The relationship between Caesarean section delivery and Socioeconomic Status in Uganda: Evidence from the DHS 2016 study.

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Abstract

Background: C-section is a surgical intervention done in situations of practical and important risks to the mother or the foetus amidst pregnancy or labour. Studies have shown that it can be done when there are important clinical procedures or when there are non-medical conditions examined; these have positive and negative adverse effects on both maternal and neonatal outcomes. Studies in Uganda have only examined trends in C-section rates and utilisation of C-sections in particular health facilities or districts, but no analysis is done on the association between C-section and wealth index (SES) in Uganda. **Methods:** We use data from the Demographic Health Survey (DHS) 2016. We use the logistic regression technique to model the relationship between C-section and wealth index (SES) while controlling for other maternal-related and other socioeconomic factors. **Results:** Women from higher wealth index quintiles were seen to an association with higher probabilities of having a C-section after controlling for other variables. **Conclusions:** The findings show that there is an association between C-section and wealth index (SES) in Uganda, though there are limitations in the study, hence caution must be taken in interpreting the results. Further research is deemed necessary to ascertain appropriate levels of C-sections in Uganda and whether there is an association between the number of antenatal visits and C-section delivery.

Introduction

Ceaseration section (C-section) is a vital procedure in convoluted births when the protection of the mother or the baby is compromised (Atuheire et al., 2019), (Ali et al., 2018), (Tsegaye et al., 2019). C-section is a surgical intervention done in situations of practical and important risks to the mother or the foetus amidst pregnancy or labour (Faisal-Cury et al., 2017), (Azene et al., 2019), (Dankwah et al., 2019). These important clinical procedures need to be considered before the conduction of C-section; pregnancy-induced hypertension, maternal weight, macrosomia among others (Dankwah et al., 2019).

Women should not die when giving birth, their children should be born when it is the right time, and every birth should be conducted in a safe manner and environment; this, therefore, indicates that maternal health is a fundamental right (Okube, 2019). C-section has greatly reduced maternal and neonatal mortality and morbidity in the world (de Loenzien et al., 2019), (Okube, 2019), (Verma et al., 2020), (Atuheire et al., 2019), (Mohanty et al., 2019), (Manyeh et al., 2018). Further, outcomes such as stillbirth, ruptured uterine, obstetric fistula among others can also be avoided if a timely and right C-section is done in maternal health (Dankwah et al., 2019). The recommended population-level C-section as stated by the World Health Organisation in 1985 is from 5 – 15 percent (Khan et al., 2018), (Kheirouri et al.,

2019). However, when there are unnecessary levels of C-section rates, it can result in wastage of healthcare resources from surgical procedures and longer hospital stays and it also leads to sufferings that are avoidable sufferings by the women (Nimi et al., 2019). Also, it is stated by Jahnke et al. (2019) that, "women who deliver by C-section have a higher risk of infection, venous thromboembolism, abnormal placentation, placenta accrete, uterine rupture, cardiac arrest, and hysterectomy than those who deliver vaginally." It is also indicated that elective C-sections are associated with sepsis and respiratory problems, these are key among the determinants of neonatal mortality (Ochieng Arunda et al., 2020).

The global average of C-sections had increased from 6.7 percent to 19.1 percent in 1990 to 2014 respectively, and it is also indicated that there are differences in the levels of C-section across different countries from as low as 0.6 percent in South Sudan to 58.9 percent in the Dominican Republic (Mohanty et al., 2019). In Uganda, Waniala et al. (2020) indicated that the C-section delivery rate between 2012 and 2016 from 3461 health facilities as obtained from the National Health Information System - District Health Information System version 2 (DHIS2) increased from 8.5 percent to 11.5 percent from 2012 to 2016 respectively. However, the overall population-based C-section delivery rate was 4.7 percent. Waniala et al. (2020) indicated that "overall, Uganda's facility-based C-section was projected to increase by 36% in 2021, while population-based C-section rate was estimated to double in the same period from 4.7 percent." The number of C-section deliveries in 21 hospitals in Uganda reduced by 7 percent from 49,369 in FY 2018/19 to 45,806 in FY 2019/2020 which lead to an overall reduction in C-section rate per delivery in the hospitals to 34 percent in FY 2019/2020 from 35 percent in FY 2018/19 (MoH, 2020). In 2008, the C-section rate in China was 54.2 percent and it was above 25 percent in most Asian, Latin American, and European countries (Okube, 2019). In Africa, on average the C-section rate is about 9%; a study conducted in Nigeria showed that the rate of C-section was 14 percent with 90 percent being emergencies and in Kenya, the average C-section rate was about 6 percent (Okube, 2019). In the US, there was an increase in the C-section rate by 60% from 20.7% in 1996 to 32.9% in 2009 (Adhikari et al., 2018). In Vietnam, the percentage of the C-section rates increased by almost 7 folds in 17 years, from 3.4% in 1997 to 27.5% in 2013-14 (de Loenzien et al., 2019). The increase in the C-section rate is also seen in the Bangladesh Demographic Health Survey report; there was an increase from 4% in 2004 to 23% in 2014 (Begum et al., 2017). There was an indication of increased C-section delivery rates in Ecuador by Jahnke et al. (2019), that is from 17.1 percent in 1991 to 41.2 percent in 2012. In Colombia, the national C-section rate as of 2017 was 46 percent (Alzate et al., 2019). The C-section rates have been increasing in the world and there is no indication that the rates of delivery by C-section are flattening; Mossialos et al. (2005) states that "there is no justification for any region to have

a higher rate than 10-15%, signifying a serious cause for concern in the majority of countries."

Several factors are associated with the rate of C-section delivery. First, Mossialos et al. (2005) show that maternal age, high levels of maternal education, previous C-section, obstetric complications, maternal requests, high-income levels, and social class are associated with high rates of C-section delivery, this is also asserted by (Kheirouri et al., 2019), (Mohanty et al., 2019), (Nimi et al., 2019), (Abbas et al., 2019), (Manyeh et al., 2018). Also, it was found that the ethnicity of a mother is associated with C-section; in the US, out of about 40% of published studies, immigrant mothers showed to have a higher rate of C-section rate as compared to the women in the host country (Minsart et al., 2013). Other maternal factors have a relationship with the increasing rise in the C-section rates as cited in many studies from Latin America, Europe, and China; such as increasing maternal body mass index (BMI), multiple pregnancies, and fear of pain (Mohanty et al., 2019), (Amjad et al., 2020), (Azene et al., 2019), (Rénes et al., 2018). It is also indicated by Mohanty et al. (2019) that, "the convenience and professional malpractices, practice style, type of birth attendant, and fear for litigation are health care provider level factors that contributed to the increase in C-section delivery rate", this is also reflected by (Ali et al., 2018). There are also indications of the association between C-section delivery rate and the number of antenatal visits attended by the women (Azene et al., 2019), (Waniala et al., 2020), (Barros et al., 2019). Key to note, globally non-medical factors constitute about one-third of the annual C-section rates; with a tune of about 18.5 million C-section rates, this, therefore, calls for an investigation into how this epidemic can be curtailed (Begum et al., 2017).

Studies have shown that there is a likely relationship between C-section rates and Socioeconomic Status (SES); some studies have shown that there is a relationship between an individual's SES and the utilisation of healthcare services, Yaya et al. (2019) stated that "in Burkina Faso, individuals from disadvantaged communities seek healthcare services considerably lower than others and in Ethiopia, poorer households use healthcare services less often than those from wealthier households. There are indications of higher costs associated with C-section as compared to normal vaginal delivery and C-section deliveries were higher among richer households (Mohanty et al., 2019). Also, Khan et al. (2018) asserted that women that are in the lowest tier of their SES often have lower rates of C-section deliveries; with some countries showing levels that are less than 1 percent. There is contrasting evidence about the association of SES and C-section delivery rates; a study by Nimi et al. (2019) showed that in the previous studies of the developing countries the C-section delivery rates increased among women in the richest class, while in developed countries, the increase in the C-section rates was observed mostly amongst the poor and less educated women.

We propose that the analysis of differences in wealth indices among the women in Uganda will

provide viable evidence in varying levels of C-section delivery rates. Therefore, the objective of this study is to evaluate the relationship between Caesarean section delivery rates and Socioeconomic Status (SES) in Uganda, controlling for other maternal-related factors.

In what follows, we begin with data and methods, variables used in the study, analysis, and results, then we introduce the section with discussions and policy implications and strengths and limitations, then the last section concludes.

Data and methods

In the study, we use data from the 2016 Uganda Demographic and Household Survey (2016 UDHS); which is a survey that is conducted every five years since 1988 (Uganda Bureau of Statistics - UBOS and ICF, 2018). The data used in the analysis is for women aged 15 – 49 years and it is an extract from the 7 databases that were generated from the UDHS that was administered between 15 June and 18 December 2016 by the Uganda Bureau of Statistics (UBOS) in collaboration with the Ministry of Health (MOH) – the women's file (IR), which is coded as UGIR7BFL.dta. The Uganda Bureau of Statistics - UBOS and ICF (2018) state that "the Demographic and Health Surveys (DHS) Program is a global program coordinated by Inner City Fund (ICF) in Rockville, Maryland, USA." The data collected from the UDHS is used to monitor and evaluate population, health, and nutrition programs regularly and the survey contains household and respondent characteristics, fertility and family planning, infant and child health and mortality, maternal health and maternal and adult mortality, child and adult nutrition, malaria, HIV/AIDS, disability, road traffic accidents, child discipline, early childhood development, and domestic violence (Uganda Bureau of Statistics - UBOS and ICF, 2018).

The data was collected by 173 trained fieldworkers who were trained by TOTs from the UDHS team that consisted of the UBOS and ICF members after receipt of training that lasted 2 days. The interviewers collected data using the computer-aided personal interviewing (CAPI) and the information was transferred from the tablets to the server of UBOS using the internet file streaming system (IFSS) (Uganda Bureau of Statistics - UBOS and ICF, 2018). More explanation of the methodology is explained separately in the UDHS report, 2018 (Uganda Bureau of Statistics - UBOS and ICF, 2018). Data concerning delivery by 10,224 women aged 15-49 years was used in the analysis.

Variables

The main dependent variable of interest is a binary variable which indicates if an individual reported conducting delivery by C-section, defined as a surgical intervention done in situations of practical and important risks to the mother or the foetus amidst pregnancy or labour (Faisal-Cury et al., 2017), (Azene et al., 2019), (Dankwah et al., 2019). This variable takes on a value of 1 if C-section was conducted on a woman and 0 if the delivery was a normal vaginal delivery.

The main independent variable of interest is a categorical variable indicating the wealth index of the women that were surveyed; from the Uganda Bureau of Statistics - UBOS and ICF (2018) "the households are given scores based on the number and the kind of consumer goods they own, ranging from a television to a bicycle or a car, and housing characteristics such as the source of drinking water, toilet facilities, and flooring materials. These scores were derived using component analysis. The National wealth quintiles are compiled by assigning the household score to each usual household member, then ranking each person in the household population by the score, and then dividing the distribution into five equal categories." These five quintiles include; lowest, second, middle, fourth, and highest wealth index. Control variables include information on maternal-related factors: number of antenatal visits, parity, and age, and other socioeconomic factors: the place of residence, years of education, and whether the women were covered by insurance (see Table 1). The selection of these variables that have a relationship with C-section delivery involved the review of the existing literature and the availability of the suitable variables in the UDHS data set.

Table 1: Variable definitions and sample descriptive statistics

Variable	Definition	% or Mean (SD)
Dependent Variable		
Delivery by C-section	= 0 if normal vaginal delivery	93.33
	= 1 if C-section	6.67
Main Independent Variables – SES		
Wealth Index	= 1 if lowest in the wealth index	23.96
	= 2 if second in wealth index	20.82
	= 3 if middle in the wealth index	19.53
	= 4 if fourth in the wealth index	18.81
	= 5 if highest in wealth index	16.87
Other SES related independent variables		
Type of residence	= 1 if urban	19.91
	= 2 if rural	80.09
Covered by Health Insurance	= 0 if no	98.86
	= 1 if yes	1.14
Years of Education	= Education in singles years	5.95 (3.97)
Maternal related independent variables		
Antenatal visits	= Number of antenatal visits during pregnancy	4.19 (6.34)
Parity	= total number of children ever born	3.94 (2.64)
age	= Age of the women	28.53 (7.17)

Source: Analysis of the Uganda Demographic Health Survey, women's database.
SES, Socioeconomic Status; C-section, delivery by caesarean section

Table 1 presents sample descriptive statistics for several other variables considered in the analysis. 6.67 percent of the women interviewed had C-section deliveries, out of the 10,244 women that had delivered by either method; the majority belonged to the lowest quintile of wealth index (23.96%) with the lowest number of women belonging to the highest quintile of the wealth index (16.87%).

80.09% of the women reside in the rural areas, with only 1.14% covered by health insurance, and the average number of years of education was 5.95 years. The mean number of antenatal visits that the women had was 4.19 visits, on average the total number of children ever born by the women represented as parity was 3.94 children and the average age of the women in the sample was 28.53 years.

Analysis

Summary statistics for all the variables considered were calculated. Univariate logistic regression models were estimated to assess the association between C-section delivery and each single regressor variable (see Table 2).

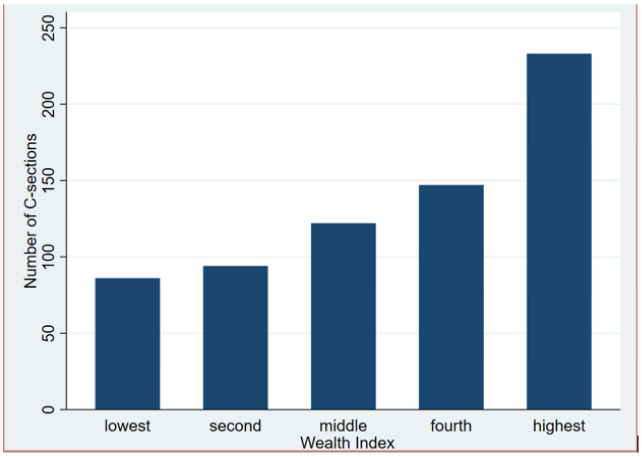
Table 2: Univariate analysis of Independent variables on C-section

Variable	Pearson χ^2	P Value
Wealth index	190.1488	0.000***
Number of antenatal visits	103.7944	0.000***
Parity	148.1141	0.000***
Age	38.9412	0.257
Rural	164.4072	0.000***
Years of education	454.1603	0.000***
Covered by Insurance	27.9851	0.000***

Notes: The dependent variable (C-section) is a binary variable taking 1 if the woman had a C-section and value of 0 otherwise. Univariate analysis done and the table reports Pearson's chi-square value and the p values. *** denotes significant at 1%, ** denotes significant at 5%, and * denotes significant at 10%.

Graphical analysis of the main independent variable and the binary independent variable was also done to show the differences in the number of C-sections across the various levels of wealth index (see figure 1).

Figure 1: Bar graph showing relationship between Wealth index and C-section



Source: Analysis of the Uganda Demographic Health Survey, women's database.
C-section, delivery by caesarean section

All variables used in the analysis of the univariate models were included in the multivariable regression analysis as covariates, and I estimated the multivariable logistic regression models of the association between C-section and SES (wealth index), controlling for maternal related factors, and other socioeconomic factors. The findings of these models are presented as probabilities (marginal effects). The overall model significance was evaluated using the likelihood ratio tests and all analyses were performed using Stata V.16 (StataCorp).

The decision by a woman i to have a C-section (A_i) is modelled as a function of a vector of maternal related factors (X^s) and a vector of other socioeconomic variables (X^p), such that:

$$A_i = f(X^s, X^p, \eta_i) \qquad \text{(Equation 1)}$$

A_i is a binary variable taking a value of 1 if the woman had a C-section and a value of 0 otherwise and η_i is a stochastic error term. The variables included in the vector X^s include an indicator variable wealth index (SES), number of antenatal

visits, parity, and age. The variables included in X^p include an indicator variable type of residence (rural), a measure of the women's number of single years of education (years of education), and an indicator variable showing whether a woman was covered by insurance. Table 1 above presents a better-detailed explanation of the variables used to estimate equation 1.

Given the binary nature of the dependent variable, a logit model was estimated where the probability of a woman *i* having a C-section is defined as $P_i = P(A_i = 1)$. Under the assumptions of the model, $P_i = \Lambda(X'\beta)$ where $\Lambda(.)$ represents the logistic cumulative distribution function (i.e., $\Lambda(X'\beta) = (e^{X'\beta}/(1 + e^{X'\beta}))$, β is a vector of parameters and the vector X includes X^s and X^p. Estimation provides $\hat{\beta}$, unbiased estimates of the model coefficients β and it can easily be shown that

$$\ln\left(\frac{p}{1-p}\right) = \text{logit}(P) = X'\beta \qquad \text{(Equation 2)}$$

so that the estimated probability of attending for screening, $\hat{P}_i$, can be estimated for each patient using $\hat{\beta}$ and appropriate values of X.

Results

Equation 1 was estimated using data from the DHS database for Uganda 2016 and the results are presented in Table 3. Several different model specifications were having various explanatory variables was considered, likelihood ratio test was used to test whether the final model was a good specification using an assumption of model 2 (m1) being nested in the final model; model 3 (m2). The control variables that were included in the final model are wealth index, number of antenatal visits, parity, age, rural, years of education, and covered by insurance. These included socioeconomic-related factors and maternal-related factors to C-section. The estimates are presented as population-averaged marginal effects for each variable on the probability of having a C-section.

Generally, the results from the preferred model indicate that after controlling for all the different factors, the probability of a woman having a C-section from the highest wealth index quintile is 5.7 percentage points higher than that of a woman from the lowest wealth index quintile. Also, Table 3 shows that the probabilities of having a C-section for women in the fourth and middle wealth index quintiles are 2.4 and 1.7 percentage points higher than that of women in the lowest wealth index quintile respectively. There is no difference in the probabilities of having a C-section in women from the second wealth index and those in the lowest quintile; this is shown in Table 3 by the marginal effect not being statistically significant at a 10% level of significance.

Table 3: Estimated marginal effects of delivery by C-section.

Variable	Marginal Effects	95% CI
Second in wealth index	0.006 (0.85)	-0.008 to 0.019
Middle in wealth index	0.017 (2.39)**	0.003 to 0.031
Fourth in wealth index	0.024 (3.24)***	0.010 to 0.039
Highest in wealth index	0.057 (6.26)***	0.039 to 0.075
Number of antenatal visits	0.000 (0.00)	-0.001 to 0.001
Parity	-0.015 (7.68)***	-0.019 to -0.011
Age	0.003 (5.34)***	0.002 to 0.004
Rural	-0.041 (5.84)***	-0.054 to -0.027
Years of education	0.003 (3.54)***	0.001 to 0.004
Covered by Insurance	0.026 (1.30)	-0.013 to 0.066
Statistics		
Observations used.	10,224	
Lrtest χ^2	79.87	
Prob > χ^2	0.0000	

Notes: The dependent variable (C-section) is a binary variable taking 1 if the woman had a C-section and value of 0 otherwise. The binary logit model is estimated and the table reports marginal effects. Absolute values of z statistics are presented in parentheses. *** denotes significant at 1%, ** denotes significant at 5%, and * denotes significant at 10%.

The estimated marginal effects of the maternal-related and other socioeconomic-related factors indicated in Table 3 above are also important for the discussion. From the maternal-related factors, the results suggest that there is a negative association of the number of children ever born by a woman with having a C-section. An additional child born by a woman is associated with having a reduced probability of having a C-section by 1.5 percentage points and this was practically and statistically significant at a 1% level of significance. Also, we find that older women are more likely to have a C-section than young women; an increase in the age of a woman is associated with a higher probability of having a C-section of 0.3 percentage points and this is practically and statistically significant at 1% level of significance. The results also suggest that there is no association whether practical or statistical between the number of antenatal visits attended by a woman with having a C-section, this a little counterintuitive to have such findings.

Table 3 also suggests women living in rural areas are less likely to have a C-section than those that live in urban areas; the probability of having a C-section for a rural woman is lower by 4.1 percentage points as compared to a woman living in the urban areas. This result is both practically and statistically significant at a 1% level of significance. Also, there is no difference in the number of C-sections between women who are covered by insurance and those not covered by insurance.

The final explanatory variable in Table 3 is the single years of education (Years of education), which is a measure of the total number of years spent in school by the women. The estimated marginal effects suggest that, when other factors are controlled, an additional year of education is associated with having a C-section; this result is practically and statistically significant at a 1% level of significance and states that the probability of having a C-section for a woman with an additional year of education is 0.3 percentage points higher.

Generally, the model finds that women from a higher social wealth index are more likely to have a C-section. Also, it suggests that older women and more educated women are more likely to have a C-section. On a contrary, for women that have given birth to many children and live in rural areas, the results suggest that they are less likely to have a C-section as compared to their counterparts. The above patterns are neither seen with the number of antenatal visits attended by the women nor with the women that are covered by insurance.

Discussion and Policy Implications.

Ceaseration section (C-section) is a vital procedure in situations when we have complications in births. and therefore if done in situations when it is needed, then maternal and perinatal deaths might be avoided. However, excessive C-sections as stated in the literature can also have harmful side effects on women and children. Policies aimed towards enhancing safe and necessary levels of C-section in Uganda should be guided by significant evidence. Hence, in this study, we aim to evaluate the relationship between C-section and wealth index (SES) for women aged 15 – 49 years in Uganda.

The study finds that C-section is common amongst women in the higher wealth index even after controlling for other maternal related factors and other socioeconomic related factors to C-section. This is also related to the findings of Mohanty et al. (2019) and Khan et al. (2018). We also find that older women and more educated women are more likely to have a C-section, this is in sync with the findings of the literature in Mossialos et al. (2005), Kheirouri et al. (2019), and Nimi et al. (2019). On a contrary, for women that have given birth to many children and live in rural areas, results suggest that they are less likely to have a C-section as compared to their counterparts, these findings are related to what Amjad et al. (2020), Rénes et al. (2018), and Mohanty et al. (2019) stated in their literature. The analysis did not find an association between the number of C-sections carried out with the number of antenatal visits done by the women and whether the women are covered by insurance or not, this is different from the findings of Barros et al. (2019), Azene et al. (2019), and Waniala et al. (2020) since they indicated that there was an association between the number of antenatal visits and the number of C-section done by women.

Given the rapid change in the level of income inequality in Uganda, there will be a tendency for women with lower incomes or the women in the lowest tier of wealth index to utilise fewer health care services. To make the women from the lower wealth index quintile access more health care services such as the costly C-section, policies such as the proposed National Health Insurance Scheme for 2019 should be fast-tracked to enable women with low income to access vital life-saving services when there is a need and this should not be attached to the amount of money a woman is to pay for the service. Though there is no association between being covered by insurance and having a C-section. Studies have shown that Universal Health Insurance enables women to have access to better health services when there is a need and not when they have funds to pay for the services.

Age and number of years of education have also shown that they are important determinants for the number of C-sections had by women. Form the review of the literature, the years of education of women in the reproductive age, about 54% of the women had not completed their primary school education (Uganda Bureau of Statistics - UBOS and ICF, 2018), this, therefore, shows that the Universal Primary School Education that is in Uganda needs to be evaluated to find out reasons why women are not completing their primary school education, this in a long run will help to improve on the quality of education attained by the women and also increase on their retention in school hence having an association with the number of the important and necessary number of C-section had by the women.

Strength and limitations

This is the first study that is examining the association between wealth index (SES) and C-section delivery while controlling other maternal related and socioeconomic factors. This study will therefore provide insight into specific issues that the government of Uganda needs to look through for women to have needed, affordable or free C-

sections. Also, the analysis uses a large representative sample of women sampled from all the regions of the country and with the many control variables added in the analysis such as age, parity, years of education, type of residence, number of antenatal visits, and covered by insurance help to reduce the issue of confounding hence helping in the creation of an independent relationship between the number of C-sections and the wealth index (SES).

The survey data lacks information on clinical indications for C-sections, and therefore the data does not distinguish between elective and emergency C-sections. Also, the study uses cross-sectional data available from DHS for Uganda 2016, and given the complex relationship between health utilisation (C-section), maternal related factors, and socioeconomic factors, endogeneity is unavoidable in the final model despite efforts to control for confounders. Hence the model represents an independent association as opposed to causal effects. There is a need to have data collected that is time-invariant data and hence individual-level heterogeneity could be controlled hence having a causal impact between wealth index and C-sections.

Conclusion

This analysis after controlling for other contextual variables shows that there is an association between the number of C-sections had and the wealth index quintile (SES). However, further research needs to be done to assess the appropriate level of C-sections needed to be carried out in Uganda. Besides, the analysis indicates that the number of antenatal visits is not associated with the number of C-sections; this is contrary to what most literature has stated, hence further research needs to be done in the identification of such an association.

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