Determinants of time to recovery from obstetric fistula by using the data of university of Gondar teaching hospital fistula center, Gondar –Ethiopia: A parametric survival regression analysis

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Abstract: Obstetric fistula is the presence of a hole between a woman's genital tract and either the urinary or the intestinal tract. Better knowledge of the risk factors for obstetric fistula could help in preventing its occurrence. The purpose of this study was to assess the characteristics of obstetric fistula patients. A retrospective and cohort study was used and 289 patients was taken from a hospital records. The study includes obstetric fistula patients who were recorded in the medical record room of cards which have the vital data and the patients with missing main data for the research were excluded. The results from the Weibull regression model revealed that older ages at first marriage, weight < 50 kg, height of >150 cm, follow-up of antenatal care, delivery at health center, duration of labour for <2 day, vaginal delivery, urban residence, accessing education, width of fistula < 5 cm, intact of urethra and duration of incontinent of urine <3 month significantly (p < 0.05) contribute to shorter stay in hospital to treated and physically cured than their counterparts. The average survival times of a patient stay in the hospital to treated and physically cured is 5.19 weeks. The finding of this study showed that age at first marriage, height, antenatal care, weight, place of delivery, mode of delivery, duration of labour, duration of incontinent of urine, educational status, residence width of fistula, and status of urethra were influential affecting recovery time of obstetric fistula patient at the Hospital.

ABOUT THE AUTHOR
The main research topic of our group is obstetric fistula, a major public health problem in the developing countries. We investigate risk factors and pathophysiological mechanisms, which cause or are associated with obstetric fistula. Additionally, we work on improving the present obstetric fistula diagnostics. The basis for all these research work is knowledge of parametric survival analysis and function in obstetric fistula. Thus, we perform studies with the aim of investigating fistula’s parameter and their effect in women.

PUBLIC INTEREST STATEMENT
This study was about obstetric fistula in Gondar referral hospital - Ethiopia. Obstetric fistulas destroy the lives of many young women in the developing countries. As it is known that main predictive factors for the recovery time of obstetric fistula patients are more health variables for this disease, data about its pathophysiological variables are important for interpretation in disease. The study presents data of the normal cohort of the University of Gondar Registry, a Survival follow-up study, starting in 2014. In many cases, due to lack of awareness for women from health workers practices, these diseases claim lots of lives of the community who should not have otherwise die. With regular research and dissemination, among other interventions, it is very possible to contain these diseases. More researches are still encouraged in this area and also in other Fistula center.
Subjects: Multivariate Statistics; Statistics & Computing; Sexual and Reproductive Health; Epidemiology

Keywords: obstetric fistula; physically cured; Kaplan-Meier; Weibull regression model

1. Background
Obstetric fistula is an abnormal opening between a woman’s vagina and bladder and/or rectum through which her urine and/or feces continually leak." Pressure from a baby’s head during prolonged or obstructed labor restricts blood flow and damages tissues between the vagina and the bladder or rectum (Harlott et al., 2017). A hole between the urinary bladder and the vagina is regarded as vesicovaginal fistula whereas a hole between the rectum and the vagina is known as rectovaginal fistula. Obstetric fistula is an indicator of the health system failing to provide accessible, timely and appropriate intrapartum care (Tunçalp et al., 2015).

Obstetric fistula (OF) remains a major public health problem in areas where unattended obstructed labor is common and maternal mortality is high. Historically, this condition occurs outside of the medical system and results in low-resource settings and is one of the most visible indicators of the enormous gaps in maternal health care between the developed and developing world. Despite its devastating impact on the lives of girls and women, obstetric fistula is still largely neglected in the developing world. It has remained a “hidden” condition, because it affects some of the most marginalized members of the population-poor, young, often illiterate girls and women in remote regions of the world (UNFPA, 2011).

Obstetric fistula is rare in high-income countries or in countries where emergency obstetric care is widely available. On the other hand, it is a childbearing-related injury that has been neglected in the developing world, despite the devastating impact it has on the lives of women (A.A.Creanga et al., 2007; WHO, Department of Making Pregnancy Safer, 2006). In developing countries like Ethiopia, where the per capita income is very low, financial restrictions have considerable significance. Although access to emergency obstetric care plays a pivotal role in the genesis of fistula, malnutrition, early marriage, poverty and illiteracy also add a huge contribution to the development of fistula.

Various studies have shown that obstetric fistula usually affects first time mothers who have labored for several days at home, with no access to emergency obstetric care including life-saving procedures like caesarean section. These women end up with obstructed labor, stillbirths and for those who survive this ordeal, an obstetric fistula often develops (Holme, 2007). Obstetric fistula patients had a low level of education, were married at a young age, and had poor access to quality maternal healthcare services(Pierre Marie Pierre Marie Tebeu et al., 2009). Prolonged labour, weight of the baby of 3.5 kg or more, respondent height of 150 cm or less (short stature), and low or no education are risk factors for obstetric fistula in western Ugandan (Justus Kafunjo Barageine et al., 2014). Some respondents, predominantly men, had misconceptions/myths about risk factors of obstetric fistula as being caused by having sex during menstrual periods, poor usage of family planning, being a curse (Nassar et al., 2013). According to Akpok and Yilmaz (2020). Female genital mutilation/cutting (FGM/C) is still widely performed around the world with serious obstetric and neonatal outcomes.

2. Statement of the problem
Obstetric fistula has been eliminated in developed countries, but remains highly prevalent in sub-Saharan Africa (Banke-Thomas et al., 2014). Obstetric fistulas destroy the lives of many young women in the developing world. While obstetric vesicovaginal fistulas have vanished from the industrialized world, despite the efforts of many charitable organizations, they continue to occur in epidemic numbers in developing countries. The national and local governments of these countries do not have either the resources or the political will to
address this problem and help these outcast women (Owens et al., 2013). Obstetric fistula affects nearly 0.3% of all labors, totaling 8000–9000 new cases in Ethiopia alone. These women are affected at an early age. The current life expectancy being 55 years, there may be 250,000 women suffering from fistula in Ethiopia. The total number of fistula patients in the world is estimated to be around 2,000,000. Since 1975, the Addis Ababa Fistula Hospital has treated more than 20,000 women with vesicovaginal and rectovaginal fistulae secondary to childbirth injury (Biruk Tafesse et al., 2007). A large number of factors have been identified which may be associated with obstetric fistula, such as early marriage, childhood, gender inequality, malnutrition, poor of education, lack of access of health center and removal of reproductive body are some of socio-cultural factors. In the developing countries factors such as lack of access to maternal health service and emergency obstetric care are contributing to the silent epidemic (Ayalnesh, 2011).

Obstetric fistula the patients are stigmatized, rejected, and socially isolated by the society in which they live. They are ostracized by their communities, divorced or separated by their husbands or sexual partners, cry for the loss of their babies, have offensive odour (due to urine or/stool leakage), and experience loss of sexual libido and orgasm. Other associated psycho-social factors found to be experienced by obstetric fistula patients include; depression, low self-esteem, feeling of embarrassment, lack of sexual pleasure or satisfaction. The afflicted patients are being divorced by their husbands and rejected by families and relations (Sambo, 1994). with no education and means of livelihood, end up either begging or employed in casual work.

Most studies show multilevel logistic regression a qualitative study using focus group discussion and thematic analysis on obstetric fistula (Abebe, 2015; Nassar et al., 2013). This study tries to identify the potential risk factors associated with recovery of patients with obstetric fistula using a parametric survival models. In addition, the aims of this study is to identify and understand the delays in receiving treatment and corresponding barriers to accessing fistula treatment, to document interventions that help to overcome barriers.

2.1. Objectives of the study
The general objective of the study was to identify determinant factors affecting recovery time of obstetric fistula patients using Survival Analysis, University of Gondar teaching hospital fistula center. The specific objectives of the study were:

(I) To estimate the survival time of obstetric fistula patients
(II) To compare survival time among the different groups of obstetric fistula patients.
(III) To determine the factors and/or covariates that affect the survival of obstetric fistula patients.

2.2. Significance of the study
The most important significance that the study used to bring obstetric fistula problem to the agenda of public health policy makers, researchers, and the public at large, so that appropriate treatment and control strategies are implemented along with a population wide surveillance intervention. This study help health care workers to anticipate and inform patients about the possible related risk factors of recovery they might encounter. It will help for the clinicians to increase recovery time among obstetric fistula patients by early diagnosis and appropriate intervention.

3. Methodology

3.1. The research design
The study design is a retrospective and cohort study with all the events-exposure had already occurred in the past and it involves quantitative method.
3.2. Inclusion and exclusion criteria

3.2.1. Inclusion criteria
This study includes obstetric fistula patients who were recorded in the medical record room of University of Gondar referral Hospital fistula center and those cards which have the vital data for the research above 18 years old during January 2014 to December 2015 for two years.

3.2.2. Exclusion criteria
This study excludes those patients who had incomplete variable registration cards, a person died by obstetric fistula, those patients who transferred to other healthcare institutions a person does not experience the event before the study ends and a person withdraws from the study for unknown/known reasons.

3.2.2.1. Data source. In this study secondary data from hospital’s registry is used to retrieve data on obstetric fistula and patients initial date of entry to follow up at Gondar specialized hospital. The patients ‘chart was used to extract the necessary information from different obstetric fistula recording formats.

4. Definition of variables

4.1. The response (dependent) variable
The response variable for the \(i\)th individual is represented by \(Y_i\) and it measures the duration to the event, which is indicated by physically cured. A patient is said to be recovered if she physically cured from her sickness and no requirement for intervention of health care professionals. If no recovery in the study period, censoring is taken as an outcome.

4.2. Predictor (independent) variables
Predictor variables are those variables which are presumed to affect or determine a dependent variable. In this study possible determinants of obstetric fistula are grouped as demographic, socio-economic, environmental and health-related factors. The predictor variables which are assumed to influence the recovery of obstetric fistula patients includes age at first marriage, age at occurrence of obstetric fistula, height of patient, weight of patient, trauma, educational status, sexual assault, parity residence of patients, follow-up of antenatal care, place of delivery, mode of delivery, duration of incontinence of urine, duration of labour, width of fistula hole, length of fistula hole and status of urethra (Figure 1).

4.3. Data analysis and presentation of findings
After completion of fieldwork, the data were coded and entered into Statistical Package for Social Sciences (SPSS) software for windows version 20 and SAS. The data generated through hospital’s registry were analyzed by employing Statistical Package for Social Science (SPSS version 20) and SAS computer softwares. Then, descriptive statistics for independent variables were presented as frequencies and percentages. Descriptive statistics which include life tables, survival distribution and Kaplan-Meier survival function estimation which are used for the estimation of the survival time from a sample (Table 1).

5. Model selection for survival of obstetric fistula patients
For the obstetric fistula patients the parametric regression models, we consider model comparison of graphical displays are based by the Cox-Snell plots. This plot would be approximately linear if the specified theoretical distribution is the correct model. Using all the covariates in the study, we fitted two parametric regression models which are Exponential and Weibull models with the corresponding AIC and BIC values (Akaike, 1974).

6. Variable selection procedures
Parametric models was used to analyze the relationship between and survival time of obstetric fistula patients and one or more predictors. At Single covariate analysis, we analysed the association between each of the independent variables and survival time of obstetric fistula patients while
7. Results

7.1. Descriptive statistics
Among the two years obstetric fistula patients in the hospital, 19.72%, 41.87% and 38.41% were in age groups ≤ 20, 21–30 and > 30, respectively. The proportion of the patients who were physically cured among these age groups were 64.9%, 75.2% and 76.6% respectively. The output of the study shows that 64.36% and 35.64% of the patients weight are < 50 kg and ≥50 kg, respectively. The physically cured proportion among this weight groups of < 50 kg and ≥50 kg were 71% and 78.6%, respectively. Those patients whose height are less than 150 cms are 38.41% and greater than 150 Cms are 61.59%. The proportion of the patients who were physically cured among the height ≥150 cm are 70.8 % and height <150 cm are 78.4%.

The study shows that 25.26% of the patients in the hospital are married before 18 years, 47.06% between 19 and 22 years and 27.68% above 23 years. Among those 78.1%,75.0% and 67.5% respectively were physically cured. Out of the entire patients accounted in this study, 59.86 % of the patients were not educated where as 40.14% were educated. The result of the study reveals that 61.59% of the patients were not obtained antenatal follow-up care.
Table 1. Summary results of obstetric fistula recovery events in different demographic and health survey (at University of Gondar referral hospital during 2014–2015)

| variables                          | Total N | Percents | Physically cured | Censored |
|------------------------------------|---------|----------|------------------|----------|
|                                    |         |          | No. of event     | Percent  | No. of event | Percent |
| Age at first marriage              |         |          |                  |          |              |         |
| <18 years                          | 73      | 25.26%   | 57               | 78.1%    | 16           | 21.9%   |
| 19–22 years                        | 136     | 47.06%   | 102              | 75.0%    | 34           | 25.0%   |
| >23 years                          | 80      | 27.68%   | 54               | 67.5%    | 26           | 32.5%   |
| Age at occurrence of fistula       |         |          |                  |          |              |         |
| ≤20 years                          | 57      | 19.72%   | 37.0             | 64.9%    | 20.0         | 35.1%   |
| 21–30 years                        | 121     | 41.87%   | 91.0             | 75.2%    | 30.0         | 24.8%   |
| ≥31 years                          | 111     | 38.41%   | 85.0             | 76.6%    | 26.0         | 23.4%   |
| Height                             |         |          |                  |          |              |         |
| <150 cm                            | 111     | 38.41%   | 87               | 78.4%    | 24           | 21.6%   |
| ≥151 cm                            | 178     | 61.59%   | 126              | 70.8%    | 52           | 29.2%   |
| Weight                             |         |          |                  |          |              |         |
| <50 kg                             | 186     | 64.36%   | 132              | 71.0%    | 54           | 29.0%   |
| ≥50 kg                             | 103     | 35.64%   | 81               | 78.6%    | 22           | 21.4%   |
| Educations                         |         |          |                  |          |              |         |
| Educated                           | 116     | 40.14%   | 92               | 79.3%    | 24           | 20.7%   |
| Not educated                       | 173     | 59.86%   | 121              | 69.9%    | 52           | 30.1%   |
| Residence                          |         |          |                  |          |              |         |
| Urban                              | 138     | 47.75%   | 108              | 78.3%    | 30           | 21.7%   |
| Rural                              | 151     | 52.25%   | 105              | 69.5%    | 46           | 30.5%   |
| Follow-up of antenatal care        |         |          |                  |          |              |         |
| Yes                                | 111     | 38.41%   | 77               | 69.4%    | 34           | 30.6%   |
| No                                 | 178     | 61.59%   | 136              | 76.4%    | 42           | 23.6%   |
| Place of delivery                  |         |          |                  |          |              |         |
| Health center                      | 104     | 35.99%   | 77               | 74.0%    | 27           | 26.0%   |
| Home                               | 185     | 64.01%   | 136              | 73.5%    | 49           | 26.5%   |
| Mode of delivery                   |         |          |                  |          |              |         |
| Vaginal                            | 177     | 61.25%   | 125              | 70.6%    | 52           | 29.4%   |
| Non-vaginal                        | 112     | 38.75%   | 88               | 78.6%    | 24           | 21.4%   |
| Durations of urine                 |         |          |                  |          |              |         |
| > 3 months                         | 223     | 77.16%   | 160              | 71.7%    | 63           | 28.3%   |
| 4–6 months                         | 66      | 22.84%   | 53               | 80.3%    | 13           | 19.7%   |
| > 7 months                         |         |          |                  |          |              |         |
| Durations of labor                 |         |          |                  |          |              |         |
| < 2 days                           | 115     | 39.79%   | 79               | 68.7%    | 36           | 31.3%   |
| 2–4 days                           | 155     | 53.63%   | 121              | 78.1%    | 34           | 21.9%   |
| > 4 days                           | 19      | 6.57%    | 13               | 68.4%    | 6            | 31.6%   |
| Width of fistula hole              |         |          |                  |          |              |         |
| ≤2 cm                              | 181     | 62.63%   | 130              | 71.8%    | 51           | 28.2%   |
| 3 cm–5 cm                          | 94      | 32.53%   | 72               | 76.6%    | 22           | 23.4%   |

(Continued)
The study also shows that 77.16% of the fistula patients joined to health center before three months incontinence of urine. And no patients were came to health center after durations of incontinence of urine more than 7 months. The proportion of the patients who were physically cured among those duration of incontinence urine groups ≤ 3 and 4–6 month were 71.7% and 80.3% respectively.

### 8. Comparison of survival experience

The Kaplan Meier estimator survival curve gives the estimate of survivor function among different groups of a covariates to make comparisons. Separate graphs of the estimates of the Kaplan-Meier survivor functions are constructed for different categorical covariates. The survivals of a patient by age at first marriage, Kaplan-Meier survivor estimates for the three age groups were plotted in Figure 2. The figure shows that the age at first marriage below eighteen years had taken more time to physically cured than those who married between nineteen to twenty-two years and above twenty-three years.

| variables          | Total N | Percents | Physically cured | Censored |
|--------------------|---------|----------|------------------|----------|
|                    |         |          | No. of event     | Percent  | No. of event | Percent |
| >5 cm              | 14      | 4.84%    | 11               | 78.6%    | 3           | 21.4%   |
| Length of fistula hole |        |          |                  |          |             |         |
| ≤2 cm              | 176     | 60.90%   | 125              | 71.0%    | 51          | 29.0%   |
| 3 cm-5 cm          | 99      | 34.26%   | 79               | 79.8%    | 20          | 20.2%   |
| >5 cm              | 14      | 4.84%    | 9                | 64.3%    | 5           | 35.7%   |
| Status of urethra  |         |          |                  |          |             |         |
| Intact             | 144     | 49.83%   | 99               | 68.8%    | 45          | 31.3%   |
| Partially damaged  | 102     | 35.29%   | 81               | 79.4%    | 21          | 20.6%   |
| Complete destructed| 43      | 14.88%   | 33               | 76.7%    | 10          | 23.3%   |
| Over all status of ob. fistula | 289 |          | 213              | 73.70%   | 76          | 26.30%  |
This impression was confirmed using formal hypothesis tests in Table 2 below shows; both log-rank and Breslow tests identify significant difference with patients whose age at first marriage below eighteen years, nineteen to twenty-two years and above twenty three years with respect to recovery time. Similarly, among different place of delivery, patient who had delivered at health center had lower recovery time than those who delivered at home. This impression was confirmed using formal hypothesis tests; both log-rank and Breslow tests identify significant difference among place of delivery.

Similarly, Kaplan-Meier survivor estimates for duration of labour, durations of incontinent of urine, width of fistula hole, educational status of patients, residence of patients, weight of patients, height of patients and status of urethra were done (Figure 3). As a results depicts that patient with fast recovery indicators like vaginal delivery, laboured for <2 day, width of fistula ≤2 cm, patients height >150 m, intact of urethra, durations of incontinent of urine ≤3 months, patients came from urban and patients who had formal educations had taken short recovery time. Also, Statistical test by using log-rank and breslow test shows that there is significant difference among the different variable groups.

![Survival Functions](image)

**Figure 3. Kaplan-Meier survivor estimates of the variable place of delivery.**

Table 2 shows the characteristics of obstetric fistula patients that were enrolled into this study. Statistical test by using log-rank and breslow test shows that there is significant difference among the different variable groups. The survivals of a patient by age at first marriage shows significant difference with patients whose age at first marriage below eighteen years, nineteen to twenty two years and above twenty three years with respect to recovery time and patient who had delivered at health center had lower recovery time than those who delivered at home. Similarly, the patient who have follow-up of antenatal care had slightly shorter recovery time compared to patient who have no follow-up of antenatal care service. As a results depicts that significant difference patient with fast recovery indicators like vaginal delivery, laboured for <2 day, width of fistula ≤2 cm, patients height >150 m, intact of urethra, durations of incontinent of urine ≤3 months, patients came from urban and patients who had formal educations had taken short recovery time. Also, Statistical test by using log-rank and breslow test shows that there is significant difference among the different variable groups (Figure 4).

Table 4 shows the result of univariate analysis using Weibull regression model on the time to event of obstetric fistula patients. The covariates like educational status, residence of patients, age at first marriage, height, follow-up of antenatal care, place of delivery, mode of delivery, durations of incontinences of urine, durations of labour, widths of fistula hole and status of urethra are statistically significant at 25% level of significance. But covariates like length of fistula and Age at occurrence of fistula are not significant. The risk factors those were statistically significant were
Table 2. Log-rank and breslow tests of survival time to recovery experience on obstetric fistula patients using demographic and health variables at University of Gondar referral hospital

| Variables                        | Mean recovery time in weeks | Test of Equality over Groups |         |         |
|----------------------------------|-----------------------------|------------------------------|---------|---------|
|                                  |                             | Log-rank/Mantel Cox          | Breslow/G. Wilcoxon |
|                                  |                             | Chi-square | DF | SIG  | Chi-square | DF | SIG  |
| Age at first marriage           |                             |                         |       |       |          |     |    |
| <18 years                        | 6.702                       | 4.359                   | 3.504 |       |          |     |    |
| 19-22 years                      | 57.216                      | 1                       | .000  | 96.851 | 1          |  .000         |
| >23 years                        |                             |                         |       |       |          |     |    |
| Age at occurrence of fistula    |                             |                         |       |       |          |     |    |
| ≤20 years                        | 5.967                       | 4.730                   | 4.670 |       |          |     |    |
| 21–30 years                      | 17.291                      | 1                       | .000  | 19.083 | 1          |  .000         |
| >31 years                        |                             |                         |       |       |          |     |    |
| Height                           |                             |                         |       |       |          |     |    |
| <150cms                         | 6.171                       | 3.882                   |       |       |          |     |    |
| ≥151 cm                          | 5.916                       | 1                       | .015  | 5.945  | 1          |  .015         |
| Weight                           |                             |                         |       |       |          |     |    |
| <50 k.g                          | 3.929                       | 6.257                   |       |       |          |     |    |
| ≥50 k.g                          | 81.439                      | 1                       | .000  | 83.439 | 1          |  .000         |
| Educational levels               |                             |                         |       |       |          |     |    |
| Not educated                     | 6.115                       | 3.824                   |       |       |          |     |    |
| educated                         | 46.640                      | 1                       | .000  | 55.057 | 1          |  .000         |
| Residence of patients            |                             |                         |       |       |          |     |    |
| Rural                            | 5.747                       | 3.990                   |       |       |          |     |    |
| urban                            | 17.536                      | 1                       | .000  | 14.842 | 1          |  .000         |
| Follow-up of antenatal care      |                             |                         |       |       |          |     |    |
| No                               |                             |                         |       |       |          |     |    |
| yes                              | 5.436                       | 4.497                   |       |       |          |     |    |
|                                  | 20.927                      | 1                       | .000  | 16.599 | 1          |  .000         |

(Continued)
| Variables                      | Mean recovery time in weeks | Test of Equality over Groups |
|-------------------------------|-----------------------------|-----------------------------|
|                               | Log-rank/Mantel Cox         | Breslow/G. Wilcoxon         |
|                               | Chi-square                  | SIG                         | Chi-square                  | SIG                         |
|                               | DF                          | SIG                         | DF                          | SIG                         |
| Place of delivery             |                             |                             |                             |                             |
| Home                          | 5.440                       | 19.801                      | 1                            | 0.000                       | 11.810                      | 1                            | 0.001                       |
| Health center                 | 4.508                       |                             |                              |                             |                             |                             |                             |
| Mode of delivery              |                             |                             |                              |                             |                             |                             |                             |
| Non-naginal                   | 3.864                       | 94.159                      | 1                            | 0.000                       | 48.658                      | 1                            | 0.000                       |
| Vaginal                       | 6.163                       |                             |                              |                             |                             |                             |                             |
| Durations of inco/ent of urine|                             |                             |                              |                             |                             |                             |                             |
| <3 months                     | 4.173                       | 6.784                       | 1                            | 0.000                       | 93.717                      | 1                            | 0.000                       |
| 3–6 months                    |                             |                             |                              |                             |                             |                             |                             |
| >7 months                     |                             |                             |                              |                             |                             |                             |                             |
| Durations of labour           |                             |                             |                              |                             |                             |                             |                             |
| <2 days                       | 3.565                       | 5.174                       | 8.106                        | 1                            | 0.000                       | 84.508                      | 1                            | 0.000                       |
| 2–4 days                      |                             |                             |                              |                             |                             |                             |                             |
| >4 days                       |                             |                             |                              |                             |                             |                             |                             |
| Widths of fistula hole        |                             |                             |                              |                             |                             |                             |                             |
| ≤2 cm                         | 3.910                       | 5.719                       | 7.561                        | 85.633                      | 2                            | 0.000                       | 22.477                      | 2                            | 0.000                       |
| 3–5 cm                        |                             |                             |                              |                             |                             |                             |                             |
| >5 cm                         |                             |                             |                              |                             |                             |                             |                             |
| Status of uthera              |                             |                             |                              |                             |                             |                             |                             |
| Intact                        | 3.680                       | 5.052                       | 7.242                        | 65.213                      | 2                            | 0.000                       | 95.171                      | 2                            | 0.000                       |
| Partially damaged             |                             |                             |                              |                             |                             |                             |                             |
| Complete destructed           |                             |                             |                              |                             |                             |                             |                             |
| Over all mean all variables   | 5.19                        |                             |                              |                             |                             |                             |                             |

DF: degree of freedom
SIG: significance level
Table 3. The AIC and BIC value for Exponential and Weibule parametric regression models

| MODEL            | AIC     | BIC     |
|------------------|---------|---------|
| Exponential model| 597.738 | 597.738 |
| Weibule model    | 396.032 | 337.3692 |

Table 4. The result of univariate analysis using Weibull regression model on the time to event of obstetric fistula patients at university of Gondar, during 2014–2015

| Covariate                              | HR     | SE     | Z      | P>|Z|     | 95% CI for HR |
|----------------------------------------|--------|--------|--------|---------|----------------|
| Age at first marriage                  | 2.170802| .4137388| 4.07 | 0.000 | 1.494127 | 3.153936 |
| Age at occurrence of fistula           | 1.303581| .1282211| 2.70 | 0.007 | 1.075012 | 1.580748 |
| Height                                 | .0503226| .0057766| 2.7  | 0.007 | .005732  | .4417925 |
| Weight                                 | .8164163| .4088204| -0.41| 0.023 | .3059656 | .678466 |
| Education                              | 2.651977| 1.478715| -1.75| 0.018 | .88909   | .910261 |
| Residence                              | 1.576839| .3237861| 2.22 | 0.007 | 1.494127 | 2.358153 |
| Antenatal care                         | 1.388723| .2027143| -2.25| 0.024 | 1.043202 | 1.848712 |
| Place of delivery                       | .9486912| .1500878| -0.33| 0.003 | .6957615 | .993568 |
| Mode of delivery                        | .1567468| .1765072| -1.65| 0.010 | .0172461 | .424647 |
| Durations of incontinences of urine    | .1467192| .0485375| 5.80 | 0.000 | .0767173 | .2805954 |
| Durations of labor                     | .2313575| .0533374| -6.35| 0.000 | .1472471 | .3635134 |
| Widths of fistula hole                  | .268392 | .0940716| -3.75| 0.000 | .1350276 | .5334779 |
| Length of fistula hole                  | .7849736| .1990998| -0.95| 0.551 | .4774823 | .8290484 |
| Status of urethra                       | .3489244| .0922614| -3.98| 0.000 | .2078067 | .5858727 |

Figure 4. Cox-Snell residual plots for parametric models comparison between Weibull and exponential regression model. As we can see from the above Cox-Snell residual plots that Weibull regression model seems the best fit among the two models. In addition to the graphical comparison of the two parametric regression models, we used Akaikie information criterion (AIC) and Bayesian information criterion (BIC) to choose the best model out of the two possible models. As shown in Table 3, the Weibull regression model with the smallest value of AIC and BIC seems to be the best fit of the two models.
included in the final Weibull regression model for the prediction of survival probability of recovery obstetric fistula women.

Table 5 indicates parameter estimates of the final multivariable Weibull regression model. Results presented in Table 5 indicates that survival time recovery of obstetric fistula patients were significantly related with educational status, residence of patients, age at first marriage, height, follow-up of antenatal care, place of delivery, mode of delivery, durations of incontinences of urine, durations of labour, widths of fistula hole and status of urethra.

From the Weibull regression model, the hazard rate for age at first marriage <18 year patients were 1.57 times (95% CI: 1.011, 3.358, p = 0.001) that of patients who had married above 23 years, whereas the hazard rate for age at first marriage in between 19–22 year patients were 1.35 times (95% CI: 1.211, 3.687, p = 0.002) that of patients who had married above 23 years. The hazard rate of patients whose height <150cms were 1.353 times (95% CI: 1.23, 4.13D, p = 0.013) that patient whose height were ≥150cms. The hazard rate of patients with intact urethra were 0.532 times (95% CI: 0.258, 1.783, p = .001) that of complete destructed of urethra and the hazard rate of a patient with partially damaged urethra were 0.695 times (95% CI: 0.435, 2.86, p = 0.000) that of patient whose urethra were complete destructed.

Considering place of delivery of patients, the hazard rate of a patients who had delivered at home were 35.7% greater than (95% CI: 1.456, 4.536, p = 0.007) that of who delivered at health center. Looking at duration of labour, the hazard rate decrease for patients who had laboured < 2 day (HR = 0.412,CI:432,965) to those patient who laboured for > 4 day. Moreover, by letting other covariates constant, the hazard rate of a patients who delivered with vaginal were 0.473 time that of who delivered with non-vaginal.

To assess the adequacy of Weibull regression model, we used the likelihood ratio test presented in Table 6. It illustrate that the model was significantly fit the data of recovery of obstetric fistula and in using the log likelihood values of the null model and the full model, it can be seen that the model has a significant improvement after the covariate is incorporated in the model.

9. Discussions
From the study using Weibull regression model, we found that the factors that significantly affects the recovery status of a patient are age at first marriage, weight, height, education status, residence of patients, follow-up of antenatal care, place of delivery, duration of labour, mode of delivery, duration of incontinence urine, width of fistula hole and status of urethra. But covariates like age at occurrence of obstetric fistula and length of fistula were not influential. Both univariate and multivariate statistical analyses were employed.

One of the factors that affect recovery from obstetric fistula is the patient’s age at first marriage. The hazard of a patient who had married early before eighteen years was higher as compared to patient who had married after twenty three years. This result is in accordance with the study in Afghanistan by Social and Health Development Program (Social and Health Development Program: SHDP, 2011). Weight of a patient is an important predictor for the recovery of obstetric fistula patient. This study shows that the hazard rate of a patient with weight ≥50 kg is higher as compared to those whose weight < 50 kg. Which indicates that smaller weight increases the chance of recovery as compared to higher weight. Height of a patient is also a prognostic factor that significantly predicts the recovery time of obstetric fistula patient. The hazard rate of a patient with height < 150cm were much higher. That is, taller patient is more likely to recover than shorter one. These results are comparable with earlier study in Ethiopia by (Tesfaye G.,2013).

The educational status of patients is another prognostic factor that significantly predicts the recovery time of obstetric fistula patient. The result obtained from this study indicates that the recovery time for educated patient is shorter than non-educated one. improving of educational
Table 5. Indicates parameter estimates of the final multivariable Weibull regression model

| Covariates                      | Covariate effects (γ) | β   | SE  | Wald | Sig. | HR  | 95.0% CI for HR |
|---------------------------------|-----------------------|-----|-----|------|------|-----|-----------------|
|                                 |                       |     |     |      |      |     |                 |
|                                 |                       |     |     |      |      |     |                 |
| Age at first marriage           |                       |     |     |      |      |     |                 |
| <18                             | -2.213                | 1.312 | .204 | 6.435 | .001 | 1.573 | 1.011 – 3.58    |
| 19–22                           | -2.463                | .834 | .098 | 8.536 | .002 | 1.351 | 1.211 – 3.687   |
| >23 (R)                         |                       |     |     |      |      |     |                 |
| Height                          |                       |     |     |      |      |     |                 |
| <150 cm                         | -1.647                | .213 | .034 | 6.354 | .013 | 1.353 | 1.23 – 4.132    |
| ≥150 cm(R)                      |                       |     |     |      |      |     |                 |
| Weight                          |                       |     |     |      |      |     |                 |
| <50 kg                          | .3154                 | -.886 | .421 | 2.113 | .201 | .435  | 1.213 – .874    |
| ≥50 kg (R)                      |                       |     |     |      |      |     |                 |
| Education                       |                       |     |     |      |      |     |                 |
| Not educated                    | -4.671                | -1.413 | .166 | 8.536 | .102 | 1.335 | 1.224 – .892    |
| Educated (R)                    |                       |     |     |      |      |     |                 |
| Residence                       |                       |     |     |      |      |     |                 |
| Urban                           | .2154                 | .548 | .079 | 6.889 | .062 | .463  | 1.235 – 5.685   |
| Rural (R)                       |                       |     |     |      |      |     |                 |
| Follow-up                       |                       |     |     |      |      |     |                 |
| Yes                             | .6521                 | -1.323 | .567 | 2.331 | .211 | .687  | .425 – .998     |
| No (R)                          |                       |     |     |      |      |     |                 |
| Mode of delivery                |                       |     |     |      |      |     |                 |
| Vaginal                         | .3562                 | -.453 | .126 | 3.665 | .025 | .473  | 1.315 – 3.857   |
| Non-vaginal(R)                  |                       |     |     |      |      |     |                 |
| Duration of inc. urine          |                       |     |     |      |      |     |                 |
| <3 months                       | .6873                 | .654 | .169 | 3.886 | .245 | .563  | .385 – .896     |
| 3–6 months(R)                   |                       |     |     |      |      |     |                 |
| Duration of labor               |                       |     |     |      |      |     |                 |

(Continued)
| Covariates                  | Covariate effects ($\gamma$) | $\beta$  | SE  | Wald | Sig. | HR   | 95.0% CI for HR |
|-----------------------------|-------------------------------|-----------|-----|------|------|------|-----------------|
|                             |                               | Lower | Upper |      |      |      |                 |
| <2 days                     |                               | .6874  | .8754|      |      |      |                 |
| 2–4 days                    |                               | -.235  | -.865|      |      |      |                 |
| >4 days (R)                 |                               | .053   | .178 | 4.523| .012 | .856 | .432            |
|                             |                               |         |      |      |      |      |                 |
|                            |                               | .178   | .303 |      |      |      |                 |
|                            |                               | .588   | .012 |      |      |      |                 |
|                            |                               | .912   |      |      |      |      |                 |
|                            |                               | .533   |      |      |      |      |                 |
| Width of fistula hole       |                               |        |      |      |      |      |                 |
| ≤ 2 cms                     |                               | -.031  | .232 |      |      |      |                 |
| 3–5 cms                     |                               | -.209  | .487 |      |      |      |                 |
| >5 cms (R)                  |                               | .029   | .059 | 6.998| .466 | .453 | .246            |
|                             |                               |         |      |      |      |      |                 |
|                            |                               | .029   | .059 |      |      |      |                 |
|                            |                               | .466   | .743 |      |      |      |                 |
|                            |                               | .453   |      |      |      |      |                 |
|                            |                               | .587   |      |      |      |      |                 |
|                            |                               | .365   |      |      |      |      |                 |
| Status of urethra           |                               |        |      |      |      |      |                 |
| Intact                      |                               | .196   | .235 |      |      |      |                 |
| Partially damaged           |                               | -.121  | -.543|      |      |      |                 |
| Completely destroyed (R)    |                               | .013   | .065 | 9.355| .001 | .532 | .258            |
|                             |                               |         |      |      |      |      |                 |
|                            |                               | .013   | .065 |      |      |      |                 |
|                            |                               | .532   |      |      |      |      |                 |
|                            |                               | .435   |      |      |      |      |                 |
|                            |                               | 2.86   |      |      |      |      |                 |
| Place of delivery           |                               |        |      |      |      |      |                 |
| Home                        |                               | .235   |      |      |      |      |                 |
| Health center (R)           |                               | -.323  | .133 | 4.665| .007 | 1.357| 1.456           |
|                             |                               |         |      |      |      |      |                 |
|                            |                               | .133   | .0    |      |      |      |                 |
|                            |                               | 1.357  |      |      |      |      |                 |
|                            |                               | 1.456  |      |      |      |      |                 |
|                            |                               | 4.536  |      |      |      |      |                 |

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status increases the chance of recovery. This result confirm with the result obtained from the previous studies (Halle-Ekane et al., 2015). Residence of patient is the strong predictor for recovery time of obstetric fistula patient. Which means, patient who live at urban have more chance to recover than patient who live at rural. This result is in accordance with the studies from North Western Nigeria by (Emmanuel Ajuluchukwu Ugwa, 2014).

For antenatal care use, the study revealed that the hazard rate of a patient who had no follow-up of antenatal care is higher than those who had antenatal care service. Use of antenatal care service improve the chance of recovery. These results confirm the result obtained from the previous study. The mode of delivery is another prognostic factor that significantly predicts the recovery time of obstetric fistula patient. The result obtained from this study indicates that the recovery time for vaginal delivery of a patient is shorter than non-vaginal delivery.

Duration of labour is an important predictor for the recovery of obstetric fistula patient. This study shows that the hazard rate of a patient who had laboured for > 4 day is higher than those who laboured for < 2 day. That is, a shorter time of obstructed labour is more likely to recover than long time laboured patient. The result is in accordance with (Tom J I P Raassen et al., 2008). Similarly, place of delivery is the stronger predictor for recovery time of obstetric fistula patient which means, patient who delivered at health center have more chance to recover than patient who delivered at home. This result is in accordance the previous study in Ethiopia by (Abebe, 2015).

The width of fistula has been found to be significant predictor for recovery of obstetric fistula patient. Which indicates that smaller size of width of fistula increases the chance of recovery as compared to large size of width of fistula hole. The result is comparable with earlier study (Ahmed & Creanga, 2015). In addition to those factors, status of urethra also had a significant effect on the recovery time of obstetric fistula patient. The finding illustrate that the hazard of recovery due to obstetric fistula patient is higher for patients who had complete destructed of urethra than those who had intact and partially damaged of urethra. The results on length of fistula and educational status were contradict with earlier study in Ethiopia by Tesfaye G.,2013) Hence, the Weibull regression model is a good to fit the recovery time of obstetric fistula patients considering in this study.

### 9.1. Conclusions

For determining the risk factors for the physically cured of obstetric fistula patients and modeling the survival time, a total of 289 patients were included in the study out of which 213 were physically cured and the rest 76 were censored. The average survival times of a patient stay in the hospital to treated and physically cured is 5.19 weeks. To predict and model the recovery time of obstetric fistula patients, the Weibull regression survival model is better fitted to predict the recovery time of the disease than the other Exponential regression model. The result indicated that recovery time of a patient is statistically different among groups classified age at first marriage, weight, height, follow-up of antenatal care, place of delivery, mode of delivery, duration of labour, duration of incontinence urine, width of fistula hole, status of urethra educational status and residence of patients.
9.2. Limitation of the study

As different literature pointed out, there are different factors that are assumed to have impacts on the survival of obstetric fistula patients such as parity, sexual assaults and trauma. However, data on these variables could not be available in hospital records, so these variables were not integrated in this study and the study was conducted based on secondary data which might have incomplete.

9.2.1. Recommendations

- Massive awareness campaign at different levels
- Determine needs and embark on massive treatment, rehabilitation, and social re-integration of patients back into their communities after successful treatment.
- Strong political will and commitment at all levels
- The local health officers and clinicians should introduce awareness for women to be delivered at health center
- Awareness have to be given for the society on the risk of early marriage before eighteen years and taking care before delivery time is reach.
- This study shows that main predictive factors for the recovery time of obstetric fistula patients are more health variables, so health workers should be cautious when a patient are complete destructed of urethra, large length and width of fistula, no follow-up of antenatal care, long obstructed labour and non-vaginal delivery
- Future interventions should test strategies for reducing stigma and improving community support to empower women living with fistula with the knowledge and means for seeking treatment.

Abbreviations

AIC: Akaike Information Criterion; AVD: Assisted Vaginal Delivery; BIC: Bayesian Information Criterion; CPD: Cephalopelvic Disproportion; CINCSERB: Collage Of Natural And Computational Science Ethical Review Board; HR: Hazard Ratio; KM: Kaplan-Meier; LL: Log Partial Likelihood; ML: Maximum Likelihood; RVF: Recto-Vaginal Fistula; UNFPA:United Nation Population Fund; VVF: Vesico Vaginal Fistula; WHO: World Health Organization.

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Availability of data and materials

The datasets analyzed during the current study were available from the corresponding author on reasonable request.

Competing interests

The authors declare they have no competing interests.

Ethical considerations

All procedures performed in studies involving human participants were in accordance with the ethical standards of University of Gondar institution and the University research committee declarations with comparable ethical standards for confidentiality.

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