances, this production function results in complementarity of inputs. Moreover, the model is flexible and can allow for elasticity of substitution to vary, therefore making it suitable for the case of health production which has various possible combinations of inputs and varied outcomes. For instance, a situation may arise where a timely visit and quality healthcare provision results in death. In another instance, a timely and poor quality of health care may result in better health outcome. The child health production function is expressed in equation 2.

$$H = H\left(C_H^i, Q_F^i, Q_i, \sqrt{(Q_F^i Q_i)}, \mu^i\right) \quad (2)$$

Where: H is as defined in equation 1. C_H^i is individual i 's health related consumption goods. Q_F^i represents provider F quality of health care as observed by individual i and Q_i is individual consumer i quality of health care. $\left(\sqrt{(Q_F^i Q_i)}\right)$ describes an interaction between provider F quality of health care and consumer i quality of health care.

In line with Lavy and Germain (1994) and others (Gertler et al., 1987; Lavy & Quigley, 1996), provider quality of health care is defined in this study as healthcare provider first visited on observation of child diarrheal illness symptoms. The assumption is that consumers gravitate toward high-quality healthcare providers (Lavy & Germain, 1994). The use of a proxy for provider quality of health care is due to data limitations; Demographic Health Surveys do not collect data on provider quality of health care. A measure for consumer quality of health care is developed by combining selected recommended preventive and treatment interventions that could be undertaken at home into a composite index. The interventions include: continued breastfeeding for two years, proper child waste disposal, feeding patterns during diarrheal episode illness episode, oral rehydration therapy, zinc supplementation and seeking health care within a day on observation of diarrheal symptoms.

The household faces the budget constraint in equation 3.

$$I = P_{cu}C_u + P_QQ + P_{cH}C_H \quad (3)$$

Where; I is household income; P_{cu} is price of consumption goods that contribute only to utility, P_Q is the price of quality health care Q , a variable denoting provider and/or consumer quality of healthcare measure since it is assumed that the expenditures for both are incurred by the consumer. The costs may include user fees, travel cost to the facility, waiting time at the facility as well as lost earnings by the households in travelling to the facility and in taking care of the sick. P_{cH} is price of health-related inputs for instance, medical care. The household maximizes equations 1 and 2 subject to the budget constraint (equation 3). Solving the maximization problem yields the hybrid health demand function of the form:

$$H = H(C_H, I, P_{cH}, P_{cu}, Q) \quad (4)$$

3.2. Estimation model

Equation 5 provides the overall structural equation to be estimated.

$$H_{nj} = \gamma + \sum_{ij} a_{ij} Q_F^{1/2} Q_i^{1/2} + \sum_i a_i Q_F^{1/2} + \sum_j a_j Q_i^{1/2} + \delta Z + \mu + \varepsilon \quad (5)$$

H_{nj} is child n health outcome in household j . This outcome is measured using the Weight-for-Age Z-score (WAZ). γ, a_i, a_j, δ and a_{ij} are technical parameters to be estimated. a_{ij} are technological parameters which are unobservable in this case and they indicate the effect of the interaction between provider side and demand side (consumer) quality of health care on health outcome. These parameters are such that $a_{ij} = a_{ji}$ and $a_{ij} \geq 0$. The sign of a_{ij} determines whether inputs Q_i and Q_j are substitutes or compliments.

Q_F is provider quality of health care while Q_i is individual consumer/caretaker quality of health-care index. Z is a vector of control variables including socioeconomic, demographic and household characteristics. ε is a random error term and μ is unobserved household characteristics.

3.3. The case study

3.3.1. Case study description

Employing the theoretical model proposed in section 3.2, this study sought to explore the interaction effect of provider and consumer quality of health care on child health in Kenya. The study utilizes a most recently available nationally representative cross-sectional household survey data from the 2014 Kenya Demographic Health Survey (KDHS). The survey covered a total of 40,300 households from 1612 clusters with 995 clusters in rural areas and 617 clusters in urban areas. It collected information on among others: healthcare utilization on observation of childhood illness symptoms; mother's socioeconomic status; child and mother's demographic characteristics; breast-feeding; sanitation practices; and child nutritional status. The 2014 KDHS also collected geographic coordinates of the sampled clusters. This dataset collected geographic information including distance to nearest community infrastructure, average monthly temperatures and average annual rainfall.

3.3.2. Description of variables

4. Dependent variable

The dependent variable is Weight-for-Age among the under-five children who had suffered from diarrheal symptoms two weeks prior to the 2014 Kenya Demographic Health Survey (KDHS). The measure was chosen because a child's weight can be affected by short-term episodes of reduced food intake as well as current illnesses and infections including diarrheal cases (McMurray, 2010). The WAZ Z-scores were computed using STATA inbuilt `zscore06` programme, which converts a child's weight and height into number of standard deviations that these measures deviate from the median value of the international reference population for children of the same age and gender. A Z-score of minus 2 standard deviations (-2 SD) is used as a cut-off point to obtain a dummy where those children whose WAZ scores is below the cut-off are said to be underweight. Since dummy variables may lead to loss of useful data, the continuous outcome variable is used in the analysis.

5. Independent variables

The key variable of interest in this study is an interaction term between provider and consumer quality of healthcare measures. Provider quality of health care is proxied by healthcare facility first visited on observation of diarrheal symptoms among the under-five children. Caretakers may decide to seek medication from private health facilities including a private clinic and a mission hospital or public health facilities at different levels of healthcare system mainly, a dispensary, a health center and a hospital. Visits to other forms of health care, such as a shop and pharmacy are also considered. The demand side quality of health care is indicated by consumer quality of healthcare composite index. The index was constructed by the use of a simple additive approach based on recommended preventive (proper breastfeeding and sanitation practices) and treatment interventions (oral rehydration therapy, zinc supplementation, continued feeding and fluid intake) at household level during diarrheal episode. The index is centered on zero, where more positive scores indicate better consumer quality of care while more negative scores signify worse performance. The expectation is that, given provider quality of health care, an increase in consumer quality of healthcare index score results in better child health.

6. Control variables

Based on existing theoretical and empirical literature on factors that have an influence on child health outcomes, the study controls for other factors relating to the child, mother/caregiver and the household. A summary of the study variables is presented in Table 1.

Table 1. Summary of Study Variables

Variables	Definition/Measurement and Range
Weight-for-Age (WAZ)	A measure of child health (Continuous variable)
Quality of Health care	
Provider quality of health care	Categorical variable for facility type (Self-treatment = 1, Dispensary = 2, Health center = 3, Hospital = 4, Private clinic/hospital = 5; Private mission hospital = 6)
Consumer quality of healthcare index	Simple additive composite Index (Continuous variable)
Provider quality* Consumer quality of healthcare index	Interaction between provider and consumer quality of healthcare measures
Child Characteristics	
Child's sex	Dummy variable (male = 1, Female = 0)
Child's age	Age in years
Child's age squared	Age in years squared
Twin birth	Dummy variable (twin birth = 1, single birth = 0)
Birth order number	Child birth order number (continuous variable)
Mother's Characteristics	
Mother's age	Age in years (Continuous variable)
Mother's age squared	Age in years squared (Continuous variable)
Mother's Education in years	Education in years
Mother's Occupation	Categorical variable (1 = unemployed, 2 = Agricultural, 3 = professional/managerial, 4 = Others (domestic, manual and services)
Household Characteristics	
Wealth index (wealth quintile)	Composite index based on household assets and housing characteristics (continuous)
Sex of household head	Dummy variable (male = 1, female = 0)
Age of the household head	Age in years (Continuous)
Age of the household head squared	Age in years squared (Continuous)
Household size	Number of household members (Continuous)
Place of residence	Dummy variable (urban = 1, rural = 0)

6.0.3. Method implementation

Since the study outcome is a continuous variable, the analysis is based on Ordinary Least Squares Regression (OLS) model. However, the proposed provider and consumer quality of healthcare measures are potentially endogenous. Specifically, the choice of healthcare provider on observation of child illness and general child health investment behaviors may be influenced by unobservable variables such as the “health mindedness” of the mother. In addition, there is a possibility of self-selection into forms of care that are perceived to be of high quality by individuals with poor health indicators as opposed to the less severe cases (Akin & Hutchinson, 1999; Leonard et al., 2002). On the other hand, selected components of the consumer quality of healthcare composite index for example, timeliness in seeking health care are influenced by consumer's perception of the child's illness severity (Nyamongo & Nyamongo, 2006; Webair & Bin-Gouth, 2013).

The method of Two-Stage-Residual-Inclusion (2SRI), an instrumental variable approach, is utilized to address the endogeneity problem (Terza, 2017; Terza et al., 2008). The instrumental

variables (IVs) chosen in the first stage should be such that they are correlated with the endogenous variable(s) and uncorrelated with the error term (Green, 2002). In this context, three instruments were chosen, that is, distance to nearest community infrastructure, annual average rainfall and an interaction between distance to community infrastructure and average monthly temperatures. The choice is informed by the use of these IVs in other studies (Adhvaryu & Nyshadham, 2010; Escamilla et al., 2018). The 2SRI model is presented in equation 6.

$$Y = \exp(X_e\beta_e + X_0\beta_0 + X_u\beta_u) = e \quad (6)$$

Where, Y = is the Z-score for WAZ, X_u is a scalar representing unobservable variables that are potentially correlated with child health, e is the regression error term, X_e is a vector of endogenous variables, X_0 is a vector of control variables that are uncorrelated with *Laxmi Narayani* and e , and $dispatch$ is a vector of coefficients.

7. Results

7.1. Sample description

The summary statistics of the analytical sample are presented in Table 2. The mean WAZ score for children who had experienced diarrheal symptoms was -0.83 , which implies that they were 0.8 standard deviations shorter than the international reference mean. The overall prevalence of the underweight among the under-five with diarrheal cases was 14%. On average, 15% of the under-five children had suffered from diarrheal symptoms. Majority of mothers'/caregivers' (35%) first place of visit for diarrheal treatment was a dispensary. Other facilities first visited were government health centers (19%), government hospital (18%), private hospitals and clinics (11%) and mission hospitals (3%). Still, others (14%) resorted to self-treatment that includes visits to pharmacies, shops, traditional practitioners and relatives.

The average score for consumer quality of healthcare index is 3.16, which generally indicates below average quality of health care. This is consistent with low implementation of some of the recommended interventions including oral rehydration solutions and zinc supplementation as indicated in the 2014 KDHS survey report. It could also be due to poor feeding patterns during an illness episode where a sick child is likely to take much less fluids and food.

The mean distance to the community infrastructure as indicated by travel time by foot was 257 minutes. The figure may be slightly overstated due to displacements done to conceal the identity of the survey respondents. The average annual rainfall was 1173 millimeters while the average annual temperature was 21°C . These variables were transformed into their logarithmic forms to normalize the positively skewed data.

The under-five were 29 months of age on average, mostly third-borns and from single births (98%). There was an almost equal representation of male (51%) and female (49%) children. Their mothers/caretakers were 29 years on average, had 7 years of schooling on average and belonged to households with an average wealth index score equal to 0.37. Majority (56%) of the mothers/caretakers indicated that they were employed in professional or managerial job while 18% were not in any form of employment. Majority of the households to which the under-five belong were male headed (70%), resided in rural areas (67%) and had 6 household members on average. The average age of the household head was 38 years.

7.2. Correlation between study variables

The pairwise correlations between the study variables are estimated to establish whether there could be multicollinearity among these variables. An absolute value of 1 would indicate a perfect

Table 2. Sample Description

Variables	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Child nutritional status					
Weight-for-age Z-score (WAZ)	2864	−0.83	1.21	−5.81	4.54
WAZ (0 = normal; 1 = underweight)	2953	0.14	0.35	0	1
Diarrhea Episode					
Diarrhea in last two weeks (Yes = 1)	19,889	0.15	0.36	0	1
Quality of health care (Provider type)	1954	2.85	1.32	1	6
Self-treatment	1954	0.14	0.35	0	1
Dispensary	1954	0.35	0.48	0	1
Health center	1954	0.19	0.39	0	1
Hospital	1954	0.18	0.38	0	1
Private health clinic	1954	0.11	0.32	0	1
Mission Hospital (NGO)	1954	0.03	0.16	0	1
Consumer quality of healthcare index	2924	−2.32	1.29	−4.43	0.80
Instruments for Endogenous provider and consumer quality of health care					
Distance to the nearest market (minutes)	19,971	257.33	208.83	1.64	1525.75
Average annual rainfall (millimeters)	19,876	1173.20	533.74	115.29	2243
Average annual temperature (°C)	19,830	21.17	3.85	11.57	30.49
Child Characteristics					
Child sex (male = 1)	20,093	0.51	0.50	0	1
Child current age in months	20,093	29.10	17.09	0	59
Child age squared	20,093	1139.08	1037.70	0	3481
Twin birth (Twin = 1)	20,093	0.02	0.16	0	1
Child's birth order number	20,093	3.41	2.29	1	15
Maternal Characteristics					
Mother's age in years	20,093	28.70	6.55	15	49
Mother's age in years squared	20,093	866.75	401.55	225	2401
Education in years	20,093	6.53	4.37	0	19
Mother's Occupation (Unemployed = 1)	20,093	2.67	0.93	1	4
Not working/unemployed	20,093	0.18	0.38	0	1
Agricultural	20,093	0.12	0.32	0	1
Professional/Managerial	20,093	0.56	0.50	0	1
Others	20,093	0.15	0.35	0	1

(Continued)

Table2. (Continued)

Variables	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Household Characteristics					
Wealth index	20,093	0.37	0.16	0	1
Sex of the household head (male = 1)	20,093	0.70	0.46	0	1
Age of household head in years	20,092	37.96	12.23	15	95
Age of household head in years squared	20,092	1590.27	1135.23	225	9025
Area of residence (urban = 1)	20,093	0.33	0.47	0	1
Household size (number of members)	20,093	5.91	2.46	1	23

Source: Author's computation KDHS, 2014

association of the study variables and 0 would indicate that the correlations are completely independent. The results of the correlation analysis presented in Appendix A. Generally, the values of the correlation coefficients are low indicating that the absence of a strong correlation between the variables included in the regression analysis.

7.3. Empirical Results—Synergistic Effect of Provider and Consumer Quality of Health Care on Child Health

The results of the interaction effects of provider and consumer quality of health care on child health are presented in Table 3. The results of the basic OLS regression model which treats the quality of healthcare variables as exogenous are presented in column (1). The 2SRI results accounting for potential endogeneity are presented in column (2). The basic OLS model indicates that the effect of the dispensary/consumer quality of health care and private clinic/consumer quality of healthcare interaction terms was positive and significant. This implies that the effect of a visit to a dispensary and to a private clinic (as opposed to self-treatment) on child nutritional status is higher by 0.13 and 0.18 units, respectively, when consumer quality of health care improves by 1 unit.

On controlling for potential endogeneity of provider and consumer quality of healthcare measures, the first stage results presented in Appendix B. indicate that there is at least one statistically significant instrumental variable in each of the reduced form equations: Consumer quality of healthcare model (model 1); Provider quality of health care (model 2) and provider and consumer interaction term (model 3). Specification tests were conducted to assess validity of the proposed IVs. The results of these tests are presented in Appendix C. Since there are multiple (including the interaction term) potentially endogenous variables, we employ Sanderson-Windmeijer (SW) multi-variate F test of excluded instruments and Kleibergen-Paap LM statistics to test for weak instrumentation and under-identification (Sanderson & Windmeijer, 2013). The results equal 5.24 ($p = 0.0221$) and 4.18 (0.0410), respectively, suggesting that the null hypothesis that the instrumentation is weak and under-identified is rejected. In addition, the Andersen Stock-Write S statistic (25.73; $p = 0.0000$) implies that we do not reject the null hypothesis that the coefficients of the endogenous regressors in the structural equation are jointly equal to zero and that the overidentifying restrictions are valid.

To establish if the quality of healthcare measures were indeed endogenous, the Durbin-Wu-Hausman test of exogeneity was conducted. From the 2SRI results presented in Table 3 (column

Table 3. Effect of Interaction between Provider and Consumer Quality of Health care on Child Health

	Child Health Model	
	(1)	(2)
Variables	OLS (Basic Model)	2SRI Model
Child Characteristics		
Child sex	−0.149*** (0.0522)	−0.128* (0.0670)
Child age in months	−0.0612*** (0.00761)	−0.0574*** (0.0182)
Child age squared	0.000822*** (0.000125)	0.000763*** (0.000254)
Twin birth	−1.317*** (0.147)	−1.232*** (0.160)
Birth order number	−0.00515 (0.0216)	−0.0231 (0.0313)
Mother's/ Caretaker Characteristics		
Age in years	0.0361 (0.0288)	0.0444 (0.0368)
Age in years squared	−0.000437 (0.000473)	−0.000425 (0.000580)
Education in years	0.0133 (0.00835)	0.0142 (0.0156)
Occupation (Reference Category: Unemployed)		
Agriculture	−0.101 (0.104)	−0.0455 (0.122)
Professional	−0.0224 (0.0738)	0.000251 (0.0912)
Others	−0.00887 (0.0935)	0.0199 (0.114)
Household Characteristics		
Wealth index	1.439*** (0.260)	1.064** (0.442)
Sex of the household head	−0.0301 (0.0577)	−0.0132 (0.0619)
Age of household head in years	0.0133 (0.0122)	0.0151 (0.0137)
Age squared	−0.000135 (0.000123)	−0.000175 (0.000140)
Area of residence	−0.0616 (0.0656)	−0.189 (0.142)
Household size	−0.0174 (0.0136)	−0.00984 (0.0169)
Quality of Healthcare Indicators		
Dispensary	−0.610*** (0.204)	−0.633*** (0.209)
Health Center	−0.338 (0.243)	−0.384 (0.247)
Hospital	−0.267 (0.232)	−0.301 (0.238)
Private clinic/hospital	−0.717** (0.283)	−0.699** (0.290)
Mission	−0.389 (0.575)	−0.471 (0.609)
Consumer quality of healthcare index	−0.0637 (0.0490)	−0.0757 (0.0509)
Provider-Consumer Quality of Healthcare Interaction		
Dispensary*Consumer quality index	0.132** (0.0599)	0.148** (0.0614)
Health Center*Consumer quality index	0.109 (0.0692)	0.123* (0.0706)
Hospital*Consumer quality index	0.0176 (0.0672)	0.0268 (0.0699)
Private clinic*Consumer quality index	0.175** (0.0787)	0.179** (0.0806)
Mission*Consumer quality index	0.00894 (0.147)	0.0539 (0.161)
Predicted Provider Quality of Healthcare Residuals		
Self-treatment		4.424* (2.286)
Dispensary residual		3.047* (1.786)

(Continued)

Table3. (Continued)

Variables	Child Health Model	
	(1)	(2)
	OLS (Basic Model)	2SRI Model
Child Characteristics		
Health center residual		4.095** (1.705)
Hospital residual		4.432** (1.785)
Private clinic residual		4.217** (1.687)
Mission		-
Predicted consumer residual		-0.132 (0.322)
Provider*consumer quality of healthcare residual		-0.0154 (0.0696)
Constant	-0.936* (0.494)	-4.234*** (1.542)
Observations	1,872	1,821

*** p < 0.01, ** p < 0.05, * p < 0.1

Source: Authors computation, 2014 KDHS

(2), the coefficients of the predicted consumer quality of health care and the predicted provider-consumer interaction residuals were not statistically significant. However, the coefficients of the predicted provider-type residuals were statistically significant at 1 and 5 percent significant levels. Therefore, we conclude that provider quality of health care was endogenous and hence the interpretation of the 2SRI model results.

The 2SRI results in the table show that the effect of provider and consumer quality of healthcare interaction terms was positive and statistically significant for three provider-consumer quality of healthcare combinations. Specifically, the coefficients for the combinations and their respective statistical significance level were: dispensary/consumer quality of health care (0.15; 5% significance level), health center/consumer quality of health care (0.12; 10% significance level) and private clinic/consumer quality of health care (0.18; 5% significance level). This implies that the effect of a visit to either a dispensary, a health center or a private clinic as opposed to self-treatment on child health was higher by 0.15, 0.12 and 0.18, respectively, when consumer quality of healthcare index score improves by 1 unit. The coefficients of the interaction terms between a hospital and consumer quality of healthcare index and a mission healthcare facility and consumer quality of healthcare index were not statistically significant.

Considering the control variables, the results indicate that being a male child decreases the WAZ score by 0.14 scores when other factors are held constant. An increase in a child's age by a month decreases the WAZ score by 0.06 units implying that older children had poor nutritional status as opposed to much younger children. The relationship between a child's age and nutritional status is u-shaped. A twin birth decreases the WAZ score by 1.23 units when other factors are held constant. An increase in the household's wealth index score by one unit increases the WAZ score by 1.06 units.

7.4. Discussion of results

As hypothesized, consumer quality of health care had a synergistic effect on the relationship between provider quality of health care as indicated by some provider types and child nutritional status. Basically, there is some form of complementarity between the providers of health care and healthcare users in production of quality health care, which, in turn, results in improvement of child health.

This finding is supported by theoretical literature suggesting that providers and consumers of health care are co-producers in production of quality health care and health (Batalden, 2010; Hibbard, 2003). The policy repercussion of this finding is that improvement in child health could be achieved through a simultaneous approach toward improvement of supply and demand side quality of health care. The positive but nonsignificant effect of some of the provider/consumer quality of healthcare combinations could be due to the fact that hospitals which from levels 4 and 5 of Kenya's healthcare system serve as places of referrals by the much lower level health facilities (Ministry of Medical Services and Ministry of Public Health and Sanitation, 2014). Some of the mission hospitals play a similar role in the country. Hence, there is a possibility that they deal with children with more severe illnesses that could affect their nutritional status the more.

The negative relationship between child sex and child health is consistent with the existing studies (Amare et al., 2019; Boah et al., 2019; Kabubo-Mariara et al., 2008). This has been associated with gender differentials in behaviors, vulnerability of males to ill health in early infancy and gender inequalities. The inverse relationship between a child's age and nutritional status support similar findings in existing empirical works (Boah et al., 2019; Kabubo-Mariara et al., 2008). This perhaps is due to the fact that much older children take less of breast milk and more complimentary foods subjecting them to higher incidences of malnutrition. The U-shaped relationship between the child's age and nutritional status could be as a result of cumulative effects of infectious illness and poor nutritional status from infancy. The observed negative effect of a twin birth on child nutritional status corroborates with a number of existing empirical studies (Kabubo-Mariara et al., 2008; Ntenda & Chuang, 2010). This perhaps could be as a result of health risks and developmental problems, such as low birthweight, inadequate breastfeeding and competition for nutritional intake usually associated with children of multiple births (Kabubo-Mariara et al., 2008; Ooki, 2010).

Better nutritional status among children whose mothers were from wealthier households substantiates the results reported in other existing studies (Ashagidigbi et al., 2018; Lartey et al., 2016; Mostafa Kamal et al., 2010), where wealth was found to be among key predictors of child health. Generally, the positive relationship between high socioeconomic status and child health outcomes is explained by the ability by richer household to access foods that have high nutritive value and to invest in child health. In addition, wealthier households have better living conditions than poorer households which in turn reduces the risks of malnutrition as a result of illnesses such as diarrhea.

7.5. Conclusion and recommendations

This study sought to investigate the interaction effect of provider and consumer quality of health care on child health. The multivariate regression results show that there is a synergistic effect of the combined effort between healthcare providers and users in production of child nutritional status. Thus, for enhanced improvement in child health, an integrated approach to quality healthcare provision should be pursued. In particular, an improvement of facility quality of health care across the country, through better infrastructure and skilled personnel should be accompanied by enhanced preventive behaviors, timely initiation of treatment upon observation of an illness and compliance with medical advice. Further, there is need to strengthen the country's first level of health care, that is, the community level to include the households since they play a critical role in improving child health through implementation of simple interventions.

An improvement of household socioeconomic status should be pursued through establishment of income generating activities (both formal and informal) for women across the country. In addition, more awareness should be created among mothers on the biological reasons leading to poor health among children of multiple births, males and much older children. This could be done by healthcare workers at the health facilities and through social media.

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Appendices

Appendix A: Correlation Matrix

	Child sex	Child age	Twin birth	Birth order	Women age	Mother education	Mother occupation	Wealth index	Sex head	Age head	Area of residence	Household size
Child sex	1											
Child age	-0.00289	1										
Twin birth	0.00217	-0.00397	1									
Birth order	-0.00525	0.0229**	0.0703***	1								
Woman age	-0.00381	0.208***	0.0422***	0.719***	1							
Mother education	0.0121	-0.0183*	0.0186**	-0.344***	-0.0693***	1						
Mother occupation	0.00153	0.0497***	0.00387	-0.0297***	0.0506***	0.182***	1					
Wealth index	0.00685	0.00313	0.00995	-0.267***	0.00113	0.651***	0.160***	1				
Sex head	0.000936	-0.0204**	-0.0114	-0.0117	-0.0548***	0.0378***	0.00396	0.0640***	1			
Age head	-0.00599	0.0224**	0.0107	0.218***	0.287***	-0.0248***	0.00583	-0.0273***	0.0838***	1		
Area of residence	-0.00670	-0.00979	-0.00744	-0.171***	-0.0492***	0.238***	0.0722***	0.511***	0.0311***	-0.113***	1	
Household size	-0.00579	0.0125	0.0877***	0.528***	0.315***	-0.210***	-0.0285***	-0.155***	0.0879***	0.466***	-0.137***	1

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix B: First Stage Results

Variables	First Stage Results						
	Model 1	Model 2					Model 3
	Consumer Quality of Health care	Provider Quality of Health care					Provider*Consumer Quality of Healthcare
		Self treatment/others	Health Center	Hospital	Private clinic	Mission	
Child Characteristics							
Child Sex	0.0516*** (0.0140)	−0.0479 (0.104)	−0.0234 (0.0974)	0.0639 (0.104)	0.00857 (0.110)	−0.0164 (0.168)	0.0685** (0.0289)
Child age in months	0.0225*** (0.00189)	0.00512 (0.0142)	−0.00383 (0.0132)	−0.00895 (0.0142)	0.00555 (0.0152)	−0.0363 (0.0224)	0.0161*** (0.00381)
Child's age squared	−0.000293*** (3.16e−05)	0.000103 (0.000243)	0.000133 (0.000228)	0.000165 (0.000248)	−8.98e−06 (0.000264)	0.000671* (0.000387)	−0.000213*** (6.34e−05)
Twin birth	0.0762* (0.0408)	−0.138 (0.300)	0.110 (0.276)	−0.388 (0.332)	−0.596 (0.403)	−0.216 (0.481)	−0.0475 (0.0780)
Birth order number	0.00638 (0.00560)	0.114*** (0.0427)	0.0101 (0.0405)	−0.00478 (0.0433)	−0.00614 (0.0451)	0.0109 (0.0665)	−0.00133 (0.0129)
Mother's Characteristics							
Age in years	0.00261 (0.00810)	−0.0511 (0.0592)	−0.0198 (0.0555)	0.0495 (0.0611)	−0.0702 (0.0621)	−0.0221 (0.0919)	0.0248 (0.0170)
Age in years squared	−5.54e−05 (0.000134)	0.000235 (0.000978)	0.000301 (0.000913)	−0.000779 (0.00101)	0.00139 (0.00102)	0.000603 (0.00148)	−0.000297 (0.000274)
Education in years	0.0173*** (0.00246)	0.0234 (0.0188)	0.0128 (0.0180)	−0.00198 (0.0180)	0.00666 (0.0192)	−0.0174 (0.0283)	0.0185*** (0.00524)
Occupation (Reference category (Unemployed))							
Agricultural	0.0306 (0.0279)	0.122 (0.205)	−0.0591 (0.184)	−0.491** (0.205)	−0.145 (0.220)	0.0273 (0.315)	−0.0258 (0.0598)
Professional	0.0265 (0.0204)	0.202 (0.155)	−0.0959 (0.138)	−0.251* (0.140)	0.0926 (0.158)	−0.00762 (0.219)	0.0156 (0.0428)
Others	0.0670*** (0.0249)	0.216 (0.191)	−0.0110 (0.174)	−0.138 (0.178)	−0.0860 (0.201)	−0.282 (0.316)	0.0433 (0.0512)
Household Characteristics							
Wealth index	0.231*** (0.0735)	0.765 (0.608)	−0.739 (0.607)	1.925*** (0.570)	3.251*** (0.600)	1.322 (0.894)	0.729*** (0.150)
Household head sex	−0.0112 (0.0154)	−0.0739 (0.117)	0.00313 (0.109)	−0.0844 (0.116)	0.0531 (0.126)	−0.0515 (0.189)	−0.0111 (0.0322)
Household head age	0.00653* (0.00359)	0.00182 (0.0260)	−0.0106 (0.0236)	−0.0306 (0.0258)	0.00202 (0.0302)	−0.0382 (0.0424)	−0.00138 (0.00793)
Age squared	−6.12e−05 (3.74e−05)	7.50e−05 (0.000273)	0.000185 (0.000247)	0.000350 (0.000271)	−6.44e−05 (0.000328)	0.000421 (0.000445)	−6.52e−06 (8.49e−05)
Area of residence	0.0181	0.572***	0.113	1.092***	0.456***	0.754***	0.105***

(Continued)

Variables	First Stage Results						
	Model 1	Model 2					Model 3
	Consumer Quality of Health care	Provider Quality of Health care					Provider*Consumer Quality of Healthcare
		Self treatment/others	Health Center	Hospital	Private clinic	Mission	
Child Characteristics							
	(0.0186)	(0.142)	(0.141)	(0.135)	(0.150)	(0.230)	(0.0404)
Household size	−0.0106***	−0.0338	−0.0654**	−0.0384	−0.0215	−0.0201	−0.0147*
	(0.00368)	(0.0271)	(0.0265)	(0.0281)	(0.0300)	(0.0448)	(0.00836)
Log of travel time to community infrastructure	−0.0159**	−0.0605	−0.195***	0.0844	−0.0498	−0.0190	−0.0195
	(0.00759)	(0.0674)	(0.0663)	(0.0634)	(0.0670)	(0.0981)	(0.0157)
Log of annual rainfall	0.0193*	−0.112	0.00930	−0.337***	−0.388***	−0.732***	−0.124***
	(0.0148)	(0.114)	(0.109)	(0.107)	(0.116)	(0.156)	(0.0261)
Log of distance to community infrastructure*average annual temperature	0.00499	−0.00159	0.00459	−0.0706**	0.0106	−0.0491	0.00333
	(0.00441)	(0.0348)	(0.0330)	(0.0334)	(0.0353)	(0.0567)	(0.00897)
Constant	0.373**	0.422	1.438	1.120	1.518	4.487**	2.207***
	(0.178)	(1.369)	(1.297)	(1.342)	(1.426)	(2.062)	(0.353)
Observations	2,809	1,863					1,848
	AIC = 6.307735 BIC = 44,303.47	LR Chi2(100) = 381.28***					AIC = 6.307735 BIC = 44,303.47

Standard errors in parentheses;*** p < 0.01, ** p < 0.05, * p < 0.1

Source: Authors computation, 2014 KDHS
Appendix C: Tests for Validity of Instruments

Test-First Stage Regression	Dependent Variable Performance
Sanderson-Windmeijer F test of excluded instruments: (Prob > F)	5.24** (0.0221)
Kleibergen-Paap rk LM statistic (under-identification) (p-value)	4.18** (0.0410)
Stock-Wright LM S statistic Wald weak-instrument-robust inference test: (Prob>F)	25.73 *** (0.0000)
Sargan statistic (overidentification test)	Equation exactly identified

*** p < 0.01, ** p < 0.05, * p < 0.1

Source: Authors computation, 2014 KDHS



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