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EFFECT OF POLLUTED WELL WATER BY BACTERIA *E. COLI* TO URINARY TRACT INFECTIONS IN PREGNANT WOMEN

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ABSTRACT

Well water Pollution has occurred in the city of Yogyakarta, 46% of them are polluted by *E-coli* bacteria. In the research journal written by KY Loh and Friends in 2007 states that 10% of pregnant women experience pain and 90% of urinary tract infections (UTI) is caused by bacteria *E coli*. Means that most UTI in pregnant women are caused by *E coli* bacteria. From this phenomenon, this study wants to prove there is a relationship between well water Pollution by *E coli* bacteria and UTI disease of pregnant women who use well water contaminated with *E coli* bacteria, and how big the relationship is. This research method uses etiological analytic observational design with the *Prospective Cohort* approach and hypothesis testing using categorical comparative. With the *chi square* statistical test continued to the *fisher* test results obtained p value = 0.011 and α = 0. 05. Thus the value of p <α, which means there is a relationship between the quality of water used with UTI sick pregnant women. The other result is Relative UTI RISK (RR) = 5.4 with 95% converting interval. For the detailed results of the RR significance of 1.441 ≤ RR ≤ 20.236 that does not exceed 1, which means that there is a meaningful relationship between pregnant women who use contaminated water quality will be affected by UTI . From the analysis of UTI risk estimation (RR) of = 5.4 with a confidence level of 95%, it can be concluded that pregnant women who use well water contaminated with *E coli* bacteria will be 5 times more likely to be exposed to the UTI risk of UTI compared to pregnant women who use well water not contaminated with *E coli* bacteria.

KEY WORDS : Pollution by *E coli*, Water wells, UTI pregnant women, The city of Yogyakarta Indonesia, The correlation of *E coli* and UTI.

INTRODUCTION

Ground water is one source of clean water that is important for human life and the environment. Although groundwater is only around 0.62 % of all water on earth, its function for humans is vital. Ground water plays a very important role for humans because it is easy to obtain, cheap, and of relatively good quality (Notodarmojo, 2005). Clean water sourced from ground water that will be used by humans for their daily needs must meet health requirements. Health requirements include microbiological, physical, chemical and radioactive parameter requirements. The clean water requirements, especially those related to microbiological parameters in the form of total coliform for water sources that are not piped, the maximum permissible level is 50 MPN/100 mL (Peraturan Menteri Kesehatan, 1990).

Within the scope of activities, total coliform bacteria that pollute water can originate from organic waste, animal waste and domestic waste from latrines, bathing and septic tank shelters (Notodarmojo, 2005). This domestic wastewater can be a source of pollutants to residents' well water. One of the domestic waste pollutants comes from human feces that predominantly contain *E. coli* bacteria (Notodarmojo, 2005). That way, *E. coli* bacteria become one of the dominant bacteria that can contaminate well water.

Likewise, what happened in the city of Yogyakarta, Indonesia, is that most of the city residents still use groundwater through shallow wells as a source of clean water for the fulfillment of daily life. However, not all sources of clean water meet clean water standards that are free from Pollution (Hendrayana, 2013; Vupalla, 2005). Ground water in the city of Yogyakarta is also polluted by domestic waste pollutants in the form of *E. coli* bacteria that come from human feces. This is reinforced from the data from the Yogyakarta City Health Office in 2015 showing that of 1060 samples of Yogyakarta City's shallow wells 490 wells (46%) did not qualify as clean water because they contained fecal coli and *E. coli*. Likewise, data from Health Ministry in Yogyakarta in the same year (2015) showed data that were close to the same, namely the source of water from ground water through well water that fulfilled the requirements of clean water at 54.5%, and the remaining 45.5% did not meet the requirements because it contained *E. coli* bacteria (Dinas Kesehatan Kota Yogyakarta, 2015; Dinas Kesehatan Kota Yogyakarta, 2016).

Well water Pollution by *E. coli* bacteria becomes urinary tract infections (UTI) risk when it is used by residents, especially residents who are vulnerable to health UTI risks such as pregnant women. Well water that contains *E. coli* bacteria when used by pregnant women to clean their genitals will put pregnant women at UTI risk of developing urinary tract infections (Lee, 2019). Reinforced by the condition of pregnant women who have anatomically and hormonal changes with high potential for UTI (Le, 2004). This UTI risk is shown by research data that as many as 15% of women will have one episode of UTI during their lifetime and 10% of them are pregnant, and up to 90% of UTI are caused by *E. coli* bacteria (Loh, 2007; Le, 2004; Ayub, 2016). UTIs in pregnant women have great health UTI risks. If left untreated, this UTI can be come resistant and also cause premature rupture of membranes, premature births, and low birth weight (Philips, 2019; Alexander, 2012; Suwarsono, 2019). The above data confirms that pregnant women are at UTI risk because of the well water pollution by *E. coli* bacteria

With great health UTI risks due to well water Pollution, especially for pregnant women, it is important to detect early the condition of well water and the impacts caused when used. This condition is the basis of this study that maintaining the health of pregnant women and the fetus in order to improve the health of pregnant women and the quality of the environment, can start from maintaining the quality of well water. Control of well water quality and detection of well water Pollution are efforts to reduce the number of pregnant women with UTI due to exposure to *E. coli* bacteria. Furthermore, this research specifically wants to find pregnant women with UTI caused by *E. coli* bacteria due to using well water which has also been contaminated with *E. coli* bacteria. In a sense, a proof of the relationship between pregnant women with UTI caused by *E. coli* bacteria will be sought due to using their well water which is also contaminated with *E. coli* bacteria.

This study is original and there are no previous studies or journals that are exactly the same both regarding the location and problem, objectives and research methods. In the study of Philipps *et al*. (2019) who also examined pregnant women with UTI with an observational *cohort* approach, but focused on providing drug treatment to pregnant women. The result is that giving drugs to pregnant women can reduce UTI. So Philip's study did not examine specifically the cause of UTI for pregnant women. Likewise, research conducted by Jenifer Le *et al*. (2004) examined UTI during pregnancy. The results mentioned that most pregnant women experience UTI pain due to bacteria, and can have an impact on the safety of babies and pregnant women. Also suggested is the need for management and initial handling. So in both studies did not examine specifically the cause of UTI for pregnant women.

The problem formulation for this research are: (1) Is there a relationship between well water pollution by *E. coli* bacteria and urinary tract infections (UTI) pain of pregnant women who use well water contaminated with *E. coli* bacteria; and (2) How big is the relationship. While the objectives of this research are (1) Finding a relationship between well water pollution by *E. coli* bacteria and urinary tract infections (UTI) pain of pregnant women who use well water contaminated with *E. coli* bacteria; and (2) find the magnitude of the relationship.

MATERIALS AND METHODS

Study Design

This research was analytic observational. With the aim is to want to find the relationship between 2 variables which is a cause-effect relationship. For a causal relationship a variable as a UTI risk factor

and a variable as an effect is called etiologic. The first type of variable is the quality of well water that is polluted and not polluted and the second variable is the sick status of UTI of pregnant women namely UTI and Non UTI. It's so all the variables are included variable categorical. It means that the variable relationship that is studied is categorical with categorical and is called categorical comparative (Dahlan, 2018).

In analytic research the level of research validity becomes an important consideration in the selection of research designs. First, try the approach with the best validity. Some of the approaches are experiment, cohort, case control, and cross sectional. The order of these methods at the same time shows the ideal design priorities. If possible choose the experimental method. If this is not possible, then the cohort design method is chosen, and so on. However, if the design cohort and case control also does not allow the design of cross sectional plus can be used as an alternative (Dahlan, 2014; Dahlan, 2018).

In this research, we try to use a method of proving the relationship between variables that is close to the ideal that is possible. In an ethics may not be done with the approach because it involves human experiments. So the approach that is still possible and adapted to the capability is analytic-etiological observational with *Cohort Prospective* approach.

Prospective cohort study is a study to determine the relationship between UTI risk factors and effects through a longitudinal approach to the front or prospective. The UTI risk factors to be investigated are identified first then followed prospectively for the onset of the effect, namely disease. Pregnant women who use well water polluted by *E. coli* bacteria are a positive UTI riskfactor (+) and pregnant women who use well water that is not polluted by *E. coli* bacteria are a negative UTI risk factor (-). Then followed longitudinally in a certain period of time both and then measured the effect of the emergence of UTI in these pregnant women. The results of this study will compare the proportion of subjects who become effect (+) and effect (-) between the group of subjects studied with UTI risk factors (+) with groups of subjects with UTI risk factors (-) (Notoatmodjo, 2014).

Study Population

The study was conducted in Yogyakarta City, Yogyakarta Special Region of Indonesia. Special Region of Yogyakarta (DIY) is a provincial-level special region with its capital in Yogyakarta. Subject research, there are two that pregnant women who take the antenatal care programmein some health centers in the city of Yogyakarta and surrounding areas, and the well water used pregnant women who are into these samples. Then, resesearcher determine population targeted and population affordable based on research design (Dahlan, 2014; Dahlan, 2018). The population targeted in this study was all pregnant women who follow antenatal care courses in health centers the city of Yogyakarta and surrounding areas. While the population is affordable is all pregnant women who come to follow the antenatal care programmeand checkups in health centers city of Yogyakarta and surrounding areas in the period from October of 2018 until December 2019 that can be found and appropriate the inclusion and exclusion criteria.

Inclusion Criteria

1. Pregnant women who follow and / or have a health insurance card (BPJS, JAMKESMAS, JAMKESDA).
2. Pregnant women who come for a pregnancy check in the antenatal careprogramme at the health center in all trimester pregnancies except in trimester 3, the estimated day of birth is less than 1 month.
3. Using well water in his home for the sake of

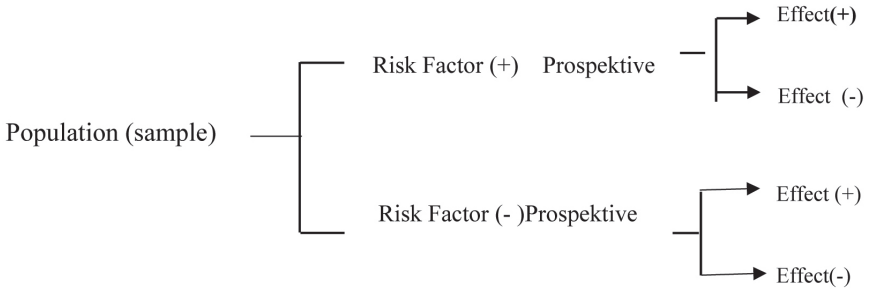

Fig. Cohort Design Concept
Source: Notoatmodjo, 2014

personal hygiene and genitals by using a *cleanser* without being treated or boiled until boiling.
4. Pregnant women who doing clean wicker the genitals is true that from the direction of front to back.
5. Pregnant women whose well water used is still natural and efforts are not being carried out *treatment* / processing with certain tools or chemicals.
6. Pregnant women who are most of the time (minimum 16 hours a day) when cleaning their genitals using a splash with water wells in their homes.
7. Willing to participate and be a respondent / participant in this study.

Exclusion Criteria

1. Pregnant women who are being hospitalized and / or are using a catheter.
2. Clean the genitals by using a splash from the well water in the wrong way, from back to front.
3. Pregnant women who in the past week have been and / or are undergoing therapy for taking medication due to UTI.
4. Not willing to participate and become respondents in this study.

The purpose of sample selection by inclusion and exclusion criteria are to answer the aims of this research and to get high validity samples (Dahlan, 2014; Dahlan, 2018). Samples were taken from two subjects, namely pregnant women who had a pregnancy check at the *puskesmas* in the form of urine and well water from the pregnant woman. The amount of sample is taken based on the comparative two proportion (Dahlan, 2016) with a value of P1 = 0.755; P2 = 0.5; á = 0.05; â = 0.2. After calculating the sample size formula, the result is large n1 = n2 = 55.17 (rounded to = 55). Means the total number of subjects in group 1 (n1) and group 2 (n2) = 110.

Data Collection

Samples were taken from an affordable population that met the inclusion and exclusion criteria for 2 research subjects, pregnant women who took part in the antenatal care program and came and could be found during the pregnancy check up at the health centers (*puskesmas*) in Yogyakarta and surrounding areas. The sample is a midstream urine sample (Kaduma, 2019). Another sample is the pregnant mother's well water. Based on the calculation of the number of samples, a minimum of 110 samples were taken. In accordance with the prospective cohort design chart, the total sample of 110 already consists of UTI risk factors (+) and UTI risk factors (-) according to real incident, and must appropiate with inclusion and exclusion criteria (Dahlan, 2014; Dahlan, 2016; Dahlan, 2018).

Furthermore, to the efficiency of time and cost, and affordability then sample taken under the incident of real women who follow courses of antenatal care and come antenatal to health centers (*puskesmas*) until the number of samples required (Dahlan, 2018). The first phase, then from the selected sample a rapid test was conducted. Quickly test examination dipsticdone by examination of leukocytes urine of pregnant women in local*puskesmas's* labortory. Diagnosis of UTI can be done by early detection of urine leukocytes. The purpose of the rapid test is to determine the early indications of a pregnant woman with UTI. If the negative rapid test results do not need to be done by culture (Hapsari, 2017; and Seputra, 2015).

Henceforth, all negative urine test results for pregnant women (Non-UTI) were traced to their place of residence and then a sample of well water was taken. The well water samples were then tested for quality at the Health Laboratory of the DIY Regional Government according to instructions from the Ministry of Health whether or not the *E. coli* bacteria was found. The technique of taking well water samples and laboratory testing according to standard operating procedure (SOP) from the Ministry of Health. Furthermore, the results of the analysis of the well water quality are categorized as polluted and not polluted. The categorization of well and polluted well water is based on the standard amount of *E. coli* bacteria in the water. If the bacterial content is greater than 50 MPN/100 mL, it is categorized as polluted. Meanwhile, if the amount of bacterial content in the water is smaller than 50 MPN / mL, it is categorized as not polluted. Water wells are categorized as polluted in the design of the cohort as a UTI risk factor (+) and the category is not polluted as a UTI risk factor (-) (Notoatmodjo, 2014; Peraturan Menteri Kesehatan, 1990; Peraturan Menteri Kesehatan, 2014).

Henceforth, all of the following samples of the negative quick urine test results for pregnant women (Non-UTI) are complete with the sampling of the well water and then proceed to the second stage after an interval of approximately 1 month (in the next *antenatal care* examination period). In the second stage, the examination of pregnant women is

carried out either by a rapid test or by urine culture.

A quick test is still done to find out an indication of a UTI. In pregnant women who indicated UTI (+) then the diagnosis is made by a doctor with history taking and physical examination. Whereas examination with urine culture (carried out at the Yogyakarta Regional Government Health Laboratory) to determine the amount of *E. coli* bacteria. Urine culture laboratory tests were carried out on urine samples of pregnant women to find the content of *E. coli* bacteria. The techniques and procedures for urine sampling and laboratory analysis are in accordance with the SOP of the medical safety and management of urinary tract infections in pregnancy. The results of the urine culture laboratory analysis are needed to support and ensure the diagnosis of UTIpain in pregnant women (Susanto, 2017; Peraturan Menteri Kesehatan, 2014; Institute of Obstetricians and Gynecologist, 2015).

To establish a diagnosis of UTI, bacteria must be found in urine through culture or with a significant amount. The significance level of bacteria in the urine is greater than 100,000 cfu / m l urine in asymptomatic patients expressed UTI. Whereas there are UTI patients with symptoms or also called symptomatic, the number of bacteria is said to be significant if it is greater than 1000 cfu / mL of urine (Seputra, 2015).

The results of the doctor's diagnosis and supported with laboratory results of urine culture and the resulting status of pregnant women in the category of UTI (+) or UTI (-). The terms UTI (+) and UTI (-) in accordance with the *cohort* design in this study. At this point, the data collection is complete and then the hypothesis analysis is performed with a statistical test.

Ethical Consideration

This research was conducted after obtaining permission or approval from the Health Research Ethics Commission/Health Research Ethics Committee of the Faculty of Medical, University of Sebelas Maret Surakarta Indonesia, Eleven March, Surakarta, Central Java, Indonesia, with the number: 36 / UN27.6 / KEPK / 2018 on October 24, 2018.

Data Analysis

After all the data is complete and valid according to the research design, the next is to prove the hypothesis by using statistical tests (Dahlan, 2014). The type of statistical test is a comparative 2x2 categorical table so the analysis uses *chi square*. If the *chi square* test requirements are not required then an alternative fisher test is chosen. What will be calculated in this *chi square* statistical test are *Relative UTI RISK* (RR), and p value (p)**.** Then prove the statistics by counting x^2 count, Sig (α) and C_1 95% (Dahlan, 2016; Dahlan, 2018 and Lemeshow, 1997).

Starting from the research data inputted into the SPSS statistical program. The results of the *chi square* statistical analysis are *Relative UTI RISK* (RR), and p value. If the p value < á means that there is the influence of variable independent of the dependent or no effect of the use of well water contaminated with the bacterium *E. coli* UTI pregnant women. While the RR value indicates the probability of an event occurring. Also seen from the analysis of statistical significance whether influential or not the independent variable against variable dependent (Dahlan, 2016; Lemeshow, 1997).

RESULTS AND DISCUSSION

The results of the observation study of this form of primary data mom pregnant who meet the criteria gained as much as 111 samples, consisting of the quality of water art and quality of water wells. The quality of urine is the result of laboratory urine culture. From the results of the culture of urine laboratory that and combined with the results of the diagnosis of pregnant women are then categorized as urinary tract infections (UTI) and non UTI based on specified standards.

The results of the categorization of the data of research that is: There are 9 pregnant women in the category of UTI (8.11%) and some 102 others in the category of non-UTI (91.89%). While the quality of the water wells that is the result of the analysis laboratory to sample water wells mother pregnant. From the well water quality data, then categorized as polluted and not polluted according to specified standards. The results of the categorization of the quality of the water wells: there are 30 data in pollutedcategory (27.03%) and there are 81 data in not pollutedcategory (72.97%).

With such a total sample of mothers pregnant both the quality of urine and quality of the water wells that had been fulfilling and used as an analysis of statistical totaling 111 samples. From the data as much as 111 samples that did not exist that is missing so that the data 100% valid. The complete data is presented as the following Table.

In research it has carried out efforts to maintain

Table 1. Water Quality Status of Well and UTI Status of Pregnant Women

Varabel	n	%
Status of Well Water		
Polluted	30	27.03
Not polluted	81	72.97
Status of UTI Pain in Pregnant Women		
UTI	9	8,11
Non UTI	102	91.89
Total	111	100.00

the validity of the data of the bias control of confounding, biased information and selection. In addition, it is also sought that the amount of valid data meets the minimum amount required in this study. In the study of Laily in 2018 show that there was no significant relationship between the level of socioeconomic and education with UTI in pregnant women (Laily, 2018). However, this research is still trying to control confounding. Variable confounding is not measured separately but variable which became the subject of research is already controlled when design with criteria of inclusion and exclusion, and does not exist anymore stage control in the analysis (Dahlan, 2018).

Because the research is an observational analytic etiologic then use design cohort prospective follows proving the hypothesis to the test statistic is an approach that the degree of validity of the most high. This is a strength of this study. Strength of this study is the establishment of diagnoses with supporting data in the form of laboratory analysis of pregnant women urine using the culture method. While weakness is a control for confounding carried out limited when it designed with approach to the criteria of inclusion and exclusion.

From the chart the flow of research seen that after all the data is valid and complete a number of minimum required in a number of samples, subsequently conducted test statistic *chi square*. The analysis steps are as follows.

First associated data between variables in detail. The results of the data that is detailed consisted of:

1. There are 78 pregnant women who are not sick with a UTI with the quality of the well water they use is not polluted.
2. There are three mothers pregnant were UTI with the quality of the water wells that use is not contaminated.
3. There are 24 pregnant women who are not sick with a UTI with the quality of the well water they use is polluted.
4. There are six mothers pregnant were sick UTI with the quality of the water wells that used contaminated.

***Chi Square* Test**

From the data presented in the form of 2x2 tabulation it will be used as a basis for statistical tests with chi square. In table test Chi square that with the hypothesis: H_0: There is no relationship between the quality of the water with the Hospital of UTI; H_1: There is a relationship between water quality and UTI pain; Level of Significance $\alpha = 0.05$; Critical Area: H_0 is rejected if the value of P value $<\alpha$.

The results of the chi square test there is 1 cell (25%) has an expected value below 5 (that is valued at 2.4), then the chisquare test does not required. Further been testing alternative that test fisher. Fisher test results p value of 0.011 which means the value of $p < \alpha$. In conclusion H_0 is rejected, then H_1 received thus can be concluded that there is a relationship between water quality were used and UTI.

The closeness of the relationship between the two variables can be seen in the *Risk Estimate* table (which is obtained from the statistical test output on the computer).

Relative Risk (RR) indicates the chance of an event occurring (risk). For cohort UTI (from table output) is a relative UTI risk (RR) which compares a mother pregnant were sick UTI with maternal pregnant are NonUTI. In the output table an estimated RR value of = 5.4 is obtained. It is also shows the relationship that the mother was pregnant that use quality water is polluted will affect the

Table 2. The data is then presented in tabulated 2x2 form as follows:

		UTI pain				Value of p
		UTI		Non UTI		
		n	%	n	%	
Water quality	Polluted	6	20	24	80	0.011
	Not Polluted	3	3,7	78	96.3	
Total		9		102		

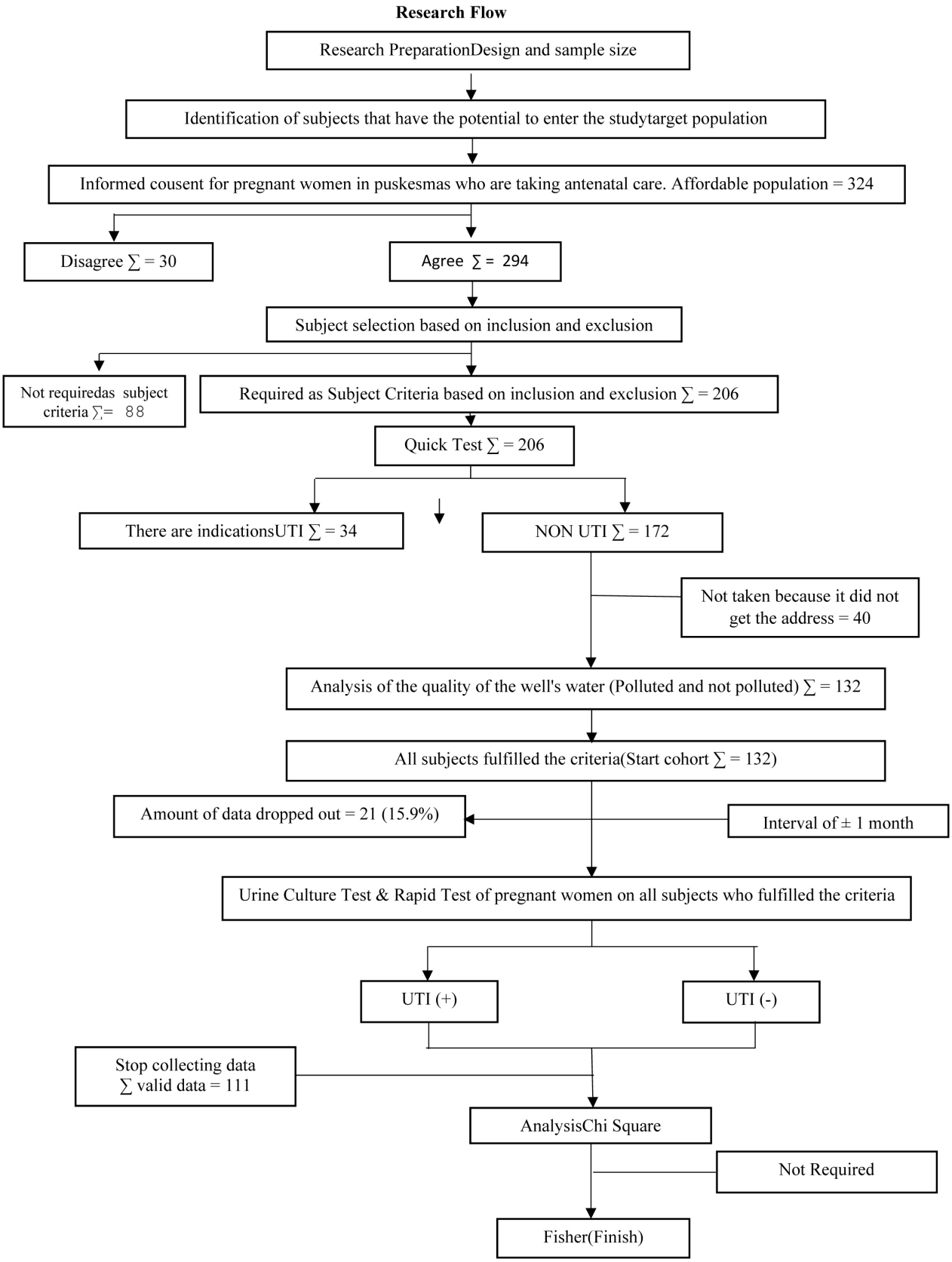
Research Flow
Research PreparationDesign and sample size
Identification of subjects that have the potential to enter the studytarget population
Informed cousent for pregnant women in puskesmas who are taking antenatal care. Affordable population = 324
Disagree ∑ = 30
Agree ∑ = 294
Subject selection based on inclusion and exclusion
Not requiredas subject criteria ∑= 88
Required as Subject Criteria based on inclusion and exclusion ∑ = 206
Quick Test ∑ = 206
There are indicationsUTI ∑ = 34
NON UTI ∑ = 172
Not taken because it did not get the address = 40
Analysis of the quality of the well's water (Polluted and not polluted) ∑ = 132
All subjects fulfilled the criteria(Start cohort ∑ = 132)
Amount of data dropped out = 21 (15.9%)
Interval of ± 1 month
Urine Culture Test & Rapid Test of pregnant women on all subjects who fulfilled the criteria
UTI (+)
UTI (-)
Stop collecting data
∑ valid data = 111
AnalysisChi Square
Not Required
Fisher(Finish)

Table 3. The closeness of the relationship between the two variables can be seen in the *Risk Estimate*

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Air_Quality (Contaminated/Not Polluted)	6.500	1.510	27.974
For cohort UTI = UTI	5.400	1.441	20.236
For cohort UTI = Non_UTI	.831	.691	.999
N of Valid Cases	111		

exposed disease UTI because of the value of the estimated RR- it exceeds 1, then viewed significance between relationship of RR. Interval convergence 95% to RR of $1.441 \leq RR \leq 20.236$ which does not pass through the numbers 1, things that show the existence of a relationship that significant between mother pregnant who use quality water contaminated will be affected by the disease UTI.

CONCLUSION

From the results oh this study found a relationship between the quality of water used with UTI in pregnant women. The relationship shows that pregnant women who use polluted water quality will be at risk of developing UTI. From the analysis of UTI risk estimation (RR) of = 5.4 with a confidence level of 95%, it can be concluded that pregnant women who use well water polluted by *E coli* bacteria will be 5 times more to be exposed to the UTI compared to pregnant women who use well water not polluted by *E coli* bacteria.

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