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Levels of impoverishment and catastrophic out-of-pocket payment for antenatal and delivery care and their determinants in Yangon region, Myanmar: a cross-sectional study

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Abstract (285 words)

Objectives: To assess the levels of impoverishment and catastrophic out-of-pocket (OOP) payments for antenatal and delivery care in Yangon Region, Myanmar and explore the determinants of impoverishment and catastrophic OOP payment.

Design, setting and participants: A community-based cross-sectional survey among women giving birth within the past 12 months was conducted during October-November 2016 using multistage sampling in Myanmar.

Outcome measures: Impact of poverty headcount and normalized poverty gap were used to assess impoverishment with a poverty threshold of 1.9 USD. Out-of-pocket payment exceeding 10% of household annual income were used to assess catastrophic payment measuring incidence, intensity and mean positive gap. A multiple logistic regression using survey package was applied to estimate odds ratios (OR) and 95% confidence interval of determinants of impoverishment and catastrophic OOP payments in the utilization of antenatal and delivery care.

Results: Of 759 included women, out-of-pocket payments were used by 75% of the women for ANC and by 99.6% for delivery care. The impact of overall poverty headcount for antenatal and delivery care were 7.9 % which was 5.6% for ANC and 1.4% for delivery care. Overall incidence of catastrophic OOP payment was 22.6% which was 14% for ANC and 9.5% for delivery care. Women's occupation, accessibility of health services and utilization of health personnel and health facilities were important determinants for impoverishment and catastrophic OOP payments for maternal health care.

Conclusions: Out-of-pocket payment for all antenatal and delivery care in Myanmar is a challenge as one-tenth of women become impoverished and one-fourth face catastrophe after utilization of antenatal and delivery care. Social determinants are important factors that require

policy integration to reduce the financial burden on these women and support the achievement of universal health coverage in the country.

Key words: impoverishment, catastrophic payments, out-of-pocket payment, antenatal care, delivery care

Strengths and limitations of this study

- This study measured the level of impoverishment and catastrophic OOP payment for antenatal and delivery care and their determinants in Myanmar where is low-income country.
- Techniques of multistage sampling and survey package of analysis were used to minimize the standard errors.
- Expenditures of antenatal and delivery care were collected in terms of societal perspective.
- Recall bias might be occurred due to retrospective interview was carried out.
- Self-reported household annual income and payments for healthcare services may be slightly over- or under-reported.

Introduction

Worldwide, nearly 830 women die from pregnancy and childbirth every day, with most of them living in poor households having limited proper maternal health care.[1] Increasing utilization of maternal health services is one of the targets of Sustainable Development Goal 3.[2] Poverty or financial problems are the major barrier to accessibility and utilization of antenatal care (ANC) and delivery by skilled birth attendants (SBAs).[3] Even though the economic indicators of most countries were improved from earlier years in 2015, there are still some countries which face financial barriers leading to worse health outcomes.[2]

Low socioeconomic level or high health care expenditures can lead to financial burdens either impoverishment or catastrophe.[4 5] Household Impoverishment is defined as 'non-poor household is impoverished by health care payment when it became poor after health care payment'.[6] 'Catastrophic health care expenditure' is defined as 'out-of-pocket (OOP) payment for health care that exceeds some estimated proportion of household income or a household's capacity to pay'.[7] These financial burdens from utilization of maternal health care have been previously reported in some African and Asian countries such as Ghana, Nepal, Bangladesh, and India.[8-10] In Myanmar, OOP payment for health services were high in public and private health facilities which was about more than 80 % for total health spending in 2012.[11] There were limited evidences about OOP payment and relating factors of impoverishment and catastrophic OOP payments of maternal health services in Myanmar.[12]

Different countries have introduced different strategies to reduce the financial burdens while accessing necessary health care during pregnancy, child birth and postpartum period.[13] Providing free maternal health services has been implemented in some low-income countries, but various studies have found low utilization of these services as well as high

maternal mortality and morbidity.[10 14 15] A study in Thailand found improvement of maternal health outcomes five years after the implementation of a universal coverage scheme with health finance reform.[16] Although some countries have begun to offer free health services or health insurance, the achievement for reducing financial burdens remains limited.[13]

Similarly, Myanmar has begun a free program for maternal health services in recent years, but OOP payment of these services has been reported.[11 17 18] In addition, reports on the actual financial burden in terms of impoverishment and catastrophic OOP payments are limited.[12] Understanding the determinants of financial burden in utilizing maternal health services is useful to identify the nature of the OOP payment situation and whether any determinants are modifiable or require policy improvement.[15 19 20] This study aimed to 1) assess the levels of impoverishment and catastrophic OOP payments for antenatal and delivery care, and 2) explore the determinants of impoverishment and catastrophic OOP payment in Yangon Region, Myanmar.

Methods

Study design and participants

This was a community-based cross-sectional survey conducted in 15 townships of Yangon Region of Myanmar during October and November 2016. According to the 2014 census report, Yangon region had the largest population among the 4 regions of Myanmar .[21] Only the south and north districts were chosen as the study area because these areas have both urban and rural populations. A two-stage stratified sampling technique was used to identify the study subjects. For the first stage, urban and rural populations from the south (urban - 110 wards, rural - 375 villages) and north (urban - 125 wards, rural - 235 villages) districts were estimated using proportional probability sampling (PPS). For the second stage, 16 wards and 16 villages were randomly selected from the overall 15 townships of the south and north districts.

The study recruited women of reproductive age (15-49 years) with a history of prior birth within the previous 12 months who were residents of the study area. Those who had mentally retardation or serious illness were excluded. The required sample size for the first objective was calculated using the one-proportion formula based on a rate of 9% of pregnant women with catastrophic OOP payments on utilization of delivery care from a previous study.[12 22] With a precision of 3%, type I error of 5%, and design effect of 2, at least 700 women were required. The households in the selected wards and villages were visited by a survey team, and the eligible woman were approached. For households with more than one eligible woman, one woman was selected randomly.

Variables

Impoverishment and catastrophic out-of-pocket payment for overall antenatal and delivery care were the two main outcome variables in this study. The OOP payments included all related

healthcare services received during antenatal and delivery care, namely hospital costs/investigation fees, drugs, consultation fees, food/living/transportation cost, productivity loss and other costs. The OOP payments were calculated for antenatal care and delivery care and then summed as total OOP payment for care. OOP payments for ANC were counted as the sum of all ANC visits but delivery care was counted at one time. Impoverishment was defined as a household which was forced below the poverty line (counted as 1.9 US dollars (USD) per day) after paying for maternal health care services.[6] Catastrophic payment was defined as payment for maternal health care services exceeding 10% of a household's annual income.[23]

Independent variables included background characteristics of women, their husband and household information, accessibility of health services and details of services provided. Household annual income and income of all household members, was recorded in Myanmar kyats and converted to US$ using the exchange rate of 1 USD equal to 1362.63 kyats. The information pertaining to accessibility to health services included availability of a health center, distance as measured in walking minutes (number of walking minutes from the woman's house to a formal health center) and types of transportation (women who used any transport to visit a health center). Details of services provided included health personnel, place of care, affordability, and OOP payment.

Data collection

Before the data collection began, 12 research assistants were trained in a two-day training workshop on how to conduct the interview and check information for completeness of data. The required list of women was obtained from the township health departments and local authorities. The eligible women were visited at their house by the research team at their convenience. After the study was explained and a consent form signed, the women were interviewed by the principal

investigator and researchers using a pre-tested structured questionnaire in a private area. Each completed interview was checked promptly and daily for any errors and edited if required.

Statistical analysis

After data collection was complete, EpiData 3.1 was used to record the data on a double entry system and validate it, and R version 3.4.2 was used in data analysis.[24 25] Categorical variables are presented by frequencies and percentages and continuous variables are shown in median with interquartile range.

The impoverishment was presented by the poverty headcount and normalized poverty gap in terms of poverty impact.[26 27] The poverty impact of the poverty headcount was calculated by subtracting pre-payment head count from post-payment head count. Similarly, the poverty impact of the normalized poverty gap was calculated by subtracting pre-payment normalized poverty gap from post-payment normalized poverty gap.[26] Poverty head count was defined as the proportion of households who had pre- or post-payment household annual income less than the defined poverty line. Normalized poverty gap was defined as the poverty gap divided by the poverty line. The poverty gap was calculated by the depth of payment below the poverty line. A pen parade graph between household income as a multiple of the poverty line (y axis) with cumulative proportion of the population ranked by household income (x axis) was plotted to show the number of non-poor households which became poor after OOP for pregnancy expenses as indicated by the vertical lines below the poverty line.

The incidence, intensity and mean positive gap of catastrophe were analyzed for catastrophic OOP payment.[23 27] Incidence was calculated by antenatal and delivery OOP payment of a household greater than the 10% threshold. Intensity was calculated by antenatal

and delivery OOP payments divided by household annual income above the 10% threshold. The mean positive gap was calculated as intensity divided by incidence.[23 27]

The determinants of impoverishment and catastrophic OOP payment were analyzed using multiple logistic regression with the survey package to consider the sampling weight in cluster design. According to this analysis, the first stage sampling weight was calculated by the total number of wards and villages divided by the selected number of wards and villages by each district and the second stage sampling weight was calculated by the total number of women divided by the selected number of women in each ward and village by each township. The final stage weight was calculated by multiplying the first stage and second stage sampling weights.[28] The adjusted Odd Ratios (OR) and 95% confidence interval were presented in the final models with the significance value less than 0.05.

Results

A total of 759 women were included in this study. Half of the women were aged 24- 35 years and 71% were housewives. More than two-thirds of their husbands had above primary school level education and 60% of them worked as a daily wage-earner. Most of the households in this study had less than five household members and 89% of them had annual household income above 1275 US dollars (USD), and 60.3% of the households had debt. More than 80% of the women said that a health center was available for them to get ANC services within 30 minutes walking distance (Table 1).

Table 2 shows the details of services provided and payment of the women for ANC and delivery care. More than half (56.4%) went to a community health personnel for antenatal care followed by specialists (22.5%) and doctors/ nurses (21.1%). Similar numbers had delivery by a community health personnel (35.4%) or doctors/nurses (35.2%), with the rest by specialists (29.4%). Most of the women used public facilities for antenatal care (78%) and delivery care (65%). Almost all women said that they could afford the cost of each ANC visit and half could afford the cost of delivery care. Out-of-pocket payments were made by 75% of the women for ANC and by 99.6% for delivery care. Hospital costs/ investigation fees were highest for antenatal and delivery care. Cost per each ANC visit was lower, but the total cost for all ANC visits was higher, than the total cost of delivery care.

Table 3 shows the level of impoverishment created by out-of-pocket payments for antenatal and delivery care. The impact on poverty headcount after payment for overall antenatal and delivery care was 7.9% of which 5.6% was for antenatal care and 1.4% for delivery care. The impact of the normalized poverty gap was quite similar for antenatal care (1.3%) and for overall antenatal and delivery care (1.4%). Individual pre-payment and post-payment income for OOP of overall antenatal and delivery care is shown in a Pen's parade graph (Fig 1). Overall

OOP payments for antenatal and delivery care lead to some extent of poverty regardless of household income level.

Table 4 presents the catastrophic OOP payments for antenatal and delivery care at different threshold levels. The incidence of catastrophic OOP payments for overall antenatal and delivery care at the 10% threshold level was 22.6%, and accounted for 14% of ANC and 9.5% of delivery care. The intensity and mean positive gap of catastrophic OOP expense for overall antenatal and delivery care at the 10% threshold level were 11.2% and 49.6%, respectively. Similar patterns of catastrophic OOP burden were found at the 20%, 30% and 40% threshold levels.

The determinants of impoverishment and catastrophic out-of-pocket payment with 10% thresholds for overall antenatal and delivery care are shown in Table 5. Occupation of women, number of household members, different health personnel providing delivery services and place of antenatal care received were the significant determinants of both impoverishment and catastrophic OOP for overall antenatal and delivery care. Availability of a health center nearby and using delivery services from private facilities were significant determinants of impoverishment, but not catastrophic OOP.

Discussion

More than three-fourths of the study women had to pay ANC and delivery care. Approximately one in ten women accessing ANC and one-fourth of women's deliveries faced impoverishment or catastrophic OOP payments to meet their pregnancy-related expenses. Women having a higher number of household members or who were forced to access special or private services were more likely to face impoverishment and catastrophic OOP payments.

In our study, even though free maternal healthcare services are nationally available, at least three-fourths of women were forced to make OOP payments, which was not changed from a previous study in Myanmar in 2015.[12] This finding was also similar to previous studies from India in 2004 [19] and Nigeria in 2010[14], even though the maternal health services considered and the methods of OOP measurement were different. A possible explanation might be due to the fact that there were high informal payments when health facilities were in short supply with no health insurance system. [11 12 14 19] The need to turn to OOP payments has been shown to influence the utilization of maternal health services and maternal mortality.[29] Importantly, another study reported that high OOP payments for maternal healthcare also lead households to impoverishment and catastrophic OOP payments.[4]

Impoverishment as measured by the impact of poverty headcount for antenatal and delivery care in our study was half of what studies from India and Uganda, which used the lower threshold of the poverty lines in those countries, found.[30 31] Even though Yangon region is the most developed region among the states and region of Myanmar, a lot of non-poor households face impoverishment and deep poverty which may be due to high maternal healthcare payments without a compensation scheme.[11 21] A similar explanation was suggested in the studies from India and Uganda, that even rich households suffered financial burdens or poverty and poor households became extremely poor or they could not use proper maternal health services at all

because of the high costs and limited affordability.[30 31] Evidence from other studies from Thailand, Ghana, Kenya and Egypt showed that the impact of the poverty headcount for healthcare expenditures when free services or a health insurance scheme was available was lower than in our study.[32-35]

One fourth of women faced catastrophic OOP expenses even when they used the maternal healthcare services, which was higher than an earlier study from Myanmar in 2015. This may be because the previous study measured catastrophic OOP payments only for delivery care, not antenatal care, and also they measured only direct and indirect medical costs, not other costs or productivity loss.[12] Higher catastrophic OOP expenses were reported in India because of poor and all antenatal, delivery and postnatal care services were measured.[30] In addition to services and methods measured, the definition of catastrophic measurement was also important for either household income or capacity to pay as well as the different thresholds for calculation.[12 19]

Woman's occupation, number of household members, availability of health center, utilization of health personnel and place of care were associated with impoverishment and catastrophic OOP. A previous study could not identify a direct association between occupation to impoverishment and catastrophic OOP payments. The significance association between women's occupation and impoverishment and catastrophic OOP payments found in our study could be explained by not earning money for housewives and cannot share their income. The effect of a larger number of household members on impoverishment and catastrophic OOP varied from decreasing to increasing in previous studies conducted in India, Kenya, China and Egypt.[20 36 37 34 35] Women who used a nearby health center or facilities having specialists and private facilities

for antenatal and delivery care where the health insurance was not available were more likely to have impoverishment and catastrophic OOP payment.[15 19 20]

There are few studies on the level of impoverishment and catastrophic OOP payment for antenatal and delivery care and their determinants in Myanmar.[12] The findings of this study provide important information on these factors for policy makers to help them consider financial burdens when strategies for increasing service utilization without health financing hardship are implemented. The study had some limitations. First, this was a cross sectional study, thus the causal relationship between the determinants and level of impoverishment and catastrophic OOP for antenatal and delivery care could not be firmly identified. Second, household annual income and payments for healthcare services were self-reported, therefore, there may have been over- or under-reporting. However, we included only women within 12 months of delivery to minimize the recall bias. Third, the payment of total antenatal care used the payment of last antenatal care visit and then multiplied by the total number of all visits. Finally, the study was conducted in Myanmar, thus the findings of OOP payment and impoverishment of antenatal and delivery may not be generalized to women in other countries.

Conclusion

High OOP payments for using antenatal and delivery care in Yangon region of Myanmar resulted in one-tenth of women become impoverished and one-fourth face catastrophe. Women with no income or those who accessed health facilities with high levels of services provided were more likely to be impoverished or face catastrophic expenses.

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Contributors

All authors contributed to the concept and design of the study. ANMM and TL participated in data collection, data analysis, interpretation of the data, and preparation of the draft manuscript. TTH, MMW, JS and EB also assisted with interpretation of the data and commented on the draft MS. All authors read and approved the final manuscript.

Competing interests

The authors declare no competing interests.

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Ethical approval

Ethical clearances for the study were obtained from the Ethical Review Committee of Prince of Songkla University, Thailand, the Department of Medical Research, Myanmar and the Norwegian National Research Ethics Committee (NSD), Norway.

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List of Tables and Figure

Table 1. Background characteristics of women and their husbands, household information and accessibility of health services (n=759)

Characteristic	n (%)
Women characteristics	
Woman's age	
15-24 years	215 (28.3)
25-34 years	376 (49.5)
35-49 years	168 (22.1)
Woman's occupation	
Housework	539 (71)
Any job	220 (29)
Husband's characteristics	
Husband's education	
Primary school and lower	242 (31.9)
More than primary school	517 (68.1)
Husband's occupation	
Daily wage earner	455 (59.9)
Other	304 (40.1)
Household characteristics	
Number of household members	
> 5 members	276 (38.4)
3-5 members	483 (63.6)
Household annual income *	
≤ 1275 USD	83 (10.9)
> 1275 USD	676 (89.1)
Household debt	
No	301 (39.7)
Yes	458 (60.3)
Accessibility of health services	
Availability of health center	

No	123 (16.2)
Yes	636 (83.8)
Walking distance in minutes	
> 30 minutes	76 (10)
≤ 30 minutes	683 (90)
Type of transportation	
Car	79 (10.4)
Motorcycle	172 (22.7)
Walking	406 (53.3)
Other	102 (13.4)

* World bank data bank 2016

Table 2. Details of services provided and payment of the women for ANC and delivery care (n=759)

	Antenatal care n (%)	Delivery care n (%)
Health personnel		
Community health personnel	428 (56.4)	269 (35.4)
Specialists	171 (22.5)	223 (29.4)
Doctors/Nurses	160 (21.1)	267 (35.2)
Place of care		
Public facilities	592 (78)	493 (65)
Private facilities	167 (22)	266 (35)
Affordability (per visit/delivery)		
No	26 (3.4)	338 (44.5)
Yes	733 (96.6)	421 (55.5)
Out of pocket payment		
No	186 (24.5)	3 (0.4)
Yes	573 (75.5)	756 (99.6)
Categories of health care cost (per visit/delivery)	**(n=573)**	**(n=756)**
Hospital cost/Investigation fees	0.73 (0-80.8)	7.34 (0-1247.6)
Drugs	0 (0-40.4)	0 (0-587.1)
Consultation fees	0 (0-23.9)	0 (0-440.3)
Food/Travel/Living cost	0.57 (0-73.4)	2.94 (0-1027.4)
Productivity loss	0 (0-117.4)	0 (0-1174.2)
Other expenses	0 (0-29.4)	0 (0-220.2)
Sum of costs	6.17 (0-862.3)	84.4 (0-2305.1)
Total out of pocket payment of care	31.7 (0-12072.2)	84.4 (0-2305.1)

Table 3. Impoverishment out-of-pocket payments for antenatal and delivery care (n=757)

	Antenatal care			Delivery care		Overall antenatal and delivery care	
	Prepayment	Post payment	Impact	Post payment	Poverty Impact	Post payment	Impact
Poverty headcount	2.4%	8.1%	5.7%	3.8%	1.5%	10.3%	7.9%
Normalized poverty gap	0.01%	1.32%	1.31%	0.53%	0.52%	1.44%	1.43%

Table 4. Catastrophic OOP payments for antenatal and delivery care at different threshold levels (n=757)

Catastrophic OOP	Threshold			
	10%	**20%**	**30%**	**40%**
Antenatal care				
Incidence	14.0%	9.2%	7.7%	5.5%
Intensity	7.7%	6.0%	5.0%	4.3%
Mean positive gap	54.7%	65.3%	65.5%	77.5%
Delivery care				
Incidence	9.5%	3.8%	2.4%	1.2%
Intensity	2.0%	1.2%	0.9%	0.7%
Mean positive gap	20.8%	32.0%	38.2%	60.8%
Overall antenatal and delivery care				
Incidence	22.6%	13.6%	10.4%	8.5%
Intensity	11.2%	8.8%	7.4%	6.3%
Mean positive gap	49.6%	64.6%	70.5%	74.7%

Table 5. Determinants of impoverishment and catastrophic out-of-pocket payments with 10% threshold for overall antenatal and delivery care (n=757)

Characteristic	Impoverishment OOP Adjusted OR (95 % CI)	Catastrophic OOP Adjusted OR (95 % CI)
Woman's occupation		
Any job (reference category)	1	1
Housework	2.52 (1.24-5.13)*	2.07 (1.21-3.52)**
Number of household members		
> 5 members (reference category)	1	1
3-5 members	5.85 (2.48-13.78)***	6.19 (3.68-10.42)***
Availability of health center		
No (reference category)	1	
Yes	3.65 (1.34-11.72)*	
Health personnel for delivery care		
Community health personnel (reference category)	1	1
Specialists	6.11 (2.80-13.32)***	5.98 (3.10-11.54)***
Doctors/Nurses	2.30 (0.94-5.63)	3.33 (1.73-6.41)***
Place of antenatal care		
Public facilities (reference category)	1	1
Private facilities	2.74 (1.44-5.22)**	2.09 (1.29-3.38)**
Place of delivery care		
Public facilities (reference category)	1	
Private facilities	2.58 (1.31-5.07)**	

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

OR : Odds Ratio

CI : Confidence Interval

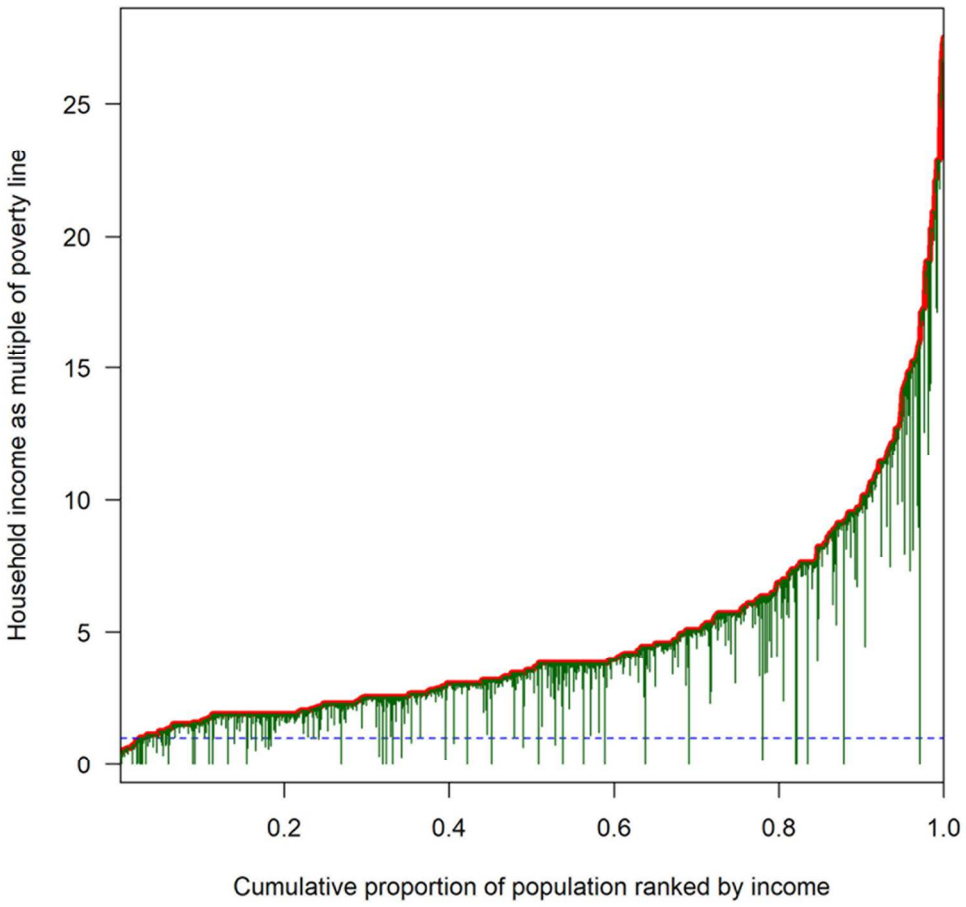

Figure 1. Pen's parade of pre- and post-payment income of overall antenatal and delivery care
Legend

Pre-payment income Post-payment income
Income based poverty line

80x81mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	9
		(*e*) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12
		(*b*) Report category boundaries when continuous variables were categorized	11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Impoverishment and catastrophic expenditures due to out-of-pocket payments for antenatal and delivery care and their determinants in Yangon region, Myanmar: a cross-sectional study

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Impoverishment and catastrophic expenditures due to out-of-pocket payments for antenatal and delivery care and their determinants in Yangon region, Myanmar: a cross-sectional study

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Abstract (300 words)

Objectives: To assess the levels of impoverishment and catastrophic expenditure due to out-of-pocket (OOP) payments for antenatal care (ANC) and delivery care in Yangon Region, Myanmar and explore their determinants.

Design, setting and participants: A community-based cross-sectional survey among women giving birth within the past 12 months in Yangon, Myanmar was conducted during October-November 2016 using three-stage cluster sampling.

Outcome measures: Impact of poverty headcount and normalized poverty gap were used to assess impoverishment with a poverty threshold of US$1.9. Out-of-pocket payments exceeding 10% of household annual income were used to assess catastrophic expenditure measuring incidence, intensity and mean positive gap. Multiple logistic regression using a survey package was used for analysis to estimate odds ratios (OR) and 95% confidence interval of determinants of impoverishment and catastrophic expenditure due to OOP payments in the utilization of ANC and delivery care.

Results: Of 759 women, out-of-pocket payments were used by 75% of the women for ANC and by 99.6% for delivery care. The impact of the poverty headcount was 5.7% for ANC, 1.5% for delivery care and 7.9% for overall ANC and delivery care. Overall incidences of catastrophic expenditure were 22.6%, 14% for ANC and 9.5% for delivery care. Women's occupation, number of household members, number of ANC visits, utilization of health personnel and health facilities were important determinants for impoverishment and catastrophic expenditure caused by accessing ANC and delivery care.

Conclusions: Out-of-pocket payment for all ANC and delivery care is a challenge as one-tenth of women using these services become impoverished and one-fourth face catastrophic expenditure after utilization of ANC and delivery care. Social characteristics and seeking services from the local

health system are important factors causing women's financial burden that require policy integration to reduce the burden and move towards the implementation of universal health coverage in the country.

Key words: impoverishment, catastrophic payments, out-of-pocket payment, antenatal care, delivery care

Strengths and limitations of this study

- This study measured the level of impoverishment and catastrophic expenditure due to OOP payment for antenatal and delivery care and their determinants in Myanmar, which is a low-income country.
- Multistage sampling and a survey package of analysis were used to minimize the realistic standard errors.
- Direct and indirect expenditures for antenatal and delivery care in terms of societal perspective were collected.
- Recall bias might have occurred due to the data collection based on retrospective interviews.
- Self-reported household annual income and payments for healthcare services may have been slightly over- or under-reported.

Introduction

Worldwide, nearly 830 women die during pregnancy and childbirth every day, with most of them living in poor households having limited proper maternal health care.[1] Increasing utilization of maternal health services is one of the targets of Sustainable Development Goal 3.[2] Poverty or financial problems are the major barrier to accessibility and utilization of antenatal care (ANC) and delivery by skilled birth attendants (SBAs).[3] Even though the economic indicators of most countries in 2015 are better than in earlier years, there are still some countries which face financial barriers leading to worse health outcomes.[2]

Low socioeconomic level or high health care expenditures can lead to financial burdens, either impoverishment or catastrophic expenditure, which use different analyses and thresholds of burden.[4 5] Impoverishment is defined as 'a non-poor household is impoverished by health care payment when it became poor after health care payment'.[6] Catastrophic expenditure is defined as 'out-of-pocket (OOP) payment for health care that exceeds some estimated proportion of household income or a household's capacity to pay'.[7] Financial burdens from utilization of maternal health care have been previously reported in some African and Asian countries such as Ghana, Nepal, Bangladesh, and India.[8-11] In Myanmar, OOP payment for health services was high in public and private health facilities and accounted for more than 80% for total health expenditures of the country in 2012.[12] Only one study of OOP payments for maternal health care in Myanmar with percentage of catastrophic health expenditures in Myanmar was found[13], therefore, the evidence on impoverishment and catastrophic payments of ANC and delivery care and their determinants was limited.

Different countries have introduced different strategies to reduce financial burdens related to accessing necessary health care during pregnancy, child birth and the postpartum period.[14] Providing free maternal health services has been implemented in some low-income

countries, but various studies have found low utilization of these services as well as high maternal mortality and morbidity.[9 15 16] A study in Thailand found improvement of maternal health outcomes five years after the implementation of a universal coverage scheme with health finance reform.[17] Although some countries have begun to offer free health services or health insurance, the achievements in terms of reducing financial burdens remains limited.[14]

Similarly, Myanmar has begun a program providing free essential drugs and health care for maternal health services in both public facility-based and primary health care settings in recent years, but OOP payment while accessing these services has been reported.[12 18 19] In addition, reports on the actual financial burden in terms of impoverishment and catastrophic expenditure due to OOP payments are limited.[13] Understanding the determinants of financial burden in utilizing maternal health services is useful to identify the nature of the OOP payment situation and whether any determinants are modifiable or require policy improvement.[16 20 21] This study aimed to assess the levels of impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care in Yangon Region, Myanmar and explore the determinants of impoverishment and catastrophic expenditure.

Methods

Study design, participants and sampling method

This was a community-based cross-sectional survey conducted in Yangon Region of Myanmar during October and November 2016. According to the 2014 census report, Yangon region had the largest population among the regions of Myanmar.[22] The study recruited women of reproductive age (15-49 years) with a history of birth within the previous 12 months who were residents of the study area. Those who had mental retardation or serious illness were excluded. The required sample size for the first objective was calculated using the one-proportion formula based on a rate of 9% of pregnant women with catastrophic expenditure due to OOP payments in utilization of delivery care

from a previous study.[13 23] With a precision of 4%, type I error of 1%, non-response rate of 10% and design effect of 2, at least 750 women were required.

Three-stage cluster sampling was used to select eligible persons. For stage one, purposive selection of two districts among the four districts of Yangon region which covered both urban and rural populations was done. There were a total of 235 wards and 610 villages in the two districts. "Wards" and "villages" refer to urban and rural populations, respectively.[24] For stage two, 16 wards and 16 villages were randomly selected from all of the wards and villages. Households were selected regarding the number of households and a ratio of urban to rural population size in the districts considering the proportional probability sampling (PPS). For stage three, we randomly selected women who had delivered within the past 12 months in each household from selected wards and villages. For households with more than one eligible woman, one woman was selected randomly.

Patient and Public Involvement

Women and household members or the public were not involved in the development of the research questions, design of the study or recruitment. The results are not directly disseminated to study participants.

Variables

Impoverishment and catastrophic expenditure due to OOP payment for overall ANC and delivery care were the two main outcome variables in this study. OOP payments included all related healthcare services received during ANC and delivery care, namely hospital costs/investigation fees, drugs, consultation fees, food/living/transportation payments, productivity loss and other costs. The OOP payments were calculated for ANC and delivery care and then summed as total OOP payments for care. OOP payments for ANC were counted as the sum of all ANC visits. Impoverishment was defined as a household which was forced below the international poverty line

(counted as 1.9 US dollars (USD) per day purchasing power parity (PPP)) after paying for maternal health care services.[6 25] Catastrophic expenditure was defined as OOP payment for maternal health care services exceeding a threshold of 10% of a household's annual income.[26]

Independent variables included background characteristics of the women and their husbands and household information, accessibility of health services, characteristics of ANC and delivery care and details of services provided. Household annual income was recorded in Myanmar kyats and converted to US$ using the exchange rate of 1 USD equal to 1362.63 kyats. The information pertaining to accessibility to health services included availability of a health center, distance as measured in walking minutes (number of walking minutes from the woman's house to a formal health center) and types of transportation (women who used any transport to visit a health center). Characteristics of ANC and delivery care included complications during pregnancy and child birth and number of ANC visits. Details of services provided included health personnel, place of care, affordability, and OOP payments.

Data collection

Before the data collection began, 12 research assistants were trained in a two-day training workshop on how to conduct the interviews and check the information for completeness of data. The list of women was obtained from the township health departments and local authorities. The eligible women were visited at their home by the research team at the woman's convenience. After the study was explained and a consent form signed, the women were interviewed by the principal investigator and researchers using a pre-tested structured questionnaire in a private area. Each completed interview was checked promptly and daily for any errors and edited if required.

Statistical analysis

After data collection was complete, EpiData 3.1 was used to record the data in a double entry system and validate it, and R version 3.4.2 was used for data analysis.[27 28] Categorical variables are

presented by frequencies and percentages and continuous variables are shown in median with interquartile range.

The impoverishment was analyzed in terms of the poverty impact of poverty headcount and normalized poverty gap.[29 30] The poverty impact of the poverty headcount was calculated by subtracting pre-payment head count from post-payment head count. Similarly, the poverty impact of the normalized poverty gap was calculated by subtracting pre-payment normalized poverty gap from post-payment normalized poverty gap.[29] Poverty head count was defined as the proportion of households who had pre- or post-payment household annual income less than the defined poverty line. Normalized poverty gap was defined as the poverty gap divided by the poverty line. The poverty gap was calculated by the depth of payment below the poverty line. A Pen's parade graph between household income as a multiple of the poverty line (y axis) with cumulative proportion of the population ranked by household income (x axis) was plotted to show the number of non-poor households which became poor after OOP for pregnancy expenses as indicated by the vertical lines below the poverty line.

Catastrophic expenditure was analyzed in terms of the incidence, intensity and mean positive gap. Incidence was calculated by the proportion of households having catastrophic expenditure due to OOP payments for ANC or delivery care. Intensity was calculated by the proportion of OOP payments exceeding the threshold. The mean positive gap was calculated as intensity divided by incidence indicating the proportion of OOP payments for ANC and delivery care by the catastrophic household.[26 30]

The determinants of the incidences of impoverishment and catastrophic expenditure were analyzed using multiple logistic regression with the survey package to consider the design weight in cluster design. According to this analysis, the first-stage weight was calculated by the total number of wards and villages divided by the selected number of wards and villages by each district and the

second-stage weight was calculated by the total number of women divided by the selected number of women in each ward and village by each district. The final stage weight was calculated by multiplying the first stage and second stage weights.[31] The adjusted Odd Ratios (OR) and 95% confidence intervals were presented in the final models with the significance value less than 0.05.

Results

A total of 759 women were included in this study. More than two-thirds of the women lived in an urban area. Half of the women were aged 24- 35 years and 71% were housewives. More than two-thirds of their husbands had above primary school level education and 60% of them worked as daily wage-earners. Most of the households had less than five household members and 89% of them had an annual household income above 1275 US dollars (USD), and 60.3% of the households had debt. More than 80% of the women said that a health center was available for them to get ANC services within 30 minutes walking distance. Only 21.2% of the women had less than four ANC visits and 15% and 23% of them faced complications during pregnancy and child birth, respectively (Table 1).

Table 2 shows the details of the services used and payments of the women for ANC and delivery care. More than half (56.4%) met community health personnel for ANC followed by specialists (22.5%) and doctors/nurses (21.1%). Similar numbers had delivery by community health personnel (35.4%) or doctors/nurses (35.2%), with the rest by specialists (29.4%). Most of the women used public facilities for ANC (78%) and delivery care (65%). Almost all of the women said that they could afford the cost of each ANC visit and half could afford the cost of delivery care. OOP payments were made by 75% of the women for ANC and by 99.6% for delivery care. Hospital costs/investigation fees were highest for ANC and delivery care. Cost per each ANC visit was lower, but the total cost for all ANC visits was higher, than the total cost of delivery care.

Table 3 shows the level of impoverishment created by OOP payments for ANC and delivery care. The impact on poverty headcount after payment for overall ANC and delivery care was 7.9%

of which 5.7% was for ANC and 1.5% for delivery care. The impact of the normalized poverty gap was quite similar for ANC (1.3%) and for overall ANC and delivery care (1.4%). Individual pre-payment and post-payment income for OOP of overall ANC and delivery care is shown in a Pen's parade graph (Fig 1). Overall OOP payments for ANC and delivery care lead to some extent of poverty regardless of household income level. Table 4 presents the data on catastrophic expenditures due to OOP payments for ANC and delivery care. The incidence of catastrophic expenditure due to OOP payments for overall ANC and delivery care was 22.6%, and 14% for ANC and 9.5% for delivery care. The intensities and mean positive gaps of catastrophic expenditure due to OOP for overall ANC and delivery care were 11.2% and 49.6%, respectively.

The determinants of impoverishment and catastrophic expenditure due to OOP payment for ANC and delivery care are shown in Table 5. Woman's occupation, number of household members, number of ANC visits, different health personnel providing delivery services, and place of ANC received were the significant determinants of both impoverishment and catastrophic expenditure for overall ANC and delivery care. Using delivery services from a private facility was a significant determinant of impoverishment, but not of catastrophic expenditure.

Discussion

Approximately one in ten women accessing ANC and one-fourth of women delivering a baby in the study area faced impoverishment or catastrophic expenditure due to OOP payments. Women with a higher number of household members or increased use of ANC visits or who accessed specialists or private services were more likely to face impoverishment or catastrophic expenditure.

Even though free maternal healthcare services are nationally available, at least three-fourths of the women incurred OOP payments, which was the same as a previous study in Myanmar in 2015.[13] This finding was also similar to previous studies from India in 2004[20] and Nigeria in 2010[15], though the maternal health services considered and the methods of OOP measurement were

different. Similarly, a study of three African countries where free delivery care was available found that 90% of the women still paid some amount of OOP for their direct medical expenses.[32] A possible explanation might be due to the existence of high informal payments or some expenses not covering by health insurance.[12 13 15 20 32] The need to turn to OOP payments has been shown to influence the utilization of maternal health services and maternal mortality.[33] Importantly, another study reported that high OOP payments for maternal healthcare also lead households to impoverishment and catastrophic expenditure.[4]

The impoverishment rates in published studies vary depending on the methods used to measure health care expenditures and the poverty line thresholds used for calculating impoverishment. We used the international poverty line in 2011 of US$ 1.9 per day. A study from Nepal used the international standard from a different year (the international poverty line in 2005 of US$ 1 per day).[10] The poverty headcount due to the use of institutional delivery reported was 17% which was higher results than us. In contrast, a study in India used their local poverty line and found higher impoverishment due to maternal health care expenditure than the findings of our study.[34] Although Yangon region is the most developed region among the states and regions of Myanmar, a lot of non-poor households face impoverishment and deep poverty which could be explained by high maternal healthcare payments without a compensation scheme.[12 22] Two studies from India using data from 2004 and 2015 found that the impact of the poverty headcount for maternal healthcare expenditures was lower after introducing free services for delivery care in 2015.[34 35]

Likewise, variations in the incidence of catastrophic expenditure due to maternal health care expenditures depend on the different maternal services measured, whether household income or capacity to pay is considered, and the catastrophic expenditure threshold used. One fourth of women faced catastrophic expenditure due to OOP payment for ANC and delivery care in our

study, which was higher than an earlier study from Myanmar in 2015. This may be because the previous study measured catastrophic expenditure based only on OOP payments for delivery care, not ANC, and also only direct and indirect medical costs, not other costs or productivity loss.[13] Higher incidences of catastrophic expenditure due to OOP were reported in India and Ethiopia because poorer women were included and all ANC, delivery and postnatal care services were measured.[34 36] Prior studies from Africa and Bangladesh concluded that more than one third of women faced catastrophic expenditure due to OOP payments for emergency obstetric care because they were poor and were required to pay for drugs.[37-39]

Woman's occupation, number of household members, utilization of health personnel, number of ANC visits and place of care were associated with impoverishment and catastrophic expenditure due to OOP payments. A previous study could not identify a direct association between occupation and impoverishment and catastrophic expenditure. The significant association between woman's occupation and impoverishment and catastrophic expenditure found in our study could be explained by woman reduced working because of their pregnancy leading to lower household income. The number of household members increased the impoverishment and catastrophic expenditure in our study which was different from a previous study from India[21] which could be explained by lower sharing financial resources among household members of our study participants. The finding of higher rates of catastrophic expenditure in women with a higher number of ANC visits in our study was the same as a study in India which included women with low economic status.[40] Other studies have found that women who used a nearby health center or facilities having specialists and private facilities for ANC and delivery care where health insurance was not available were more likely to have impoverishment and catastrophic expenditure.[16 20 21 33 40 41]

Only one previous study from Myanmar in rural areas of a township in Ayeyarwaddy region measured catastrophic health expenditure resulting from maternal health care.[13] Our study included

both rural and urban areas of Yangon region, and provides important information on these factors for policy makers to help them consider financial burdens leading to impoverishment or catastrophic expenditure.

The study had some limitations. First, this was a cross sectional study, thus the causal relationship between the determinants and level of impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care could not be firmly identified. Second, household annual income and payments for healthcare services were self-reported, therefore, there may have been over- or under-reporting. Third, the payment of total ANC used the payment of last ANC visit and then multiplied by the total number of all visits. Fourth, recall bias might have occurred due to the data gathering through retrospective interviews. However, we included only women within 12 months of delivery to minimize the recall bias. Finally, the socioeconomic status of the people in the Yangon region is better than in other regions; therefore, the findings of this study are not likely representative of the entire country.

Conclusion

High OOP payments for using ANC and delivery care in the Yangon region of Myanmar resulted in one-tenth of the women becoming impoverished and one-fourth suffering a catastrophic expenditure. Women with no income or those who accessed health facilities with high levels of services provided were more likely to be impoverished or face catastrophic expenses.

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Contributors

All authors contributed to the concept and design of the study. ANMM and TL participated in data collection, data analysis, interpretation of the data, and preparation of the draft manuscript. TTH, MMW, JS and EB also assisted with interpretation of the data and commented on the draft MS. All authors read and approved the final manuscript.

Competing interests

The authors declare no competing interests.

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Ethical approval

Ethical clearances for the study were obtained from the Ethical Review Committee of Prince of Songkla University, Thailand, the Department of Medical Research, Myanmar and the Norwegian National Research Ethics Committee (NSD), Norway.

Data sharing statement

No additional data available. Original data without identity can be provided on request after the Ethical Review Committee of Prince of Songkla University are informed and approved.

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List of Tables and Figure

Table 1. Background characteristics of women and their husbands, household information, accessibility of health services and characteristics of ANC and delivery care (n=759)

Characteristic	n (%)
Women's characteristics	
Place of residence	
Urban	542 (72.4)
Rural	217 (28.6)
Age	
15-24 years	215 (28.3)
25-34 years	376 (49.5)
35-49 years	168 (22.1)
Occupation	
Housework	539 (71)
Any job	220 (29)
Husbands' characteristics	
Education	
Primary school and lower	242 (31.9)
More than primary school	517 (68.1)
Occupation	
Daily wage earner	455 (59.9)
Other	304 (40.1)
Household characteristics	
Number of household members	
> 5 members	276 (38.4)
3-5 members	483 (63.6)
Household annual income *	
≤ 1275 USD	83 (10.9)
> 1275 USD	676 (89.1)
Household debt	
No	301 (39.7)
Yes	458 (60.3)
Accessibility of health services	
Availability of health center	
No	123 (16.2)
Yes	636 (83.8)
Walking distance in minutes	
> 30 minutes	76 (10)
≤ 30 minutes	683 (90)
Type of transportation	
Car	79 (10.4)
Motorcycle	172 (22.7)
Walking	406 (53.3)

Other	102 (13.4)
Characteristics of ANC and delivery care	
Number of ANC visits	
1-3	161 (21.2)
4-6	262 (34.5)
> 6	336 (44.3)
Complication during pregnancy	
No	645 (85.0)
Yes	114 (15.0)
Complication during birth	
No	584 (76.9)
Yes	175 (23.1)

* World Bank data bank 2016

Table 2. Details of services used and payments of the women for ANC and delivery care (n=759)

	Antenatal care n (%)	Delivery care n (%)
Health personnel		
Community health personnel	428 (56.4)	269 (35.4)
Specialists	171 (22.5)	223 (29.4)
Doctors/Nurses	160 (21.1)	267 (35.2)
Place of care		
Public facilities	592 (78)	493 (65)
Private facilities	167 (22)	266 (35)
Affordability (per visit/delivery)		
No	26 (3.4)	338 (44.5)
Yes	733 (96.6)	421 (55.5)
Out of pocket payments		
No	186 (24.5)	3 (0.4)
Yes	573 (75.5)	756 (99.6)
Categories of health care cost (per visit/delivery)	**(n=573)**	**(n=756)**
Hospital cost/Investigation fees	0.73 (0-80.8)	7.34 (0-1247.6)
Drugs	0 (0-40.4)	0 (0-587.1)
Consultation fees	0 (0-23.9)	0 (0-440.3)
Food/Travel/Living cost	0.57 (0-73.4)	2.94 (0-1027.4)
Productivity loss	0 (0-117.4)	0 (0-1174.2)
Other expenses	0 (0-29.4)	0 (0-220.2)
Sum of costs	6.17 (0-862.3)	84.4 (0-2305.1)
Total out of pocket payment of care	31.7 (0-12072.2)	84.4 (0-2305.1)

Table 3. Impoverishment due to OOP payments for ANC and delivery care

		Antenatal care		**Delivery care**		**Overall antenatal and delivery care**	
	Prepayment	Post payment	Impact	Post payment	Impact	Post payment	Impact
Poverty headcount	2.4%	8.1%	5.7%	3.8%	1.5%	10.3%	7.9%
Normalized poverty gap	0.01%	1.32%	1.31%	0.53%	0.52%	1.44%	1.43%

Table 4. Catastrophic expenditures due to OOP payments for ANC and delivery care

Catastrophic expenditure	Antenatal care (%)	Delivery care (%)	Overall antenatal and delivery care (%)
Incidence	14.0	9.5	22.6
Intensity	7.7	2.0	11.2
Mean positive gap	54.7	20.8	49.6

Table 5. Determinants of impoverishment and catastrophic expenditure due to OOP payments

Characteristic	Impoverishment Adjusted OR (95 % Cl)	Catastrophic expenditure Adjusted OR (95 % Cl)
Woman's occupation		
Any job (reference category)	1	1
Housework	2.53 (1.22-5.25)*	2.08 (1.16-3.73)*
Number of household members		
> 5 members (reference category)	1	1
3-5 members	6.03 (2.57-14.15)***	6.75 (3.89-11.70)***
Number of ANC visits		
1-3 (reference category)	1	1
4-6	1.32 (0.41-4.23)	2.32 (1.13-4.75)*
> 6	5.84 (2.20-15.15)***	6.41 (3.40-12.11)***
Health personnel for delivery care		
Community health personnel (reference category)	1	1
Specialists	3.74 (1.55-9.00)**	3.94 (1.97-7.86)***
Doctors/Nurses	1.96 (0.74-5.19)	2.90 (1.50-7.62)**
Place of antenatal care		
Public facilities (reference category)	1	1
Private facilities	2.18 (1.07-4.45)*	2.20 (1.30-3.71)**
Place of delivery care		
Public facilities (reference category)	1	
Private facilities	2.70 (1.23-5.91)*	

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

OR : Odds Ratio

CI : Confidence Interval

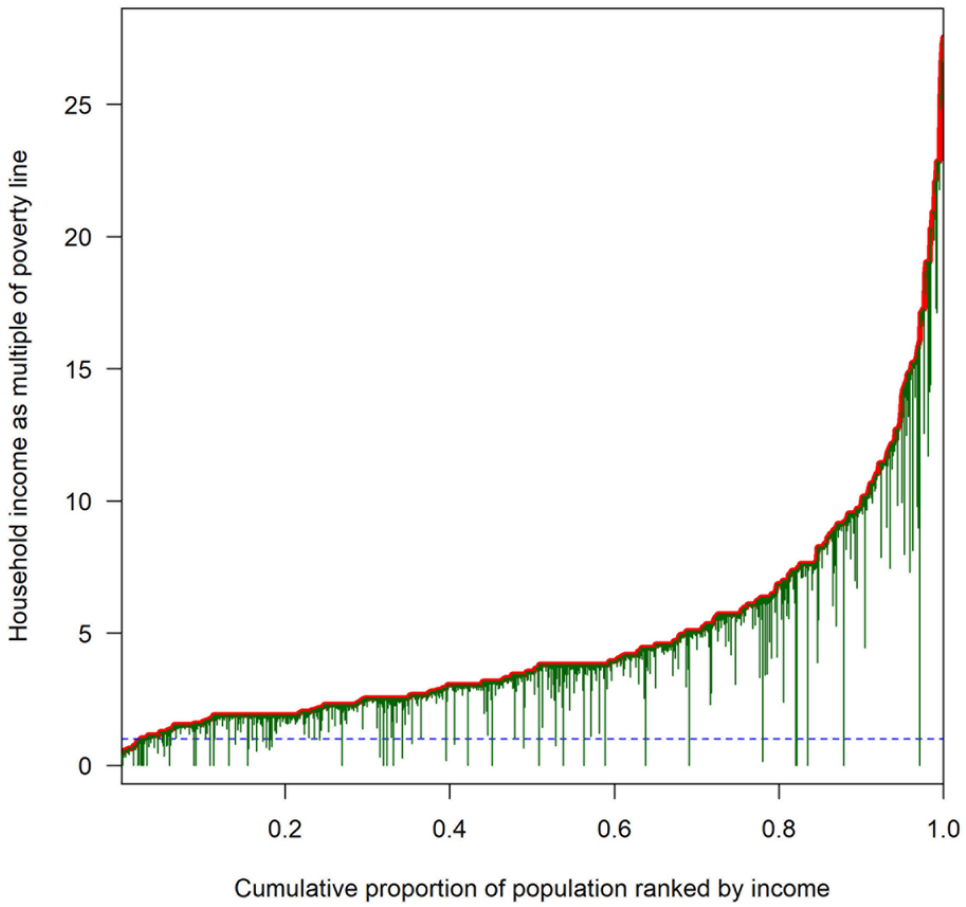

Figure 1. Pen's parade of pre- and post-payment income of overall antenatal and delivery care
Legend

Pre-payment income Post-payment income
Income based poverty line

80x81mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-10
		(*b*) Report category boundaries when continuous variables were categorized	10
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Impoverishment and catastrophic expenditures due to out-of-pocket payments for antenatal and delivery care and their determinants in Yangon region, Myanmar: a cross-sectional study

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Impoverishment and catastrophic expenditures due to out-of-pocket payments for antenatal and delivery care and their determinants in Yangon region, Myanmar: a cross-sectional study

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Abstract (297 words)

Objectives: To assess the levels of impoverishment and catastrophic expenditure due to out-of-pocket (OOP) payments for antenatal care (ANC) and delivery care in Yangon Region, Myanmar and explore their determinants.

Design, setting and participants: A community-based cross-sectional survey among women giving birth within the past 12 months in Yangon, Myanmar was conducted during October-November 2016 using three-stage cluster sampling.

Outcome measures: Poverty impact of out-of-pocket payments measured by the differences between the pre-payment and post-payment headcount ratio and normalized poverty gap was used to assess impoverishment with a poverty threshold of US$1.9. Out-of-pocket payments exceeding 10% of household annual income were used to assess catastrophic expenditure incidence and intensity. The determinants of impoverishment and catastrophic expenditure due to OOP payments in the utilization of ANC and delivery care were analyzed using multiple logistic regression analysis in a survey package.

Results: Of 759 women, out-of-pocket payments were made by 75% of the women for ANC and 99.6% for delivery care. The impact of these payments increased the poverty headcount ratio by 5.7% among women using the ANC services, 1.5% among those using delivery care and 7.9% among those using both ANC and delivery care. Similarly, these payments reflected the incidence of catastrophic expenditure by 14%, 9.5%, and 22.6%, respectively. The determinants of impoverishment and catastrophic expenditure were women's occupation, number of household members, number of ANC visits, and utilization of skilled health personnel and health facilities.

Conclusions: Out-of-pocket payment for all ANC and delivery care is a challenge as one-tenth of women using these services become impoverished and one-fourth face catastrophic expenditure after utilization of ANC and delivery care. Policy integration was required to reduce women's

financial burden of seeking maternal health services relating social characteristics and move towards the implementation of universal health coverage in the country.

Key words: impoverishment, catastrophic payments, out-of-pocket payment, antenatal care, delivery care

Strengths and limitations of this study

- This study measured the level of impoverishment and catastrophic expenditure due to OOP payment for antenatal and delivery care and their determinants in Myanmar, which is a low-income country.
- Multistage sampling and the analysis using a survey package applied in this study could minimize the standard errors and better precision of an estimate of the samples.
- Potentially direct and indirect expenditures occurred during the utilization of antenatal and delivery care which presented the real situation were declared.
- Recall bias might have occurred due to the data collection based on retrospective interviews.
- Self-reported household annual income and payments for healthcare services may have been slightly over- or under-reported.

Introduction

Worldwide, nearly 830 women die during pregnancy and childbirth every day, with most of them living in poor households having limited proper maternal health care.[1] Increasing utilization of maternal health services is one of the targets of Sustainable Development Goal 3.[2] Poverty or financial problems are the major barrier to accessibility and utilization of antenatal care (ANC) and delivery by skilled birth attendants (SBAs).[3] Even though the economic indicators of most countries in 2015 are better than in earlier years, there are still some countries which face financial barriers leading to worse health outcomes.[2]

Low socioeconomic level or high health care expenditures can lead to financial burdens, either impoverishment or catastrophic expenditure, which use different analyses and thresholds of burden.[4 5] Impoverishment is defined as a non-poor household becomes poor after paying for health care.[6] Catastrophic expenditure is defined as 'out-of-pocket (OOP) payment for health care that exceeds some estimated proportion of household income or a household's capacity to pay'.[7] Financial burdens from utilization of maternal health care have been previously reported in some African and Asian countries such as Ghana, Nepal, Bangladesh, and India.[8-11] In Myanmar, OOP payment for health services was high in public and private health facilities and accounted for more than 80% for total health expenditures of the country in 2012.[12] Only one study of OOP payments for maternal health care in Myanmar with percentage of catastrophic health expenditures in Myanmar was found[13], therefore, the evidence on impoverishment and catastrophic payments of ANC and delivery care and their determinants was limited.

Different countries have introduced different strategies to reduce financial burdens related to accessing necessary health care during pregnancy, child birth and the postpartum period.[14] Providing free maternal health services has been implemented in some low-income countries, but various studies have found low utilization of these services as well as high maternal mortality and

morbidity.[9 15 16] A study in Thailand found improvement of maternal health outcomes five years after the implementation of a universal coverage scheme with health finance reform.[17] Although some countries have begun to offer free health services or health insurance, the achievements in terms of reducing financial burdens remains limited.[14]

Similarly, Myanmar has begun a program providing free essential drugs and health care for maternal health services in both public facility-based and primary health care settings in recent years, but OOP payment while accessing these services has been reported.[12 18 19] In addition, reports on the actual financial burden in terms of impoverishment and catastrophic expenditure due to OOP payments are limited.[13] Understanding the determinants of financial burden in utilizing maternal health services is useful to identify the nature of the OOP payment situation and whether any determinants are modifiable or require policy improvement.[16 20 21] This study aimed to assess the levels of impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care in Yangon Region, Myanmar and explore the determinants of impoverishment and catastrophic expenditure.

Methods

Study design, participants and sampling method

This was a community-based cross-sectional survey conducted in Yangon Region of Myanmar during October and November 2016. According to the 2014 census report, Yangon region had the largest population among the regions of Myanmar.[22] The study recruited women of reproductive age (15-49 years) with a history of birth within the previous 12 months who were residents of the study area. Those who had mental retardation or serious illness were excluded. The required sample size for the first objective was calculated using the one-proportion formula based on a rate of 9% of pregnant women with catastrophic expenditure due to OOP payments in utilization of

delivery care from a previous study.[13 23] With a precision of 4%, type I error of 1%, non-response rate of 10% and design effect of 2, at least 750 women were required.

Three-stage cluster sampling was used to select eligible persons. For stage one, purposive selection of two districts among the four districts of Yangon region which covered both urban and rural populations was done. There were a total of 235 wards and 610 villages in the two districts. "Wards" and "villages" refer to urban and rural populations, respectively.[24] For stage two, 16 wards and 16 villages were randomly selected from all of the wards and villages. Households were selected regarding the number of households and a ratio of urban to rural population size in the districts considering the proportional probability sampling (PPS). For stage three, we randomly selected women who had delivered within the past 12 months in each household from selected wards and villages. For households with more than one eligible woman, one woman was selected randomly.

Outcome and independent variables

Impoverishment and catastrophic expenditure due to OOP payment for overall ANC and delivery care were the two main outcome variables in this study. OOP payments included the expenses on all related healthcare services received during ANC and delivery care, namely hospital costs/investigation fees, drugs, consultation fees, food/living/transportation payments, productivity loss and other costs. The OOP payments were calculated for ANC and delivery care and then summed as total OOP payments for care. OOP payments for ANC were counted as the sum of all ANC visits. Impoverishment was defined as a situation where a household fell below the international poverty line (1.9 US dollars in PPP) after paying for maternal health care services.[6 25] Catastrophic expenditure was defined as OOP payment for maternal health care services exceeding a threshold of 10% of a household's annual income.[26]

Independent variables included background characteristics of the women and their husbands and household information, accessibility of health services, characteristics of ANC and delivery care and details of services provided. Household annual income was classified into ≤ 1275 USD or >1275 USD according to GDP per capita of Myanmar from the data of World Bank 2016. The household annual income was recorded in Myanmar kyats and converted to US$ using the exchange rate of 1 USD equal to 1362.63 kyats. The information pertaining to accessibility to health services included availability of a health center, distance as measured in walking minutes (number of walking minutes from the woman's house to a formal health center) and types of transportation (women who used any transport to visit a health center). Characteristics of ANC and delivery care included complications during pregnancy and child birth and number of ANC visits. Details of services provided included health personnel, place of care, affordability, and OOP payments.

Data collection

Before the data collection began, 12 research assistants were trained in a two-day training workshop on how to conduct the interviews and check the information for completeness of data. The list of women was obtained from the township health departments and local authorities. The eligible women were visited at their home by the research team at the woman's convenience. After the study was explained and a consent form signed, the women were interviewed by the principal investigator and researchers using a pre-tested structured questionnaire in a private area. Each completed interview was checked promptly and daily for any errors and edited if required.

Statistical analysis

After data collection was complete, EpiData 3.1 was used to record the data in a double entry system and validate it, and R version 3.4.2 was used for data analysis.[27 28] Categorical variables

are presented by frequencies and percentages and continuous variables are shown in median with interquartile range.

The impoverishment was measured by the poverty impact of OOP payment which was calculated by the differences between the pre-payment and post-payment headcount ratio and normalized poverty gap.[29 30] We considered the maternal health care services from ANC to delivery care and the pre-payment period was counted at one point before utilizing the ANC, thus the pre-payment headcount ratio and normalized poverty gap for ANC and delivery care was the same value. Pre-payment and post-payment headcount ratio was measured by the proportion of households having household annual income below the poverty line before and after the women using the ANC and delivery care, respectively. Normalized poverty gap was calculated by the depth of OOP payment below the poverty line divided by the poverty line. A Pen's parade graph between household income as a multiple of the poverty line (y axis) with cumulative proportion of the population ranked by household income (x axis) was plotted to show the number of non-poor households which became poor after OOP for pregnancy expenses as indicated by the vertical lines below the poverty line. Catastrophic expenditure was measured by the incidence and intensity. Incidence was calculated by the proportion of households who face catastrophic expenditure due to OOP payments for ANC or delivery care. Intensity was calculated by the proportion of OOP payments for ANC and delivery care exceeding the 10% threshold of household's annual income.[26 30]

The determinants of the incidences of impoverishment and catastrophic expenditure were analyzed by multiple logistic regression model using the survey package which the design weight is considered for a cluster sampling. For analyzing the weighted samples, the first-stage weight was calculated by the total number of wards and villages divided by the selected number of wards and villages by each district and the second-stage weight was calculated by the total number of

women divided by the selected number of women in each ward and village by each district. The final stage weight was calculated by multiplying the first stage and second stage weights.[31] The adjusted Odd Ratios (OR) and 95% confidence intervals were presented in the final models with the significance value less than 0.05.

Results

A total of 759 women were included in this study. More than two-thirds of the women lived in an urban area. Half of the women were aged 24- 35 years and 71% were housewives. More than two-thirds of their husbands had above primary school level education and 60% of them worked as daily wage-earners. Most of the households had less than five household members and 89% of them had an annual household income above 1275 US dollars (USD), and 60.3% of the households had debt. More than 80% of the women said that a health center was available for them to get ANC services within 30 minutes walking distance. Only 21.2% of the women had less than four ANC visits and 15% and 23% of them faced complications during pregnancy and child birth, respectively (Table 1).

Table 2 shows the details of the services used and payments of the women for ANC and delivery care. More than half (56.4%) met community health personnel for ANC followed by specialists (22.5%) and doctors/nurses (21.1%). Similar numbers had delivery by community health personnel (35.4%) or doctors/nurses (35.2%), with the rest by specialists (29.4%). Most of the women used public facilities for ANC (78%) and delivery care (65%). Almost all of the women said that they could afford the cost of each ANC visit and half could afford the cost of delivery care. OOP payments were made by 75% of the women for ANC and by 99.6% for delivery care. Hospital costs/investigation fees were highest for ANC and delivery care. Cost per each ANC visit was lower, but the total cost for all ANC visits was higher, than the total cost of delivery care.

Table 3 shows impoverishment due to OOP payments for ANC and delivery care. The impact on poverty headcount ratio after payment of ANC and delivery care was increased by 7.9% of which 5.7% was for ANC and 1.5% for delivery care. The impact of the normalized poverty gap was quite similar for ANC (1.3%) and for overall ANC and delivery care (1.4%). Individual pre-payment and post-payment income for OOP of overall ANC and delivery care is shown in a Pen's parade graph (Fig 1). Overall OOP payments for ANC and delivery care lead to some extent of poverty regardless of household income level. Table 4 presents the data on catastrophic expenditures due to OOP payments for ANC and delivery care. The incidence of households facing catastrophic expenditure due to OOP payments for ANC, delivery care and overall ANC and delivery care were 14%, 9.5% and 22.6%, respectively. Intensities of catastrophic expenditures was found in the utilizing ANC more than delivery care.

The determinants of impoverishment and catastrophic expenditure due to OOP payment for ANC and delivery care are shown in Table 5. Housewives, lower number of household members and high costs of payment by increasing number of ANC visits, delivery care by specialists, private health facilities were positively associated with both impoverishment and catastrophic expenditure for overall ANC and delivery care. Using delivery services from a private facility with high payment comparing to public facilities was a significant determinant of impoverishment, but not of catastrophic expenditure.

Discussion

Approximately one in ten women accessing ANC and one-fourth of women delivering a baby in the study area faced impoverishment or catastrophic expenditure due to OOP payments. Women with a higher number of household members or increased use of ANC visits or who accessed specialists or private services were more likely to face impoverishment or catastrophic expenditure.

Even though free maternal healthcare services are nationally available, at least three-fourths of the women incurred OOP payments, which was the same as a previous study in Myanmar in 2015.[13] This finding was also similar to previous studies from India in 2004[20] and Nigeria in 2010[15], though the maternal health services considered and the methods of OOP measurement were different. Similarly, a study of three African countries where free delivery care was available found that 90% of the women still paid some amount of OOP for their direct medical expenses.[32] A possible explanation might be due to the existence of high informal payments or some expenses not covering by health insurance.[12 13 15 20 32] The need to turn to OOP payments has been shown to influence the utilization of maternal health services and maternal mortality.[33] Importantly, another study reported that high OOP payments for maternal healthcare also lead households to impoverishment and catastrophic expenditure.[4]

The impoverishment rates in published studies vary depending on the methods used to measure health care expenditures and the poverty line thresholds used for calculating impoverishment. We used the international poverty line in 2011 of US$ 1.9 per day. A study from Nepal used the international standard from a different year (the international poverty line in 2005 of US$ 1 per day).[10] The poverty headcount ratio due to the use of institutional delivery reported was 17% which was higher results than us. In contrast, a study in India used their local poverty line and found higher impoverishment due to maternal health care expenditure than the

findings of our study.[34] Although Yangon region is the most developed region among the states and regions of Myanmar, a lot of non-poor households face impoverishment and deep poverty which could be explained by high maternal healthcare payments without a compensation scheme.[12 22] Two studies from India using data from 2004 and 2015 found that the impact of the poverty headcount ratio for maternal healthcare expenditures was lower after introducing free services for delivery care in 2015.[34 35]

Likewise, variations in the incidence of catastrophic expenditure due to maternal health care expenditures depend on the different maternal services measured, whether household income or capacity to pay is considered, and the catastrophic expenditure threshold used. One fourth of women faced catastrophic expenditure due to OOP payment for ANC and delivery care in our study, which was higher than an earlier study from Myanmar in 2015. This may be because the previous study measured catastrophic expenditure based only on OOP payments for delivery care, not ANC, and also only direct and indirect medical costs, not other costs or productivity loss.[13] Higher incidences of catastrophic expenditure due to OOP were reported in India and Ethiopia because poorer women were included and all ANC, delivery and postnatal care services were measured.[34 36] Prior studies from Africa and Bangladesh concluded that more than one third of women faced catastrophic expenditure due to OOP payments for emergency obstetric care because they were poor and were required to pay for drugs.[37-39]

Woman's occupation, number of household members, utilization of health personnel, number of ANC visits and place of care were associated with impoverishment and catastrophic expenditure due to OOP payments. A previous study could not identify a direct association between occupation and impoverishment and catastrophic expenditure. The significant association between woman's occupation and impoverishment and catastrophic expenditure found in our study could be explained by woman reduced working because of their pregnancy

leading to lower household income. The number of household members increased the impoverishment and catastrophic expenditure in our study which was different from a previous study from India[21] which could be explained by lower sharing financial resources among household members of our study participants. The finding of higher rates of catastrophic expenditure in women with a higher number of ANC visits in our study was the same as a study in India which included women with low economic status.[40] Other studies have found that women who used a nearby health center or facilities having specialists and private facilities for ANC and delivery care where health insurance was not available were more likely to have impoverishment and catastrophic expenditure.[16 20 21 33 40 41]

Only one previous study from Myanmar in rural areas of a township in Ayeyarwaddy region measured catastrophic health expenditure resulting from maternal health care.[13] Our study included both rural and urban areas of Yangon region, and provides important information on these factors for policy makers to help them consider financial burdens leading to impoverishment or catastrophic expenditure.

The study had some limitations. First, this was a cross sectional study, thus the causal relationship between the determinants and level of impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care could not be firmly identified. Second, household annual income and payments for healthcare services were self-reported, therefore, there may have been over- or under-reporting. Third, the payment of total ANC used the payment of last ANC visit and then multiplied by the total number of all visits. Fourth, recall bias might have occurred due to the data gathering through retrospective interviews. However, we included only women within 12 months of delivery to minimize the recall bias. Finally, the socioeconomic status of the people in the Yangon region is better than in other regions; therefore, the findings of this study are not likely representative of the entire country.

Conclusion

High OOP payments for using ANC and delivery care in the Yangon region of Myanmar resulted in one-tenth of the women becoming impoverished and one-fourth suffering a catastrophic expenditure. Women with no income or those who accessed health facilities with high levels of services provided were more likely to be impoverished or face catastrophic expenses.

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Contributors

All authors contributed to the concept and design of the study. ANMM and TL participated in data collection, data analysis, interpretation of the data, and preparation of the draft manuscript. TTH, MMW, JS and EB also assisted with interpretation of the data and commented on the draft MS. All authors read and approved the final manuscript.

Competing interests

The authors declare no competing interests.

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Ethical approval

Ethical clearances for the study were obtained from the Ethical Review Committee of Prince of Songkla University, Thailand, the Department of Medical Research, Myanmar and the Norwegian National Research Ethics Committee (NSD), Norway.

Patient and Public Involvement

Women and household members or the public were not involved in the development of the research questions, design of the study or recruitment. The results are not directly disseminated to study participants.

Data sharing statement

No additional data available. Original data without identity can be provided on request after the Ethical Review Committee of Prince of Songkla University are informed and approved.

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List of Tables and Figure

Table 1. Background characteristics of women and their husbands, household information, accessibility of health services and characteristics of ANC and delivery care (n=759)

Characteristic	n (%)
Women's characteristics	
Place of residence	
Urban	542 (72.4)
Rural	217 (28.6)
Age	
15-24 years	215 (28.3)
25-34 years	376 (49.5)
35-49 years	168 (22.1)
Occupation	
Housework	539 (71)
Any job	220 (29)
Husbands' characteristics	
Education	
Primary school and lower	242 (31.9)
More than primary school	517 (68.1)
Occupation	
Daily wage earner	455 (59.9)
Other	304 (40.1)
Household characteristics	
Number of household members	
> 5 members	276 (38.4)
3-5 members	483 (63.6)
Household annual income	
≤ 1275 USD	83 (10.9)
> 1275 USD	676 (89.1)
Household debt	
No	301 (39.7)
Yes	458 (60.3)
Accessibility of health services	
Availability of health center	
No	123 (16.2)
Yes	636 (83.8)
Walking distance in minutes	
> 30 minutes	76 (10)
≤ 30 minutes	683 (90)
Type of transportation	
Car	79 (10.4)
Motorcycle	172 (22.7)

Walking	406 (53.3)
Other	102 (13.4)
Characteristics of ANC and delivery care	
Number of ANC visits	
1-3	161 (21.2)
4-6	262 (34.5)
> 6	336 (44.3)
Complication during pregnancy	
No	645 (85.0)
Yes	114 (15.0)
Complication during birth	
No	584 (76.9)
Yes	175 (23.1)

Table 2. Details of services used and payments of the women for ANC and delivery care (n=759)

	Antenatal care n (%)	Delivery care n (%)
Health personnel		
Community health personnel	428 (56.4)	269 (35.4)
Specialists	171 (22.5)	223 (29.4)
Doctors/Nurses	160 (21.1)	267 (35.2)
Place of care		
Public facilities	592 (78)	493 (65)
Private facilities	167 (22)	266 (35)
Affordability (per visit/delivery)		
No	26 (3.4)	338 (44.5)
Yes	733 (96.6)	421 (55.5)
Out-of-pocket payments		
No	186 (24.5)	3 (0.4)
Yes	573 (75.5)	756 (99.6)
Categories of health care cost (per visit/delivery)	**(n=573)**	**(n=756)**
Hospital cost/Investigation fees	0.73 (0-80.8)	7.34 (0-1247.6)
Drugs	0 (0-40.4)	0 (0-587.1)
Consultation fees	0 (0-23.9)	0 (0-440.3)
Food/Travel/Living cost	0.57 (0-73.4)	2.94 (0-1027.4)
Productivity loss	0 (0-117.4)	0 (0-1174.2)
Other expenses	0 (0-29.4)	0 (0-220.2)
Sum of costs	6.17 (0-862.3)	84.4 (0-2305.1)
Total out-of-pocket payment of care	31.7 (0-12072.2)	84.4 (0-2305.1)

Table 3. Impoverishment due to OOP payments for ANC and delivery care

	Before utilizing ANC or delivery care	**Antenatal care**		**Delivery care**		**Overall antenatal and delivery care**	
	Pre-payment (%)	Post-payment (%)	Impact (%)	Post-payment (%)	Impact (%)	Post-payment (%)	Impact (%)
Poverty headcount ratio	2.4	8.1	5.7	3.8	1.5	10.3	7.9
Normalized poverty gap	0.01	1.32	1.31	0.53	0.52	1.44	1.43

Table 4. Catastrophic expenditures due to OOP payments for ANC and delivery care

Catastrophic expenditure	Antenatal care	Delivery care	Overall antenatal and delivery care
Incidence (%)	14.0	9.5	22.6
Intensity (%)	7.7	2.0	11.2

Table 5. Determinants of impoverishment and catastrophic expenditure due to OOP payments

Characteristic	Impoverishment Adjusted OR (95 % Cl)	Catastrophic expenditure Adjusted OR (95 % Cl)
Woman's occupation		
Any job (reference category)	1	1
Housework	2.53 (1.22-5.25)*	2.08 (1.16-3.73)*
Number of household members		
> 5 members (reference category)	1	1
3-5 members	6.03 (2.57-14.15)***	6.75 (3.89-11.70)***
Number of ANC visits		
1-3 (reference category)	1	1
4-6	1.32 (0.41-4.23)	2.32 (1.13-4.75)*
> 6	5.84 (2.20-15.15)***	6.41 (3.40-12.11)***
Health personnel for delivery care		
Community health personnel (reference category)	1	1
Specialists	3.74 (1.55-9.00)**	3.94 (1.97-7.86)***
Doctors/Nurses	1.96 (0.74-5.19)	2.90 (1.50-7.62)**
Place of antenatal care		
Public facilities (reference category)	1	1
Private facilities	2.18 (1.07-4.45)*	2.20 (1.30-3.71)**
Place of delivery care		
Public facilities (reference category)	1	
Private facilities	2.70 (1.23-5.91)*	

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

OR : Odds Ratio

CI : Confidence Interval

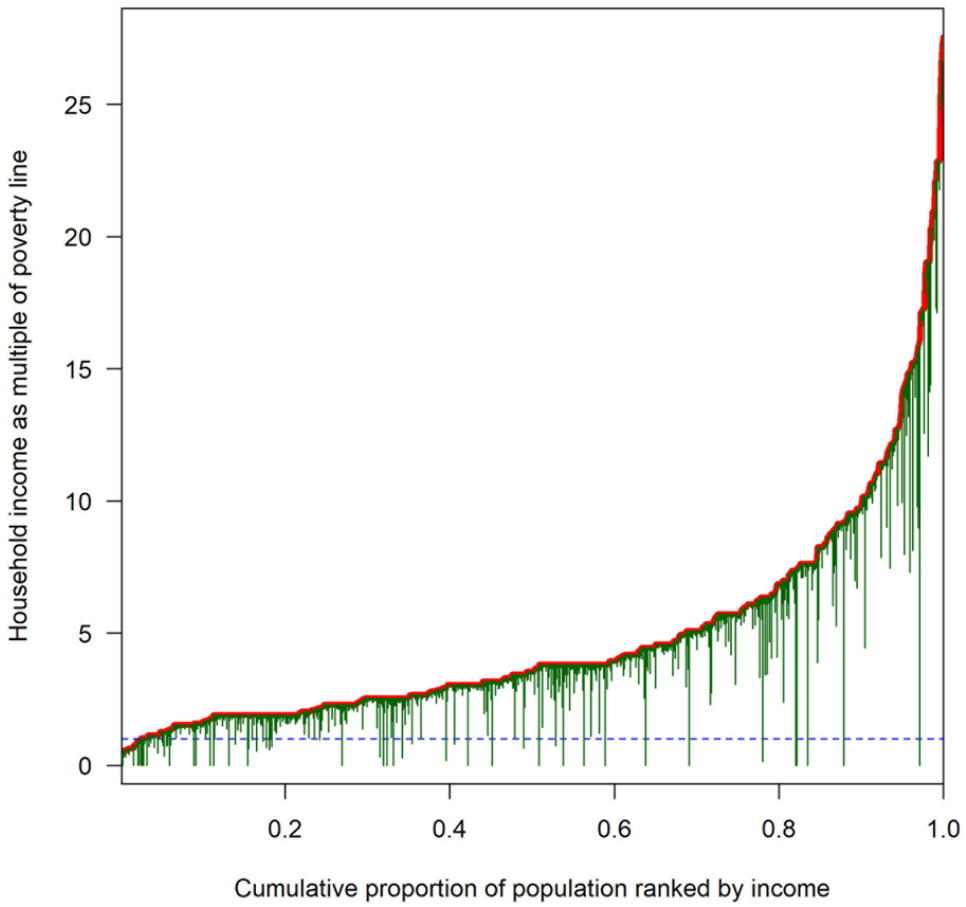

Figure 1. Pen's parade of pre- and post-payment income of overall antenatal and delivery care
Legend

Pre-payment income Post-payment income
Income based poverty line

80x81mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-9
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8-9
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-10
		(*b*) Report category boundaries when continuous variables were categorized	9-10
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Impoverishment and catastrophic expenditures due to out-of-pocket payments for antenatal and delivery care in Yangon region, Myanmar: a cross-sectional study

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Impoverishment and catastrophic expenditures due to out-of-pocket payments for antenatal and delivery care in Yangon region, Myanmar: a cross-sectional study

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Abstract (249 words)

Objectives: (i) To assess the levels of impoverishment and catastrophic expenditure due to out-of-pocket (OOP) payments for antenatal care (ANC) and delivery care in Yangon Region, Myanmar; and (ii) to explore the determinants of impoverishment and catastrophic expenditure.

Design, setting and participants: A community-based cross-sectional survey among women giving birth within the past 12 months in Yangon, Myanmar was conducted during October-November 2016 using three-stage cluster sampling procedure.

Outcome measures: Poverty headcount ratio, normalized poverty gap and catastrophic expenditure incidence due to OOP payments in the utilization of ANC and delivery care were the main outcomes. The determinants of impoverishment and catastrophic expenditure were analyzed using multiple logistic regression analysis.

Results: Of 759 women, out-of-pocket payments were made by 75% of the women for ANC and 99.6% for delivery care. The changes of poverty headcount ratio after payments were shown by 4.3% among women using the ANC services, 1.3% among those using delivery care and 6.1% among those using both ANC and delivery care. The incidences of catastrophic expenditure after payments were found by 12% for ANC, 9.1% for delivery care, and 20.9% for both ANC and delivery care. The determinants of impoverishment and catastrophic expenditure were women's occupation, number of household members, number of ANC visits, and utilization of skilled health personnel and health facilities.

Conclusions: Out-of-pocket payment for all ANC and delivery care is a challenge as one-tenth of women using these services become impoverished and one-fourth face catastrophic expenditure after utilization of ANC and delivery care.

Keywords: impoverishment, catastrophic expenditure, out-of-pocket payment, antenatal care, delivery care

Strengths

- This study measured impacts of OOP payments for antenatal and delivery care on levels of impoverishment and catastrophic expenditure in Myanmar, one of the few studies on this issue in a low-income country. Other determinants of impoverishment and catastrophic expenditure were also analyzed using logistic regression and found to be important.
- Multistage sampling design and the use of adjusted standard errors in the analysis minimized the bias and provided more precise estimates.
- The factors related in terms of social determinants of OOP payments for antenatal and delivery care were collected in this study.

Limitations

- The data on the expenditure of antenatal and delivery care were obtained by women's self-reported experiences, which could have resulted in some recall bias.
- Household annual income and payments for healthcare services were self-reported, therefore, there may have been over- or under-reporting.

Introduction

Worldwide, nearly 830 women die during pregnancy and childbirth every day, with most of them living in poor households having limited proper maternal health care.[1] Increasing utilization of maternal health services is one of the targets of Sustainable Development Goal 3.[2] Poverty or financial problems are the major barrier to accessibility and utilization of antenatal care (ANC) and delivery by skilled birth attendants (SBAs).[3] Even though the economic indicators of most countries in 2015 are better than in earlier years, there are still some countries which face financial barriers leading to worse health outcomes.[2]

Low socioeconomic level or high health care expenditures can lead to financial burdens, either impoverishment or catastrophic expenditure, which use different analyses and thresholds of burden.[4 5] Financial burdens from utilization of maternal health care have been previously reported in some African and Asian countries such as Ghana, Nepal, Bangladesh, and India.[6-9] In Myanmar, OOP payment for health services was high in public and private health facilities and accounted for more than 80% for total health expenditures of the country in 2012.[10] Only one study of OOP payments for maternal health care in Myanmar with percentage of catastrophic health expenditures in Myanmar was found[11], therefore, the evidence on impoverishment and catastrophic payments of ANC and delivery care and their determinants was limited.

Different countries have introduced different strategies to reduce financial burdens related to accessing necessary health care during pregnancy, child birth and the postpartum period.[12] Providing free maternal health services has been implemented in some low-income countries, but various studies have found low utilization of these services as well as high maternal mortality and morbidity.[7 13 14] A study in Thailand found improvement of maternal health outcomes five years after the implementation of a universal coverage scheme with health finance reform.[15] Although

some countries have begun to offer free health services or health insurance, the achievements in terms of reducing financial burdens remains limited.[12]

Similarly, Myanmar has begun a program providing free essential drugs and health care for maternal health services in both public facility-based and primary health care settings in recent years, but OOP payment while accessing these services has been reported.[10 16 17] In addition, reports on the actual financial burden in terms of impoverishment and catastrophic expenditure due to OOP payments are limited.[11] Understanding the determinants of financial burden in utilizing maternal health services is useful to identify the nature of the OOP payment situation and whether any determinants are modifiable or require policy improvement.[14 18 19] This study aimed to assess the levels of impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care in Yangon Region, Myanmar and explore the determinants of impoverishment and catastrophic expenditure.

Methods

Study design, participants and sampling method

This was a community-based cross-sectional survey conducted in Yangon Region of Myanmar during October and November 2016. According to the 2014 census report, Yangon region had the largest population among the regions of Myanmar.[20] The study recruited women of reproductive age (15-49 years) with a history of birth within the previous 12 months who were residents of the study area. Those who had mental retardation or serious illness were excluded. The required sample size for the first objective was calculated using the one-proportion formula based on a rate of 9% of pregnant women with catastrophic expenditure due to OOP payments in utilization of delivery care from a previous study.[11 21] With a precision of 4%, type I error of 1%, non-response rate of 10% and design effect of 2, at least 750 women were required.

Three-stage cluster sampling was used to select eligible persons. For stage one, purposive selection of two districts among the four districts of Yangon region which covered both urban and rural populations was done. There were a total of 235 wards and 610 villages in the two districts. "Wards" and "villages" refer to urban and rural populations, respectively.[22] For stage two, 16 wards and 16 villages were randomly selected from all of the wards and villages. Households were selected regarding the number of households and a ratio of urban to rural population size in the districts considering the proportional probability sampling (PPS). For stage three, we randomly selected women who had delivered within the past 12 months in each household from selected wards and villages. For households with more than one eligible woman, one woman was selected randomly.

Outcome and independent variables

Main outcome measures were the poverty headcount ratio, normalized poverty gap and catastrophic expenditure incidence due to OOP payments in the utilization of ANC and delivery care. OOP payments included the expenses on all related healthcare services received during ANC and delivery care, namely hospital costs/investigation fees, drugs, consultation fees, food/living/transportation payments and other costs. The OOP payments were calculated for ANC and delivery care and then summed as total OOP payments for care. OOP payments for ANC were counted as the sum of all ANC visits. Impoverishment was defined as a situation where a household fell below the international poverty line (1.9 US dollars in PPP) after paying for maternal health care services.[23 24] Catastrophic expenditure was defined as OOP payment for maternal health care services exceeding a threshold of 10% of a household's annual income.[25]

Independent variables included background characteristics of the women and their husbands and household information, accessibility of health services, characteristics of ANC and delivery care and details of services provided. Household annual income was classified into ≤

1275 US dollars (USD) or >1275 USD according to GDP per capita of Myanmar from the data of World Bank 2016. The household annual income was recorded in Myanmar kyats and converted to USD using the exchange rate of 1 USD equal to 1362.63 kyats. The information pertaining to accessibility to health services included availability of a health center, distance as measured in walking minutes (number of walking minutes from the woman's house to a formal health center) and types of transportation (women who used any transport to visit a health center). Characteristics of ANC and delivery care included complications during pregnancy and child birth and number of ANC visits. Details of services provided included health personnel, place of care, affordability, and OOP payments.

Data collection

Before the data collection began, 12 research assistants were trained in a two-day training workshop on how to conduct the interviews and check the information for completeness of data. The list of women was obtained from the township health departments and local authorities. The eligible women were visited at their home by the research team at the woman's convenience. After the study was explained and a consent form signed, the women were interviewed by the principal investigator and researchers using a pre-tested structured questionnaire in a private area. Each completed interview was checked promptly and daily for any errors and edited if required.

Statistical analysis

After data collection was complete, EpiData 3.1 was used to record the data in a double entry system and validated it, and R version 3.4.2 was used for data analysis.[26 27]

We considered the maternal health care services from ANC to delivery care and the pre-payment period was counted at one point before utilizing the ANC, thus the pre-payment headcount ratio and normalized poverty gap for ANC and delivery care was the same. Pre-payment and post-payment headcount ratio was measured by the proportion of households having

household annual income below the poverty line before and after the women using the ANC and delivery care, respectively. The average of the relative income shortfall of the poor from the poverty line was calculated to represent a normalized poverty gap. A Pen's parade graph between household income as a multiple of the poverty line (y axis) with cumulative proportion of the population ranked by household income (x axis) was plotted to show the number of non-poor households which became poor after OOP for pregnancy expenses as indicated by the vertical lines below the poverty line. Catastrophic expenditure was measured by the incidence and intensity. Incidence was calculated by the proportion of households who face catastrophic expenditure due to OOP payments for ANC or delivery care. Intensity was calculated by the proportion of OOP payments for ANC and delivery care exceeding the 10% threshold of household's annual income.[25 28]

All independent variables collected were used to test for the determinants of the incidences of impoverishment and catastrophic expenditure. A multiple logistic regression model with sampling weights was applied to adjust for the cluster sampling design. For analyzing the weighted samples, the first-stage weight was calculated by the total number of wards and villages divided by the selected number of wards and villages by each district and the second-stage weight was calculated by the total number of women divided by the selected number of women in each ward and village by each district. The final stage weight was calculated by multiplying the first stage and second stage weights.[29] The adjusted Odd Ratios (OR) and 95% confidence intervals were presented in the final models with the significance value less than 0.05.

Patient and Public Involvement

Women and household members or the public were not involved in the development of the research questions, design of the study or recruitment. The results are not directly disseminated to study participants.

Results

A total of 759 women were included in this study. More than two-thirds of the women lived in an urban area. Half of the women were aged 24- 35 years and 71% were housewives. More than two-thirds of their husbands had above primary school level education and 60% of them worked as daily wage-earners. Most of the households had less than five household members and 89% of them had an annual household income above 1275 USD, and 60.3% of the households had debt. More than 80% of the women said that a health center was available for them to get ANC services within 30 minutes walking distance. Only 21.2% of the women had less than four ANC visits and 15% and 23% of them faced complications during pregnancy and child birth, respectively (Table 1).

Table 2 shows the details of the services used and payments of the women for ANC and delivery care. More than half (56.4%) met community health personnel for ANC followed by specialists (22.5%) and doctors/nurses (21.1%). Similar numbers had delivery by community health personnel (35.4%) or doctors/nurses (35.2%), with the rest by specialists (29.4%). Most of the women used public facilities for ANC (78%) and delivery care (65%). Almost all of the women said that they could afford the cost of each ANC visit and half could afford the cost of delivery care. OOP payments were made by 75% of the women for ANC and by 99.6% for delivery care. Hospital costs/investigation fees were highest for ANC and delivery care. Cost per each ANC visit was lower, but the total cost for all ANC visits was higher, than the total cost of delivery care.

Table 3 shows impoverishment due to OOP payments for ANC and delivery care. The poverty headcount ratio at pre-payment was 2.4%. The change of poverty headcount ratio comparing post-payment with pre-payment for women using both ANC and delivery care was shown by 6.1% of which 4.3% was for ANC and 1.3% for delivery care. The change of the

normalized poverty gap was quite similar to the poverty headcount ratio that it was 1.25% for ANC and 0.49% for delivery care. Individual pre-payment and post-payment income for OOP of overall ANC and delivery care is shown in a Pen's parade graph (Fig 1). Overall OOP payments for ANC and delivery care lead to some extent of poverty regardless of household income level. Table 4 presents the data on catastrophic expenditure due to OOP payments for ANC and delivery care. The incidence of households facing catastrophic expenditure due to OOP payments for ANC, delivery care and overall ANC and delivery care were 12%, 9.1% and 20.9%, respectively. Intensities of catastrophic expenditures was found in the utilizing ANC more than delivery care.

The determinants of impoverishment and catastrophic expenditure due to OOP payment for ANC and delivery care are shown in Table 5. Women who were housewives, had lower number of household members, used more ANC visits and had delivery care by specialists or had ANC at private health facilities were more likely to face the impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care. Women who used delivery care at private facilities comparing to public facilities increased the odds of impoverishment, but not with catastrophic expenditure.

Discussion

Approximately one in ten women accessing ANC and one-fourth of women delivering a baby in the study area faced impoverishment or catastrophic expenditure due to OOP payments. Women with a higher number of household members or increased use of ANC visits or who accessed specialists or private services were more likely to face impoverishment or catastrophic expenditure.

Even though free maternal healthcare services are nationally available, at least three-fourths of the women incurred OOP payments, which was the same as a previous study in Myanmar conducted in 2015.[11] This finding was also similar to previous studies from India in 2004[18] and Nigeria in 2010[13], although the maternal health services considered and the methods of OOP measurement were different. Similarly, a study of three African countries where free delivery care was available found that 90% of the women still paid some amount of OOP for their direct medical expenses.[30] A possible explanation might be due to the existence of high informal payments or some expenses not being covered by health insurance.[10 11 13 18 30] The need to turn to OOP payments has been shown to influence the utilization of maternal health services and maternal mortality.[31] Importantly, another study reported that high OOP payments for maternal healthcare also lead households to impoverishment and catastrophic expenditure.[4]

The impoverishment rates in published studies vary depending on the methods used to measure health care expenditures and the poverty line thresholds used for calculating impoverishment. Our study used the international poverty line in 2011 of 1.9 USD per day, but a study from Nepal used the international poverty line in 2005 of 1 USD per day and reported the poverty headcount ratio due to the use of institutional delivery reported for 17%[8] which was higher than that of our study. In contrast, a study in India used the local poverty line and found higher impoverishment due to maternal health care expenditure than the findings of our study.[32]

Although Yangon region is the most developed region in Myanmar, a lot of non-poor households face impoverishment and deep poverty which could be explained by high maternal healthcare payments without a compensation scheme.[10 20] Two studies from India using data from 2004 and 2015 found that the change of the poverty headcount ratio for maternal healthcare expenditures was lower after introducing free services for delivery care in 2015.[32 33]

Likewise, variations in the incidence of catastrophic expenditure due to maternal health care expenditures depend on the different maternal services measured, whether household income or capacity to pay is considered, and the catastrophic expenditure threshold used. One fourth of women faced catastrophic expenditure due to OOP payment for ANC and delivery care in our study, which was higher than an earlier study from Myanmar in 2015. This may be because the previous study measured catastrophic expenditure based only on OOP payments for delivery care, not ANC, and also only direct and indirect medical costs, not other costs or productivity loss.[11] Higher incidences of catastrophic expenditure due to OOP were reported in India and Ethiopia because poorer women were included and all ANC, delivery and postnatal care services were measured.[32 34] Prior studies from Africa and Bangladesh concluded that more than one third of women faced catastrophic expenditure due to OOP payments for emergency obstetric care because they were poor and were required to pay for drugs.[35-37]

Woman's occupation, with lower number of household members, utilization of health personnel, increased number of ANC visits and place of care were associated with impoverishment and catastrophic expenditure due to OOP payments. A previous study could not identify a direct association between occupation and impoverishment and catastrophic expenditure. The significant association between woman's occupation and impoverishment and catastrophic expenditure found in our study could be explained by woman reduced working because of their pregnancy leading to lower household income. The number of household

members increased the impoverishment and catastrophic expenditure in our study which was different from a previous study from India[19] which could be explained by lower sharing financial resources among household members of the study participants. The finding of higher rates of catastrophic expenditure in women with a higher number of ANC visits was also similar to a study in India which included women with low economic status.[38] Other previous studies have found that women who used a nearby health center or facilities having specialists and private facilities for ANC and delivery care where health insurance was not available were more likely to have impoverishment and catastrophic expenditure.[14 18 19 31 38 39]

Only one previous study from Myanmar in rural areas of a township in Ayeyarwaddy region measured catastrophic health expenditure resulting from maternal health care.[11] Our study included both rural and urban areas of Yangon region, and provides important information on these factors for policy makers to help them consider financial burdens leading to impoverishment or catastrophic expenditure.

The study had some limitations. First, this was a cross sectional study, thus the causal relationship between the determinants and level of impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care could not be firmly identified. Second, household annual income and payments for healthcare services were self-reported, therefore, there may have been over- or under-reporting. Third, the payment of total ANC used the payment of last ANC visit and then multiplied by the total number of all visits. Fourth, recall bias might have occurred due to the data gathering through retrospective interviews. However, we included only women within 12 months of delivery to minimize the recall bias. Finally, the socioeconomic status of the people in the Yangon region is better than in other regions; therefore, the findings of this study are not likely representative of the entire country.

Conclusions

High OOP payments for utilization of ANC and delivery care in the Yangon region of Myanmar resulted in one-tenth of the women becoming impoverished and one-fourth suffering a catastrophic expenditure. Women with lower number of household members or increased use of ANC visits or who accessed specialists or private services were more likely to face impoverishment or catastrophic expenditure.

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Contributors

All authors contributed to the concept and design of the study. ANMM and TL participated in data collection, data analysis, interpretation of the data, and preparation of the draft manuscript. TTH, MMW, JS and EB also assisted with interpretation of the data and commented on the draft MS. All authors read and approved the final manuscript.

Competing interests

The authors declare no competing interests.

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Ethical approval

Ethical clearances for the study were obtained from the Ethical Review Committee of Prince of Songkla University, Thailand, the Department of Medical Research, Myanmar and the Norwegian National Research Ethics Committee (NSD), Norway.

Data sharing statement

No additional data available. Original data without identity can be provided on request after the Ethical Review Committee of Prince of Songkla University are informed and approved.

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List of Tables and Figure

Table 1. Background characteristics of women and their husbands, household information, accessibility of health services and characteristics of ANC and delivery care (n=759)

Characteristic	n (%)
Women's characteristics	
Place of residence	
Urban	542 (72.4)
Rural	217 (28.6)
Age	
15-24 years	215 (28.3)
25-34 years	376 (49.5)
35-49 years	168 (22.1)
Occupation	
Housework	539 (71)
Any job	220 (29)
Husbands' characteristics	
Education	
Primary school and lower	242 (31.9)
More than primary school	517 (68.1)
Occupation	
Daily wage earner	455 (59.9)
Other	304 (40.1)
Household characteristics	
Number of household members	
> 5 members	276 (38.4)
3-5 members	483 (63.6)
Household annual income	
≤ 1275 USD	83 (10.9)
> 1275 USD	676 (89.1)
Household debt	
No	301 (39.7)
Yes	458 (60.3)
Accessibility of health services	
Availability of health center	
No	123 (16.2)
Yes	636 (83.8)
Walking distance in minutes	
> 30 minutes	76 (10)
≤ 30 minutes	683 (90)
Type of transportation	
Car	79 (10.4)
Motorcycle	172 (22.7)

Walking	406 (53.3)
Other	102 (13.4)
Characteristics of ANC and delivery care	
Number of ANC visits	
1-3	161 (21.2)
4-6	262 (34.5)
> 6	336 (44.3)
Complication during pregnancy	
No	645 (85.0)
Yes	114 (15.0)
Complication during birth	
No	584 (76.9)
Yes	175 (23.1)

Table 2. Details of services used and payments of the women for ANC and delivery care (n=759)

	Antenatal care n (%)	Delivery care n (%)
Health personnel		
Community health personnel	428 (56.4)	269 (35.4)
Specialists	171 (22.5)	223 (29.4)
Doctors/Nurses	160 (21.1)	267 (35.2)
Place of care		
Public facilities	592 (78)	493 (65)
Private facilities	167 (22)	266 (35)
Affordability (per visit/delivery)		
No	26 (3.4)	338 (44.5)
Yes	733 (96.6)	421 (55.5)
Out-of-pocket payments		
No	186 (24.5)	3 (0.4)
Yes	573 (75.5)	756 (99.6)
	(n=573)	**(n=756)**
Total costs of care	31.7 (0-12072.2)	84.4 (0-2305.1)
Total out-of-pocket payments of care	31.7 (0-10633.8)	73.4 (0-1541.1)
Categories of out-of-pocket payments (per visit/delivery)		
Hospital cost/Investigation fees	0.73 (0-80.8)	7.34 (0-1247.6)
Drugs	0 (0-40.4)	0 (0-587.1)
Consultation fees	0 (0-23.9)	0 (0-440.3)
Food/Travel/Living cost	0.57 (0-73.4)	2.94 (0-1027.4)
Other expenses	0 (0-29.4)	0 (0-220.2)
Sum of costs	4.8 (0-759.6)	73.4 (0-1541.1)

Table 3. Impoverishment due to OOP payments for ANC and delivery care (n=757)

	Impoverishment due to OOP payments (%)						
	Before utilizing ANC or delivery care	Antenatal care		Delivery care		Overall antenatal and delivery care	
	Pre-payment	Post-payment	Change	Post-payment	Change	Post-payment	Change
Poverty headcount ratio	2.4	6.7	4.3	3.7	1.3	8.5	6.1
Normalized poverty gap	0.01	1.26	1.25	0.50	0.49	1.40	1.39

Table 4. Catastrophic expenditure due to OOP payments for ANC and delivery care (n=757)

Catastrophic expenditure due to OOP payments	**Antenatal care**	**Delivery care**	**Overall antenatal and delivery care**
Incidence (%)	12.0	9.1	20.9
Intensity (%)	6.1	1.7	9.2

Table 5. Determinants of impoverishment and catastrophic expenditure due to OOP payments for overall ANC and delivery care (n=757)

Characteristic	Impoverishment Adjusted OR (95% CI)	Catastrophic expenditure Adjusted OR (95% CI)
Woman's occupation		
Other (ref.)	1	1
Housewife	4.81 (1.91-12.12)***	2.18 (1.16-4.10)*
Number of household members		
> 5 (ref.)	1	1
3-5	7.13 (2.77-18.33)***	7.82 (4.41-13.89)***
Number of ANC visits		
1-3 (ref.)	1	1
4-6	1.26 (0.35-4.52)	2.06 (0.99-4.31)
> 6	5.73 (1.90-17.26)**	5.63(2.96-10.70)***
Health personnel for delivery care		
Community health personnel (ref.)	1	1
Specialists	2.97 (1.14-7.76)*	4.83 (2.24-10.44)***
Doctors/Nurses	2.22 (0.78-6.33)	3.45 (1.64-7.27)**
Place of antenatal care		
Public facilities (ref.)	1	1
Private facilities	2.46 (1.14-5.32)*	2.42 (1.40-4.17)**
Place of delivery care		
Public facilities (ref.)	1	
Private facilities	3.29 (1.41-7.70)**	

$p < 0.05$ *, $p < 0.01$ **, $p < 0.001$ ***, OR: Odds Ratio, CI: Confidence Interval

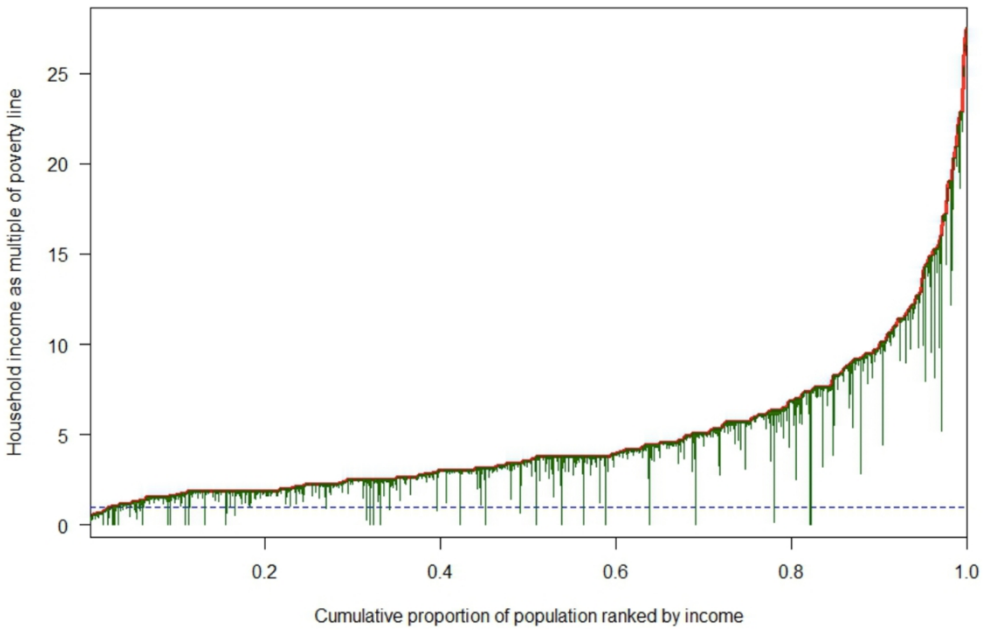

Figure 1

83x53mm (600 x 600 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10
		(*b*) Report category boundaries when continuous variables were categorized	9-10
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Impoverishment and catastrophic expenditures due to out-of-pocket payments for antenatal and delivery care in Yangon region, Myanmar: a cross-sectional study

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Impoverishment and catastrophic expenditures due to out-of-pocket payments for antenatal and delivery care in Yangon region, Myanmar: a cross-sectional study

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Abstract (257 words)

Objectives: (i) To assess the levels of impoverishment and catastrophic expenditure due to out-of-pocket (OOP) payments for antenatal care (ANC) and delivery care in Yangon Region, Myanmar; and (ii) to explore the determinants of impoverishment and catastrophic expenditure.

Design, setting and participants: A community-based cross-sectional survey among women giving birth within the past 12 months in Yangon, Myanmar was conducted during October-November 2016 using three-stage cluster sampling procedure.

Outcome measures: Poverty headcount ratio, normalized poverty gap and catastrophic expenditure incidence due to OOP payments in the utilization of ANC and delivery care as well as the determinants of impoverishment and catastrophic expenditure.

Results: Of 759 women, out-of-pocket payments were made by 75% of the women for ANC and 99.6% for delivery care. The poverty headcount ratios after payments increased to 4.3% among women using the ANC services, to 1.3% among those using delivery care and to 6.1% among those using both ANC and delivery care. The incidences of catastrophic expenditure after payments were found to be 12% for ANC, 9.1% for delivery care, and 20.9% for both ANC and delivery care. The determinants of impoverishment and catastrophic expenditure were women's occupation, number of household members, number of ANC visits, and utilization of skilled health personnel and health facilities. The associations of the outcomes with these variables bear both negative and positive signs.

Conclusions: Out-of-pocket payments for all ANC and delivery care services are a challenge to women, as one-tenth of them become impoverished and a further one-fourth incur catastrophic expenditures after visiting facilities that offer these services.

Keywords: impoverishment, catastrophic expenditure, out-of-pocket payment, antenatal care, delivery care

Strengths

- This study measured impacts of OOP payments for antenatal and delivery care on levels of impoverishment and catastrophic expenditure in Myanmar, one of the few studies on this issue in a low-income country. Other determinants of impoverishment and catastrophic expenditure were also analyzed using logistic regression and found to be important.
- Multistage sampling design and the use of adjusted standard errors in the analysis minimized the sampling bias and provided reliable and policy relevant estimates.
- The data on social determinants of OOP payments for antenatal and delivery care were also collected and the evidence from their analysis has been incorporated in this study.

Limitations

- The data on expenditures of antenatal and delivery care are based on women's self-reported experiences during service utilization, and may thus contain some recall bias.
- Household annual incomes as well OOP payments for healthcare services are self-reported and may suffer from over- or under-reporting.

Introduction

Worldwide, nearly 830 women die during pregnancy and childbirth every day, with most of them living in poor households having limited proper maternal health care.[1] Increasing utilization of maternal health services is one of the targets of Sustainable Development Goal 3.[2] Poverty or financial problems are the major barrier to accessibility and utilization of antenatal care (ANC) and delivery by skilled birth attendants (SBAs).[3] Even though the economic indicators of most countries in 2015 were better than in earlier years, there are still some countries which face financial barriers leading to worse health outcomes.[2]

Low socioeconomic level or high health care expenditures can lead to financial burdens, either impoverishment or catastrophic expenditure, which use different analyses and thresholds of burden.[4 5] Financial burdens from utilization of maternal health care have been previously reported in some African and Asian countries such as Ghana, Nepal, Bangladesh, and India.[6-9] In Myanmar, OOP payments for health services were high in public and private health facilities and accounted for more than 80% of total health expenditures of the country in 2012.[10] Only one study of OOP payments for maternal health care in Myanmar with percentage of catastrophic health expenditures in Myanmar was found[11]; therefore, the evidence on impoverishment and catastrophic payments of ANC and delivery care and their determinants in Myanmar to date is limited.

Different countries have introduced different strategies to reduce financial burdens related to accessing necessary health care during pregnancy, child birth and the postpartum period.[12] Providing free maternal health services has been implemented in some low-income countries, but various studies have found low utilization of these services as well as high maternal mortality and morbidity.[7 13 14] A study in Thailand found improvement of maternal health outcomes five years after the implementation of a universal coverage scheme with health finance reform.[15] Although

some countries have begun to offer free health services or health insurance, the achievements in terms of reducing financial burdens remain limited.[12]

Similarly, Myanmar has begun a program providing free essential drugs and health care for maternal health services in both public facility-based and primary health care settings in recent years, but OOP payments while accessing these services have been reported.[10 16 17] In addition, reports on the actual financial burden in terms of impoverishment and catastrophic expenditure due to OOP payments are limited.[11] Understanding the determinants of financial burden in utilizing maternal health services is useful to identify the nature of the OOP payment situation and whether any determinants are modifiable or require policy improvement.[14 18 19] This study aimed to assess the levels of impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care in Yangon Region, Myanmar and explore the determinants of impoverishment and catastrophic expenditure.

Methods

Study design, participants and sampling method

The study was based on a community-based cross-sectional survey conducted in Yangon Region of Myanmar during October and November 2016. According to the 2014 census report, Yangon region had the largest population among the regions of Myanmar.[20] The study recruited women of reproductive age (15-49 years) with a history of birth within the previous 12 months who were residents of the study area. Those who had mental retardation or serious illness were excluded. The required sample size for the first objective was calculated using the one-proportion formula based on a rate of 9% of pregnant women with catastrophic expenditure due to OOP payments in utilization of delivery care from a previous study.[11 21] With a precision of 4%, type I error of 1%, non-response rate of 10% and design effect of 2, at least 750 women were required.

Three-stage cluster sampling was used to select eligible persons. For stage one, purposive selection of two districts among the four districts of Yangon region which covered both urban and rural populations was done. There were a total of 235 wards and 610 villages in the two districts. "Wards" and "villages" refer to urban and rural populations, respectively.[22] For stage two, 16 wards and 16 villages were randomly selected from all of the wards and villages. Households were selected regarding the number of households and the ratio of urban to rural population size in the districts considering proportional probability sampling (PPS). For stage three, we randomly selected women who had delivered within the past 12 months in each household from selected wards and villages. For households with more than one eligible woman, one woman was selected randomly.

Involvement of patients and the general public in the study

Women and household members and the public were not involved in the development of the research questions, in design of the fieldwork or in the recruitment of research assistants. The results reported in the paper were not disseminated to study participants.

Outcome and independent variables

The main outcome measures were the poverty headcount ratio, normalized poverty gap and catastrophic expenditure incidence due to OOP payments in the utilization of ANC and delivery care. OOP payments included the expenses of all related healthcare services received during ANC and delivery care, namely hospital costs/investigation fees, drugs, consultation fees, food/living/transportation payments and other costs. The OOP payments were calculated for ANC and delivery care and then summed as total OOP payments for care. OOP payments for ANC were counted as the sum of all ANC visits. Impoverishment was defined as a situation where a household fell below the international poverty line (1.9 US dollars in PPP) after paying

for maternal health care services.[23 24] Catastrophic expenditure was defined as OOP payment for maternal health care services exceeding a threshold of 10% of a household's annual income.[25]

Independent variables included background characteristics of the women and their husbands and household information, accessibility of health services, characteristics of ANC and delivery care and details of services provided. Household annual income was classified into ≤ 1275 USD or >1275 USD according to GDP per capita of Myanmar from the World Bank 2016 data. The household annual incomes were recorded in Myanmar kyats and converted to US$ using the exchange rate of 1 USD equal to 1362.63 kyats. The information pertaining to accessibility to health services included availability of a health center, distance as measured in walking minutes (number of walking minutes from the woman's house to a formal health center) and types of transportation (women who used any transport to visit a health center). Characteristics of ANC and delivery care included complications during pregnancy and child birth and number of ANC visits. Details of services provided included health personnel, place of care, affordability, and OOP payments.

Data collection

Before the data collection began, 12 research assistants were trained in a two-day training workshop on how to conduct the interviews and check the information for data completeness. The lists of women were obtained from the township health departments and local authorities. The eligible women were visited at their home by the research team at the woman's convenience. After the study was explained and a consent form signed, the women were interviewed by the principal investigator and researchers using a pre-tested structured questionnaire in a private area. Each completed interview was checked promptly for any errors and edited if required. All questionnaires were reviewed at the end of each day for accuracy of the data obtained.

Statistical analysis

After the data collection was completed, EpiData 3.1 was used to record the data in a double entry system, and R version 3.4.2 was used for data analysis.[26 27]

We considered the maternal health care services from ANC to delivery care and the pre-payment period was counted at one point before utilizing the ANC, thus the pre-payment headcount ratio and normalized poverty gap for ANC and delivery care were the same. Pre-payment and post-payment headcount ratios were measured by the proportion of households having household annual income below the poverty line before and after the women used the ANC and delivery care, respectively. The average of the relative income shortfall of the poor from the poverty line is the normalized poverty gap. A Pen's parade graph between household income as a multiple of the poverty line (y axis) with the cumulative proportion of the population ranked by household income (x axis) was plotted to show the number of non-poor households which became poor after OOP for pregnancy expenses as indicated by the vertical lines below the poverty line. Catastrophic expenditure was measured by the incidence and intensity. Incidence was calculated by the proportion of households who faced catastrophic expenditure due to OOP payments for ANC or delivery care. Intensity was calculated by the proportion of OOP payments for ANC and delivery care exceeding the 10% threshold of the household's annual income.[25 28]

Data on dependent variables (impoverishment and catastrophic expenditures) and on independent variables (the determinants) were collected and analyzed using multiple logistic regression, with sampling weights being applied to adjust for the cluster sampling design. The first-stage adjustment weight was calculated by dividing the total number of wards and villages in each district by the selected number of wards and villages. The second-stage weight was calculated by dividing the total number of women by the selected number of women in each ward and village. The final stage weight was calculated by multiplying the first stage and second stage

weights.[29] The adjusted Odds Ratios (OR) and 95% confidence intervals were used for presenting the final estimates. A p value less than 0.05 was considered to be statistically significant.

Results

A total of 759 women were included in the study. More than two-thirds of the women lived in an urban area. Half of the women were aged 24- 35 years and 71% were housewives. More than two-thirds of their husbands had above primary school level education and 60% of them worked as daily wage-earners. Most of the households had less than five household members and 89% of them had an annual household income above 1275 US dollars (USD), and 60.3% of the households had debt. More than 80% of the women said that a health center was available for them to get ANC services within 30 minutes walking distance. Only 21.2% of the women had less than four ANC visits and 15% and 23% of them faced complications during pregnancy and child birth, respectively (Table 1).

Table 2 shows the details of the services used and payments of the women for ANC and delivery care. More than half (56.4%) met community health personnel for ANC followed by specialists (22.5%) and doctors/nurses (21.1%). Similar numbers had delivery by community health personnel (35.4%) or doctors/nurses (35.2%), with the rest by specialists (29.4%). Most of the women used public facilities for ANC (78%) and delivery care (65%). Almost all of the women said that they could afford the cost of each ANC visit and half could afford the cost of delivery care. OOP payments were made by 75% of the women for ANC and by 99.6% for delivery care. Hospital costs/investigation fees were highest for ANC and delivery care. Cost per each ANC visit was lower, but the total cost for all ANC visits was higher, than the total cost of delivery care.

Table 3 shows the changes in impoverishment due to OOP payments for ANC and delivery care. The poverty headcount ratio at pre-payment was 2.4%. The poverty headcount

ratio considering the post-payment and pre-payment for women using both ANC and delivery care showed that poverty increased to 6.1% after service utilization with the decomposition of 4.3% for ANC and 1.3% for delivery care. The increase in the normalized poverty gap showed a similar trend, with 1.25% for ANC and 0.49% for delivery care services. The individual pre-payment and post-payment incomes associated with OOP of both ANC and delivery care are shown in the Pen's parade (Fig 1). Overall, the OOP payments for ANC and delivery care lead to poverty regardless of household income levels. Table 4 presents the evidence on catastrophic expenditures due to OOP payments for ANC and delivery care. The incidence for households incurring catastrophic expenditure due to OOP payments for ANC, delivery care and overall for ANC and delivery care combined were 12%, 9.1% and 20.9%, respectively. Intensities of catastrophic expenditures were greater among women using ANC services than for those using delivery care.

The determinants of impoverishment and catastrophic expenditure due to OOP payments for ANC and delivery care are shown in Table 5. Housewives, women who had lower numbers of household members, and those who used more ANC services and those who were delivered by specialists or had ANC at private health facilities were more likely than their counterparts to face impoverishment and/or catastrophic expenditures due to OOP payments. Women who used delivery care at private facilities had elevated odds ratios for impoverishment, but notably not for incurring catastrophic expenditures.

Discussion

Approximately one in ten women accessing ANC and one-fourth of women delivering a baby in the study area faced impoverishment or catastrophic expenditure due to OOP payments. Women with a higher number of household members or increased use of ANC visits or who accessed specialists or private services were more likely to face impoverishment or catastrophic expenditure.

Even though free maternal healthcare services are nationally available, at least three-fourths of the women incurred OOP payments, which was the same as a previous study in Myanmar conducted in 2015.[11] This finding was also similar to previous studies from India in 2004[18] and Nigeria in 2010[13], although the maternal health services considered and the methods of OOP measurement were different. Similarly, a study of three African countries where free delivery care was available found that 90% of the women still paid some amount of OOP for their direct medical expenses.[30] A possible explanation might be due to the existence of high informal payments or some expenses not being covered by health insurance.[10 11 13 18 30] The need to turn to OOP payments has been shown to influence the utilization of maternal health services and maternal mortality.[31] Importantly, another study reported that high OOP payments for maternal healthcare also lead households to impoverishment and catastrophic expenditure.[4]

The impoverishment rates in published studies vary depending on the methods used to measure health care expenditures and the poverty line thresholds used for calculating impoverishment. Our study used the international poverty line in 2011 of US$ 1.9 per day, but a study from Nepal used the international poverty line in 2005 of US$ 1 per day and reported the poverty headcount ratio of 17% after the use of institutional delivery[8] which was higher than that of our study. In contrast, a study in India used the local poverty line and found higher impoverishment due to maternal health care expenditure than the findings of our study.[32]

Although Yangon region is the most developed region in Myanmar, a lot of non-poor households face impoverishment and deep poverty which could be explained by high maternal healthcare payments without a compensation scheme.[10 20] Two studies from India using data from 2004 and 2015 found that the poverty headcount ratio for maternal healthcare expenditures declined after introducing free services for delivery care in 2015.[32 33]

Likewise, variations in the incidence of catastrophic expenditure due to maternal health care expenditures depend on the different maternal services measured, whether household income or capacity to pay is considered, and the catastrophic expenditure threshold used. One fourth of women faced catastrophic expenditure due to OOP payments for ANC and delivery care in our study, which was higher than an earlier study from Myanmar in 2015. This may be because the previous study measured catastrophic expenditure based only on OOP payments for delivery care, not ANC, and also only direct and indirect medical costs, not other costs or productivity loss.[11] Higher incidences of catastrophic expenditure due to OOP payments were reported in India and Ethiopia because poorer women were included and all ANC, delivery and postnatal care services were considered.[32 34] Prior studies from Africa and Bangladesh concluded that more than one third of women faced catastrophic expenditure due to OOP payments for emergency obstetric care because they were poor and were required to pay for drugs.[35-37]

Woman's occupation was associated with impoverishment and catastrophic expenditure due to OOP payments but a previous study could not identify a direct association between occupation and impoverishment and catastrophic expenditure. The significant association between woman's occupation, impoverishment and catastrophic expenditure found in our study, could be explained by woman's low levels of employment. Lower number of household members were also associated with the impoverishment and catastrophic expenditure in our study. This finding was different from a previous study from India[19], which could be explained by the lower

sharing of financial resources among household members of the study participants. The finding of higher rates of catastrophic expenditures in women with a higher number of ANC visits was also similar to a study in India which included women with low economic status.[38] Other previous studies have found that women who used a nearby health center or facilities having specialists and private facilities for ANC and delivery care where health insurance was not available were more likely to have impoverishment and catastrophic expenditures.[14 18 19 31 38 39]

Only one previous study from Myanmar in rural areas of a township in Ayeyarwaddy region measured catastrophic health expenditures resulting from maternal health care.[11] Our study included both rural and urban areas of Yangon region, and provides important information on these factors for policy makers to help them consider financial burdens leading to impoverishment or catastrophic expenditures.

The study had some limitations. First, this was a cross sectional study, thus the causal relationship between the determinants and level of impoverishment and catastrophic expenditures due to OOP payments for ANC and delivery care could not be firmly identified. Second, household annual income and payments for healthcare services were self-reported, therefore there may have been over- or under-reporting. Third, the payment of total ANC used the payment of last ANC visit and then multiplied by the total number of all visits. Fourth, recall bias might have occurred due to data gathering through retrospective interviews. However, we included only women within 12 months of delivery to minimize the recall bias. Finally, the socioeconomic status of the people in the Yangon region is better than in other regions; therefore, the findings of this study are not likely representative of the entire country.

Conclusions

High OOP payments for utilization of ANC and delivery care in the Yangon region of Myanmar resulted in one-tenth of the women becoming impoverished and one-fourth suffering a catastrophic expenditure. Women with few household members, or with a large number of ANC visits, or who had been attended by specialists or had used private services were more likely than other women to face impoverishment or catastrophic expenditures.

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Contributors

All authors contributed to the concept and design of the study. ANMM and TL participated in data collection, data analysis, interpretation of the data, and preparation of the draft manuscript. TTH, MMW, JS and EB also assisted with interpretation of the data and commented on the draft MS. All authors read and approved the final manuscript.

Competing interests

None declared.

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Ethical approval

Ethical clearances for the study were obtained from the Ethics Review Committee of Prince of Songkla University, Thailand, the Department of Medical Research, Myanmar and the Norwegian National Research Ethics Committee (NSD), Norway.

Data sharing statement

No additional data available. Original data without identity can be provided on request after the Ethics Review Committee of Prince of Songkla University is informed and provides their approval.

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List of Tables and Figures

Table 1. Background characteristics of women and their husbands, household information, accessibility of health services and characteristics of ANC and delivery care (n=759)

Characteristic	n (%)
Women's characteristics	
Place of residence	
Urban	542 (72.4)
Rural	217 (28.6)
Age	
15-24 years	215 (28.3)
25-34 years	376 (49.5)
35-49 years	168 (22.1)
Occupation	
Housework	539 (71)
Any job	220 (29)
Husbands' characteristics	
Education	
Primary school and lower	242 (31.9)
More than primary school	517 (68.1)
Occupation	
Daily wage earner	455 (59.9)
Other	304 (40.1)
Household characteristics	
Number of household members	
> 5 members	276 (38.4)
3-5 members	483 (63.6)
Household annual income	
≤ 1275 USD	83 (10.9)
> 1275 USD	676 (89.1)
Household debt	
No	301 (39.7)
Yes	458 (60.3)
Accessibility of health services	
Availability of health center	
No	123 (16.2)
Yes	636 (83.8)
Walking distance in minutes	
> 30 minutes	76 (10)
≤ 30 minutes	683 (90)
Type of transportation	
Car	79 (10.4)
Motorcycle	172 (22.7)

Walking	406 (53.3)
Other	102 (13.4)
Characteristics of ANC and delivery care	
Number of ANC visits	
1-3	161 (21.2)
4-6	262 (34.5)
> 6	336 (44.3)
Complication during pregnancy	
No	645 (85.0)
Yes	114 (15.0)
Complication during birth	
No	584 (76.9)
Yes	175 (23.1)

Table 2. Details of services used and payments of the women for ANC and delivery care (n=759)

	Antenatal care n (%)	Delivery care n (%)
Health personnel		
Community health personnel	428 (56.4)	269 (35.4)
Specialists	171 (22.5)	223 (29.4)
Doctors/Nurses	160 (21.1)	267 (35.2)
Place of care		
Public facilities	592 (78)	493 (65)
Private facilities	167 (22)	266 (35)
Affordability (per visit/delivery)		
No	26 (3.4)	338 (44.5)
Yes	733 (96.6)	421 (55.5)
Out-of-pocket payments		
No	186 (24.5)	3 (0.4)
Yes	573 (75.5)	756 (99.6)
	(n=573)	**(n=756)**
Total costs of care	31.7 (0-12072.2)	84.4 (0-2305.1)
Total out-of-pocket payments of care	31.7 (0-10633.8)	73.4 (0-1541.1)
Categories of out-of-pocket payments (per visit/delivery)		
Hospital cost/Investigation fees	0.73 (0-80.8)	7.34 (0-1247.6)
Drugs	0 (0-40.4)	0 (0-587.1)
Consultation fees	0 (0-23.9)	0 (0-440.3)
Food/Travel/Living cost	0.57 (0-73.4)	2.94 (0-1027.4)
Other expenses	0 (0-29.4)	0 (0-220.2)
Sum of costs	4.8 (0-759.6)	73.4 (0-1541.1)

Table 3. Impoverishment due to OOP payments for ANC and delivery care (n=757)

	Impoverishment due to OOP payments (%)						
	Before utilizing ANC or delivery care	Antenatal care		Delivery care		Overall antenatal and delivery care	
	Pre-payment	Post-payment	Change	Post-payment	Change	Post-payment	Change
Poverty headcount ratio	2.4	6.7	4.3	3.7	1.3	8.5	6.1
Normalized poverty gap	0.01	1.26	1.25	0.50	0.49	1.40	1.39

Table 4. Catastrophic expenditures due to OOP payments for ANC and delivery care (n=757)

Catastrophic expenditures due to OOP payments	**Antenatal care**	**Delivery care**	**Overall antenatal and delivery care**
Incidence (%)	12.0	9.1	20.9
Intensity (%)	6.1	1.7	9.2

Table 5. Determinants of impoverishment and catastrophic expenditure due to OOP payments for overall ANC and delivery care (n=757)

Characteristic	Impoverishment Adjusted OR (95% CI)	Catastrophic expenditure Adjusted OR (95% CI)
Woman's occupation		
Other (ref.)	1	1
Housewife	4.81 (1.91-12.12)***	2.18 (1.16-4.10)*
Number of household members		
> 5 (ref.)	1	1
3-5	7.13 (2.77-18.33)***	7.82 (4.41-13.89)***
Number of ANC visits		
1-3 (ref.)	1	1
4-6	1.26 (0.35-4.52)	2.06 (0.99-4.31)
> 6	5.73 (1.90-17.26)**	5.63(2.96-10.70)***
Health personnel for delivery care		
Community health personnel (ref.)	1	1
Specialists	2.97 (1.14-7.76)*	4.83 (2.24-10.44)***
Doctors/Nurses	2.22 (0.78-6.33)	3.45 (1.64-7.27)**
Place of antenatal care		
Public facilities (ref.)	1	1
Private facilities	2.46 (1.14-5.32)*	2.42 (1.40-4.17)**
Place of delivery care		
Public facilities (ref.)	1	
Private facilities	3.29 (1.41-7.70)**	

$p < 0.05$ *, $p < 0.01$ **, $p < 0.001$ ***, OR: Odds Ratio, CI: Confidence Interval

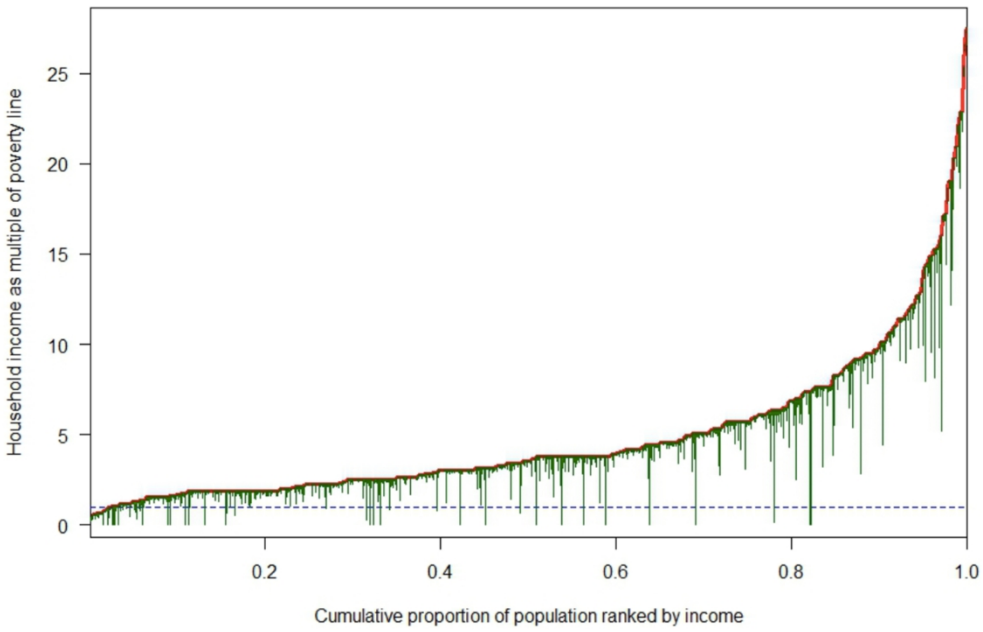

Figure 1

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8-9
		(*e*) Describe any sensitivity analyses	N/A

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10
		(*b*) Report category boundaries when continuous variables were categorized	9-10
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.