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Discovering Thoughts, Inventing Future

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Utilization of Conceptual and Theoretical Framework in Research by Nurse Educators in Akwa Ibom and Cross River States, Nigeria

By Akpabio, I. I. & Uyanah, D. A
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A descriptive cross-sectional survey was used to study a convenient sample of 84 subjects representing 36% of the target population of 231 NE in the two states. A 32-item validated questionnaire was used for data collection.

While 77% of the respondents used CF during training, only 35% did so after training period. Utilization of CF in the sub-sections of the research was: Introduction (Mean=4.30; SD=1.30), Literature review (Mean=7.29;SD= 1.95), Methodology (Mean=3.62;SD=1.02) and Discussions (Mean=5.10; SD=1.51).

Utilization of CF was mostly limited to literature review and very low after training period. Continuing education programmes should be used to improve knowledge and skills for application of CF in research.

Keywords: *conceptual-framework; education; knowledge; nurse-educators; nursing; professionalism; research; training; theoretical-framework; utilization.*

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Akpabio, I. I. [α] & Uyanah, D. A [σ]

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I. Introduction

Advancing the clinical research enterprise remains an integral part of nursing activities to promote quality nursing practice. However, nursing research may not achieve its full purposes without appropriate utilization of conceptual or theoretical framework as a tool to guide the research process. According to Smyth (2004), a conceptual or theoretical framework is described as a set of broad ideas and principles taken from relevant fields of enquiry and used to structure a subsequent presentation. It is assumed to be a starting point for conceptualizing ideas in the research.

Akpabio and Ebong (2010) enumerated the advantages of using conceptual framework in a study to include the provision of a focus to direct the study, improving the researcher's ability with explanation of the relationship between variables of interest when communicating research findings and provision of expanded scope for application of research findings in practice. When properly articulated, a conceptual framework has potential usefulness as a tool to assist a researcher to develop awareness and understanding of the situation under study, make meaning of subsequent findings and thereafter communicate the findings effectively to guide implementation.

The usefulness of conceptual framework is further highlighted by Smyth (2004) who emphasized that conceptual framework is increasingly needed to enrich, strengthen and keep research on track by providing clear links from the literature to the research goals and questions. Furthermore, he enumerated other usefulness to include guiding the research design, providing reference points for discussion of literature, analysis of part of the data and contributing to the trustworthiness of the study.

In recent years, many scientists have further emphasized the need for application of conceptual framework in research. Kaiser (2004) noted that research without theory results in discreet information or data, which does not add to the accumulated knowledge of the discipline. In her assertion, theory guides the research process, forms the research questions, aids in design, analysis and interpretation of findings. It enables the scientist to weave the facts together providing positive and direct relationships between variables under study.

George (2009) further noted that conceptual framework could allow researchers to build upon one another's work thereby building a body of knowledge. In her submission, pragmatic, conceptually-based research helps accumulate deeper understanding overtime, thus moving a discipline such as nursing forward. Commenting also on conceptual framework and theories, George (2009) identified them as the skeleton on which to build nursing research. In her submission, it is from the framework that principles, assumptions and ideas are taken to frame the study.

Thus, as important as the use of conceptual framework is in research, and although nursing research has received a major impetus to include a conceptual basis for study in recent years, there is dearth of literature reporting results of investigation of nurses' knowledge or awareness of existing theories or models

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and actual framework utilization in research work. Similarly, as important as it is to have good knowledge of conceptual framework and to utilize same for the conduct of research, it is often observed that many nursing research reports presented by nurse educators do not reflect any evidence of being guided by any theoretical or conceptual framework.

Additionally, in recent years, the Nursing and Midwifery Council of many nations including Nigeria have made it mandatory for nursing students to utilize conceptual framework in research submitted to the Council in partial fulfillment for their training. In many instances, the student's research projects are observed to reflect poor application of conceptual framework. To be successful, the students need good guidance by nurse educators who themselves should have good knowledge of conceptual framework and the ability to apply same in their research work. In many instances also, the nurses haphazardly apply conceptual framework during their training but fail to do so during studies conducted after their training.

This study therefore investigated nurse educator's knowledge and level of utilization of conceptual framework in research in two states in Nigeria, which included Akwa Ibom and Cross River States. Specific objectives were to:

i. determine the frequency distribution of knowledge of conceptual and theoretical framework enumerated by the nurse educators;
ii. assess nurse educators' knowledge of criteria for selecting a framework to guide research;
iii. determine the proportion of nurse educators who conducted research:
   (a) during their training
   (b) after their training
iv. determine the proportion of nurse educators who utilized conceptual framework in research:
   (a) during their training,
   (b) after their training.
v. Ascertain the level of conceptual framework utilization in each sub-section of the research.

Hypotheses:

Two null hypotheses were also formulated for the study as follows:

1. The proportion of nurse educators who utilized conceptual framework in research during training will not be significantly higher than those who used framework after training.
2. The level of conceptual framework application in research will not be significantly different in the sub-sections of the research, which include introduction, literature review, methodology and discussion of findings/ recommendations.

II. Literature Review

A close study of research reports in learned Journals globally shows none or part application of conceptual framework in nursing research. Utilization of conceptual and theoretical framework should be expected to apply to all sub-sections of a study. In George's (2009) assertion, utilization of conceptual framework in nursing research should imply actual implementation during research conceptualization stage, during the literature review, in the methodology section, in the discussion section and recommendations arising from the study. These would similarly reflect in the study reports.

When done this way, the framework could adequately assist in identifying meaningful and relevant variables for the study, enhance selection of plausible approaches for the research endeavour, and enhance the development and refinement of the problem area as well as predicting of relationships between the variables under study. Similarly, it could enhance clear and accurate interpretation of research findings and appropriate development of clinical practice protocols. This is necessary because translating research findings to practice is often a challenge due to barriers including poor or none explanation of the relationship between the variables in the study during project design and presentation of research reports to guide practice.

Additionally, where nurse researchers apply conceptual framework to studies, the framework chosen are not usually relevant since the problem being investigated does not fit into the framework. Where there is relevance, the relationships among variables are not properly defined or explained to guide practice often due to poor knowledge of the theoretical or conceptual framework.

Recounting the challenges that could account for the limitation in application of conceptual framework in research, Akpabio and Ebong (2010) enumerated factors including limited knowledge in understanding concepts within the models, lack of skills in explaining relationship among variables based on the framework and inability to identify, understand and formulate assumptions from the model and relate them to the research variables.

It is important to acknowledge the fact that conceptual and theoretical frameworks are abstractions that could be difficult to understand. Reviewing the enumerated challenges that could limit application of conceptual framework in research as documented by Akpabio and Ebong (2010), nurse educators need to have not only a good knowledge of existing theories and models but also a good understanding of concepts within the models, criteria for selecting the theories or models and also possess needed skills in explaining relationships among variables based on the framework. They also need to have the ability to identify and relate

assumptions within the study to the research variables all through the sub-sections of the research. These expectations are vital since it could be observed that theories or concepts within each framework represent assumptions and philosophical views of the models' designers.

Nurse researchers could use either nursing or none-nursing frameworks or at times both to provide a conceptual context for studies. Although each framework focuses on the concepts about person, environment, health and illness as well as nursing, each model however defines the concepts differently, links them in diverse ways and gives different process as being central to nursing (Berman, Snyder, Kozier et al, 2008). These reasons provide the need for nurse researchers to possess adequate knowledge of the various theoretical and conceptual frameworks, which could be a good fit for their studies.

Furthermore, a specific research endeavour can focus on one or a few aspects of a conceptual framework (Fawcett, 2002). The use of a specific model according to her could determine the kind of information that should be gathered and the way the information should be organized and interpreted.

On the other hand, a conceptual framework should not be seen as possessing all the concepts or ideas to predict the relationships between variables in a study. This is so since a framework is a construction of knowledge bounded by the life experiences of the individual that developed it.

Furthermore, Miles and Huberman (2004) opined that a researcher should not be expected to analyze all the data in a study using the framework but should remain open to new or unexpected occurrences in the data and the investigation generally since doing otherwise could limit the results from the investigation and render the study less useful.

Considering aforementioned reasons and to expand the scope of predicting relationships among variables in studies, advanced researches usually combine two or more conceptual models or theories to guide a research paying particular attention to remove some of the concepts that are not relevant to explain relationships in the particular study of interest.

The requirement therefore is that nurse researchers should by very skilled in identifying, selecting and applying needed concepts to avoid limiting the scope of investigation or making the study clumsy and meaningless through unnecessary inclusion of concepts that are not relevant for the particular study. All of these require good knowledge that is relevant for utilizing theories and conceptual models for studies.

Commenting on steps in applying conceptual framework in the various sub-sections of the research, George (2009) asserted that at the introductory section of the research, it should be necessary to introduce the framework as a good fit for the research problem. Secondly, at the end of the literature review, it is necessary to thoroughly describe the framework, explain its application to the study, and how the framework has been used in studies about similar problems.

Thirdly, in the methodology section, it is necessary to explain how the framework is being used in the design and how data collection methods such as questionnaire items reflect the concepts in the framework. Fourthly, the framework should be used in the discussion section to describe how study findings are consistent or inconsistent with the framework. Finally, suggestions for practice and further research should be offered in such a way that they are congruent with the frameworks' concepts and propositions.

Nurse educators as role models and change agents are strategically placed to facilitate staff development and organizational change affecting nursing practice through research. According to National League for Nursing Board of Governors (2002), nurse educators are the key resource in preparing a nursing workforce that will provide quality care to meet the health care needs of the population. Additionally, the National League for Nursing Board of Governors (2012) emphasized that regardless of the setting in which the nurse educators are employed, there is a core knowledge and skills that are essential if one is to be effective and achieve excellence in the role. That core knowledge and skills in their assertion entail the ability to conduct research, facilitate learning, advance the total development and professional socialization of the learner, design appropriate learning experiences and evaluate learning outcomes.

In summarizing the need for conceptual framework in research, it could be stated that when the problem being investigated fits into an existing framework, it can guide the study appropriately, the conceptual definitions and problem refinement can be drawn from the framework, the data collection instrument would be congruent with the framework, findings would be interpreted based on explanations provided by the framework thus enriching the values of its findings. Similarly, the implications of the findings and practical implementation of research findings would be based on the explanatory power of the framework thereby making research utilization in actual nursing practice easily acceptable and much easier.

III. Materials and Methods

The study involved a descriptive cross-sectional survey approach to determine nurse educators' knowledge and utilization of conceptual framework in research; during and after their training. The study settings were two states namely Akwa Ibom and Cross River States in the South-South Geo-Political Zone of Nigeria. Written ethical approval was obtained from the Ministries of Health in the two states as well as the

principals of the selected schools while informed consents were obtained from the nurse educators who participated in the study. The distributions of schools were eight Schools of Nursing, seven Schools of Midwifery and two Schools of Psychiatric Nursing making a total of seventeen (17) schools in the two states. From the nominal roll of each school, the total population of nurse educators in the two States was 231.

Simple random sampling method of balloting was used to select ten schools from the seventeen schools. From the ten selected schools, a convenience sampling technique was used to select one hundred (100) subjects representing 43% of the target population. The instrument for data collection was a 32-item questionnaire developed by the researchers and arranged in four sections.

Section A required respondents to supply their bio-data, section B was concerned with knowledge of theoretical and conceptual framework and criteria for selection; section C was to provide data on the proportion of nurse educators who had ever used conceptual framework in research while section D dealt with levels of conceptual framework application in the various sub-sections of research. The instrument was validated with test-retest reliability estimates of 0.82 for section A and 0.86 for sections B, C, and D.

The data were collected by the authors assisted by two trained research assistants. From a total of 100 questionnaires administered, 84 were sufficiently completed and used for data analysis giving a return rate of 84%.

IV. Data Analysis

The socio-demographic data and the frequency counts on the various categories of aspects of use of framework in research were converted to percentages and to show whether the proportion of respondents who utilized conceptual framework in research during training was significantly higher than those who used framework after training, the normal Z-test for proportions was used. Additionally, a two-way ANOVA and Fishers' modified t-test statistics were used to test whether the level of conceptual framework application in research was significantly different in the subsections of the research. All two hypotheses were tested at .05 level of significance.

The data on the level of conceptual framework application were recorded as the sum of the level of application items for each of the chapters. Thus, there was an aggregate score for introductory part of research, literature review, research method and discussion of findings. These scores were considered continuous such that a high score means high level of application and low score means low level of application. The frequency counts on the various categories of aspects of use of conceptual framework in research were converted to percentages.

V. Results

Results of the socio-demographic characteristics of the study subjects are presented in Table 1.

Table 1 : Socio-demographic data of respondents (n = 84)

Variable	Category	N	Percentage
Gender	Male	17	20.2
	Female	67	79.8
	Total	84	100
Age	21 – 30	5	6.0
	31 – 40	12	14.2
	41 – 50	49	58.4
	51 – 60	15	17.8
	61 and above	3	3.6
	Total	84	100
Professional Rank	Nursing Officer I	1	1.2
	Nursing Officer II	10	11.9
	Senior Nursing Officer	2	2.4
	Principal Nursing Officer	6	7.1
	Asst. Chief Nursing Officer	1	1.2
	Chief Nursing Officer	38	45.2
	Deputy Director (NS)	20	31.0
	Total	84	100
Professional Qualification	RN/RM	17	20
	RNT with Diploma	13	16
	B.Sc./B.N.Sc./PGDE	49	58
	M.Sc.	5	58
	Total	84	100
Years of Experience	1 – 10	14	17
	11 – 20	14	17
	21 – 30	39	46
	31 – 35	17	20
	Total	84	100

From Table 1, 67 (79.8%) of the respondents were females while 17 (20.2%) were males. In terms of age, 5 (6.0%) were in the age bracket of 21-30 years, 12 (14.2%) were aged 31-40 years, 49 (58.4%) were aged 41-50 years; 15 (17.8%) were aged 51-60 years while only 3 (3.6%) were in the range of 61 years and above.

In terms of professional rank, the highest numbers were represented by Chief Nursing Officers (CNO) who were 38 (45.2%) followed by Deputy Directors who were 20 (31.0%). Regarding professional qualifications, 49 (58.3%) of them had B.Sc. in various fields including nursing, 5 (6.0%) were holders of masters degrees in various fields including nursing. Majority, 56 (66.7%) had between 21 and 35 years experience in nursing/nurse educators' job. With the frequency distribution on knowledge of theoretical and conceptual framework, the results are presented in Tables 2 and 3.

Table 2 : Frequency Distribution of Knowledge of Theoretical Framework (n = 84)

Numbers of theoretical framework	Frequency	%	Cum %
Nil	13	15.5	15.5
1	5	6.0	21.4
2	4	4.8	26.2
3	9	10.7	36.9
4	14	16.7	53.6
5	39	46.4	100.0
Total	84	100.0	

Table 3 : Frequency Distribution on Knowledge of Conceptual Framework (n = 84)

Number of conceptual framework	Frequency	%	Cum %
Nil	30	35.7	35.7
1	10	11.9	47.6
2	8	9.5	57.1
3	14	16.7	73.8
4	9	10.7	84.5
5	13	15.5	100.0
Total	84	100.0	

On knowledge of the theoretical framework, Table 2 shows that 13 (15.5%) of nurse educators did not have knowledge to list any, and only 39 (46.4%) were able to list five.

On knowledge of conceptual framework presented in Table 3, 30 (35.7%) of the respondents could not list any and only 13 (15.5%) were able to list five conceptual framework. The result on knowledge of criteria for selecting framework is presented in Table 4.

Table 4 : Frequency Distribution on Knowledge of Criteria for Selecting Framework (n = 84)

Knowledge of criteria	Frequency	%	Cum %
Nil	29	34.5	34.5
1	6	7.1	41.7
2	7	8.3	56.0
3	13	15.5	65.5
4	29	34.5	100.0
Total	84	100	

From Table 4, 29 (34.5%) of the respondents were not able to list any criterion for selecting framework, 13 (15.5%) listed three criteria and 29 (34.5%) identified four criteria.

The results of the analysis on research conducted during and after the respondents' training are presented in Table 5.

Table 5 : Analysis on research conducted during and after training (n =84)

Number of research conducted	During training	Cum %	After training	Cum %
1	21 (25.0%)	25	14 ((16.7%)	16.7
2	28 (33.3%)	58.3	7 (8.3%)	24.6
3	11 (13.1%)	71.4	3 (3.6%)	28.2
4	5 (6.0%)	77.4	2 (2.4%)	30.6
5 and above	7 (8.3%)	85.7	5 (6%)	36.6
Nil	12 (14.3%)	100	53 (63.1%)	100
Total	84 (100%)		84 (100%)	

From Table 5, 12 (14.3%) of the respondents never conducted research during training as against 53 (63.1%) who did not do so after training. During training, 21 (25.0%) of the respondents conducted one research, 28 (33.3%) conducted two studies and 2 (2.4%) conducted ten studies. On the other hand, after training, 14 (16.7%) conducted one research and 5 (6.0%) conducted 5 studies and above.

Results of analysis on application of theoretical and conceptual framework during and after training are presented in Table 6.

Table 6 : Frequency distribution on application of theoretical and conceptual framework during and after training (n = 84)

Application of framework	During Training	Cum %	After Training	Cum %
1	21 (25.0%)	25	11 ((13.1%)	13.1
2	28 (33.3%)	58.3	9 (10.7%)	23.8
3	11 (13.1%)	71.4	3 (3.6%)	27.4
4	5 (6.0%)	77.4	2 (2.4%)	29.8
5 and above	Nil	-	4 (4.8%)	34.6
Nil	19 (22.6%)	100	55 (65.4%)	100
Total	84 (100%)		84 (100%)	

From Table 6, 19 (22.6%) of the respondents did not use any framework in research during their training, 21 (25%) used a conceptual framework only once, 28 (33.3%) applied a framework twice while only five (6%) applied theoretical or conceptual framework four times. On the other hand, as many as 55 (65.4%) did not apply any framework in their studies after training, 11 (13.1%) did so only once and 4 (4.8%) applied framework five times and above.

a) Results from hypotheses

Ho1: The proportion of nurse educators who utilize conceptual framework in research during training will not be significantly higher than those who did so after training. To compare the proportion of respondents who use framework during and after training, the normal Z-test for proportions was applied.

From the result, the proportion of respondents who used framework during training was 77.4% while that after training was 34.6%.

Z = 5.61 i.e. the computed Z-value was 5.61. Since the calculated Z-value (5.61) was greater than the critical Z-value (±1.654) at .05 level of significance, the null hypothesis was rejected. This means that the proportion of nurse educators who use framework during training is significantly higher than those who use a framework after training.

Ho2: The level of conceptual framework application in research will not be significantly different in the sub-sections of the research.

To test this hypothesis, a two-way ANOVA for repeated treatment design was carried out with persons and sections of the research as factors. The repeated treatment design allowed for the removal of the differential effect of individuals' differences, which could swell the error term in the ANOVA model and make significant results appear not significant. The descriptive statistics (Mean and standard deviations) by sections of the research are given in Table 7.

Table 7 : ANOVA of level of Application of Framework in research: Person by Section of research

Section of Research	N	Mean	Standard deviation		
			1.297		
Introduction	84	4.30	1.949		
Literature review	84	7.29	1.017		
Methodology	84	3.62	1.510		
Discussion of findings	84	5.10			
Source of variation	**Sum of squares**	**df**	**Mean square**	**F**	**P**
Persons	1830.112	83	22.050	4.898*	0.003
Section of research	4026.780	3	1342.260	298.147*	0.000
Error	1121.092	249	4.502	—	—
Total	6977.984	335	—	—	—

*****Significant at 0.05 level, $P < 0.05$*

From table 7, mean level of application of framework was highest in Literature review (7.29) followed by discussion section (5.10) and the least level of application was in the methodology section (3.62). The observed differences were tested for overall significance using a two-ANOVA for repeated measures design. The results were similarly given in Table 8. For both persons and sections of research, the P-values

associated with the computed F-values were less than the chosen level of significance, given their respective degrees of freedom (83, 249 and 3,249). As a result, the null hypothesis of no significant overall differences due to both persons and sections of research was rejected. This means that there are significant main differences in level of application of framework due to both persons and sections of the research.

The main focus of this study was on differences due to sub-sections of the research. Further analysis was carried out in this direction. Multiple comparisons were done using Fisher's modified t-test recommended by Edwards (1972). The results are presented in Table 8.

Table 8 : Multiple comparison of application of framework in research; by Sections of Research

Section	Introduction Mean = 4.30	Literature review Mean = 7.29	Methodology Mean = 3.62	Discussion Mean = 5.10
Introduction (4.30)	—	2.99	0.68	0.80
Lit. review (7.29)	9.144	—	3.67	2.19
Methodology (3.62)	2.080	11.223	—	1.48
Discussion (5.10)	2.446	6.697	4.526	—

** Significant at 0.05 level. df = 166, Critical t = ±1.96*

***Values above diagonal are mean difference, and values below diagonal are computed t-vales.*

From Table 8, all the paired differences were significant since all the computed t-values were greater than the critical t-values of ±1.96. Comparing introduction with literature review, t-value is 9.14. Comparing introduction with methodology, t-value is 2.08, comparing introduction with discussion, t-value is 2.45, comparing literature review with methodology, t-value is 11.23, comparing literature review with discussion, t-value is 6.70, comparing methodology with discussion, t-value is 4.53.

VI. Discussion

The study showed that as many as 30 (35.7%) and 13 (15.5%) of the respondents could not list any of the theoretical and conceptual framework respectively. Furthermore, 34.5% of the respondents had no knowledge of any criteria for selecting conceptual framework for research while 7.1% could only identify one criterion. These results are very worrisome.

Although there is dearth of literature reporting results of investigation of nurses' knowledge of existing theories and models, and actual utilization of conceptual framework in research, Akpabio and Ebong (2010) enumerated challenges associated with non-utilization of framework to include limited knowledge of existing theories and models as well as limited knowledge in understanding concepts within the model. The authors also acknowledged the fact that theoretical and conceptual frameworks are abstractions that could be difficult to understand.

However, due to the numerous benefits that can accrue through application of conceptual framework in research, it is very important that nurse educators who train others and who themselves should be knowledgeable concerning theoretical and conceptual framework application in research posses adequate knowledge not only of the theories and models but how to apply them in research. This argument is in line with the submission of the National League for Nursing Board of Governors (2012) who emphasized that regardless of the settings in which the nurse educators are employed, there is a core knowledge that is essential if they are to be effective and achieve excellence in the role. They identified the core knowledge to entail the ability to conduct research and facilitate learning.

The proportion of nurse educators who did not conduct research during training was 14.3% while those who did not do so after training stood at 63.1%. Whereas 22.6% of the respondents did not use framework for research during their training, as many as 66.7% did not do so after their training.

These findings could imply that nurse educators use conceptual or theoretical framework because it is an institutional requirement during training and they fail to use framework in research after training probably because its use is no longer demanded. This argument corroborates Akpabio and Ebong's (2010) assertion that lack of institutional requirement for use of conceptual framework can be a factor against its utilization.

Further results also showed that the level of conceptual framework application in research was significantly different in the various sub-sections of the research. From the results, the highest difference was between methodology with a mean level of application as 3.62 and literature review with a mean level of application as 7.29, while the least difference was between introduction section with 4.30 and methodology section of research with 3.62. Furthermore, the mean level of utilization of conceptual framework at the discussion section was 5.1. These findings does not correspond to the submission by George (2009) who stated that utilization of conceptual framework in nursing research should imply actual implementation during research conceptualization stage, during the literature review, in the methodology

section and in the discussion and recommendation sections of the research.

George's (2009) assertion therefore implies that it is necessary to utilize conceptual or theoretical framework in all sections of the research work. Aforementioned facts are vital since a conceptual framework is meant to keep research on tract, providing clear links from the literature to the research goals and questions, guide the research designs, provide reference points for discussion and contribute to the trustworthiness of the study. Thus, when used this way, conceptual or theoretical framework can enable the researcher to weave the facts together, providing positive and direct relationships between variables under study.

VII. Conclusion

Based on the study findings, it is concluded that may nurse educators in the study areas do not have adequate knowledge of theories and models for application as conceptual framework as well as the criteria for selecting them for use in their research. Similarly, many who use theoretical or conceptual framework during training do not do so after training. Furthermore, the few who utilize framework to guide their research do not use the framework to guide the various sub-sections of the study but only make reference to conceptual or theoretical framework at the literature review followed slightly to reference of the framework in the discussion section.

VIII. Recommendations

It is therefore recommended as follows:

- Continuing education programmes, workshops and seminars should be used to improve nurse educators' level of knowledge of theories and models for application in research as well as the criteria for selecting them for application research.
- Nursing Journals where research reports are published should demand as a requirement the inclusion of conceptual or theoretical framework that guided the research in papers for publication. These recommendations are likely to improve nurse educators' knowledge and utilization of conceptual and theoretical framework in research.

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Effectiveness of *in-Situ* Generated Monochloramine for the Control of *Legionella* in a Real Industrial Cooling Tower

By Maria Anna Coniglio, Vito Strano, Salvatore D'Angelo, Marco Antonio Guercio, Raimondo Spada & Stefano Melada

University of Catania, Italy

Abstract- The aim of the study was to determine the effectiveness of in-situ-formed monochloramine for the control of Legionella growth in a real cooling tower system. The cooling tower utilizes an industrial water (makeup) made of by blending industrial raw water and decarbonated raw water. A generator device injecting in-situ-formed monochloramine into the cooling system was installed. The detection of Legionella, heterotrophic plate count (HPC - 22°C) and continuous monitoring of oxidation reduction potential (ORP) were carried out to check the efficacy of monochloramine. Water samples were monthly collected for 6 months from the makeup, two collecting basins and the blow-down. Monochloramine was injected at 4 mg/L for 60 days to achieve a mean residual concentration of 0.145 mg/L in the blow-down. Over time, at the same pumping rates, a greater monochloramine residual was achieved so the dosage was decreased at 2.5 mg/L. L. pneumophila (SG 7-14) decreased from an initial load >10.000 cfu/L to undetectable levels and remained stable till the end of the experimental period while HPC decreased slowly (mean count <10.000 cfu/ml) after the first 60 days.

Keywords: legionella sp.; in-situ formed monochlorammine; industrial cooling tower.

GJMR-K Classification: NLMC Code: QW 50

Strictly as per the compliance and regulations of:

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Maria Anna Coniglio [α], Vito Strano [σ], Salvatore D'Angelo [ρ], Marco Antonio Guercio [ω], Raimondo Spada [¥] & Stefano Melada[§]

Abstract- The aim of the study was to determine the effectiveness of in-situ-formed monochloramine for the control of *Legionella* growth in a real cooling tower system. The cooling tower utilizes an industrial water (makeup) made of by blending industrial raw water and decarbonated raw water. A generator device injecting in-situ-formed monochloramine into the cooling system was installed. The detection of *Legionella,* heterotrophic plate count (HPC - 22°C) and continuous monitoring of oxidation reduction potential (ORP) were carried out to check the efficacy of monochloramine. Water samples were monthly collected for 6 months from the makeup, two collecting basins and the blow-down. Monochloramine was injected at 4 mg/L for 60 days to achieve a mean residual concentration of 0.145 mg/L in the blow-down. Over time, at the same pumping rates, a greater monochloramine residual was achieved so the dosage was decreased at 2.5 mg/L. *L. pneumophila* (SG 7-14) decreased from an initial load >10.000 cfu/L to undetectable levels and remained stable till the end of the experimental period while HPC decreased slowly (mean count <10.000 cfu/ml) after the first 60 days. From an initial value of 300-400 mV during the first 60 days, the ORP dropped to around 150 mV, which rather explains why monochloramine residuals in the blow-down increased at the end of the experimental time. The results indicate that in-situ-formed monochloramine can control *Legionella* and HPC growth in industrial cooling towers using industrial raw water and decarbonated raw water. Moreover, the ORP can be useful for monitoring the effectiveness of monochloramine.

Keywords: legionella sp.; in-situ formed monochlorammine; industrial cooling tower.

I. Introduction

Cooling towers have been consistently attributed to community-acquired legionellosis outbreaks (Engelhart et al. 2007; Yu 2008) because *Legionella* emitted by contaminated cooling towers can be transported over several kilometers within respirable vesicles (Walser et al. 2013). Typical operating conditions maintained in a cooling system, such as temperature range, pH as well as continuous airflow, make it ideal for biological growth or biofouling. In cooling towers biofouling can interfere with normal system operation (for example, heat transfer resistance) and it can also enhance corrosion and scaling problems, which may be critical risk factors for *Legionella* growth together with stagnant water and nutrient availability in the makeup water (Ludensky 2005). Thus, in order to minimize the production of contaminated aerosols by *Legionella* it is necessary to minimize microbial multiplication.

Due to its low cost and high effectiveness, chlorine is the most used biocide as antifouling agent in cooling towers (Nebot et al. 2007; Rubio et al. 2015). However, it is highly reactive with natural organic matter contained in water - especially when the cooling tower utilizes wastewater as makeup water (Hsieh et al. 2010; Li et al. 2011a) - leading to the formation of by-products such as trihalomethanes or haloaceto-nitriles which can have adverse impact on human health and ecosystems (Schwarzenbach et al. 2006; Nieuwenhuijsen et al. 2000).

In cooling water bromine is less effective than chlorine against *L. pneumophila*. Nonetheless, with continuous or semi-continuous low level dosing it can reduce and control *Legionella* populations as long as the residual concentrations are maintained in the circulating water (Thomas et al. 1999). Bromine is also used for the oxidation of biofouling but unfortunately it is toxic for the environment, in which it is released via blow-down water (Meesters et al. 2003).

Among the oxidizing agents, monochloramine seems to be the most materials respectful and to produce the lowest concentration of by-products in drinking water (Melada et al. 2015). It is also more effective for decreasing *Legionella* within the biofilms in drinking water systems (Coniglio et al. 2015) and even at concentrations as low as 1 ppm it is able to penetrate complex biofilm matrixes like that in cooling towers (Turetgen 2004; van Schalkwyk et al. 2010). It has been demonstrated that in the presence of organic nitrogen compounds, like in cooling systems employing secondary-treated municipal wastewater as makeup water, adding pre-formed monochloramine to reduce biological growth of *Legionella* species is better than forming monochloramine in-situ (Chien et al. 2012). Moreover, pre-formed monochloramine was found to be

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less aggressive than free chlorine, while still being an effective biocide (Li et al. 2011b).

Thus, as far as we know, at the moment there are few studies on the effectiveness against *Legionella* of in-situ-formed monochloramine in cooling systems. For this reason, in the present study the effectiveness of in-situ formed monochloramine was evaluated for its ability to control biological growth in a cooling system.

II. Materials and Methods

A cooling tower system of an Italian industrial plant was considered. The cooling tower system studied has a flow rate of 270-300 m^3/h of recirculating cooling water, an average of 6-10 m^3/h of makeup water and a water evaporation of about 4 m^3/h. The water lost by evaporation is reintegrated with an industrial water (makeup water) made of by blending industrial raw water and decarbonated raw water. A drawing of the cooling system is depicted in Figure 1.

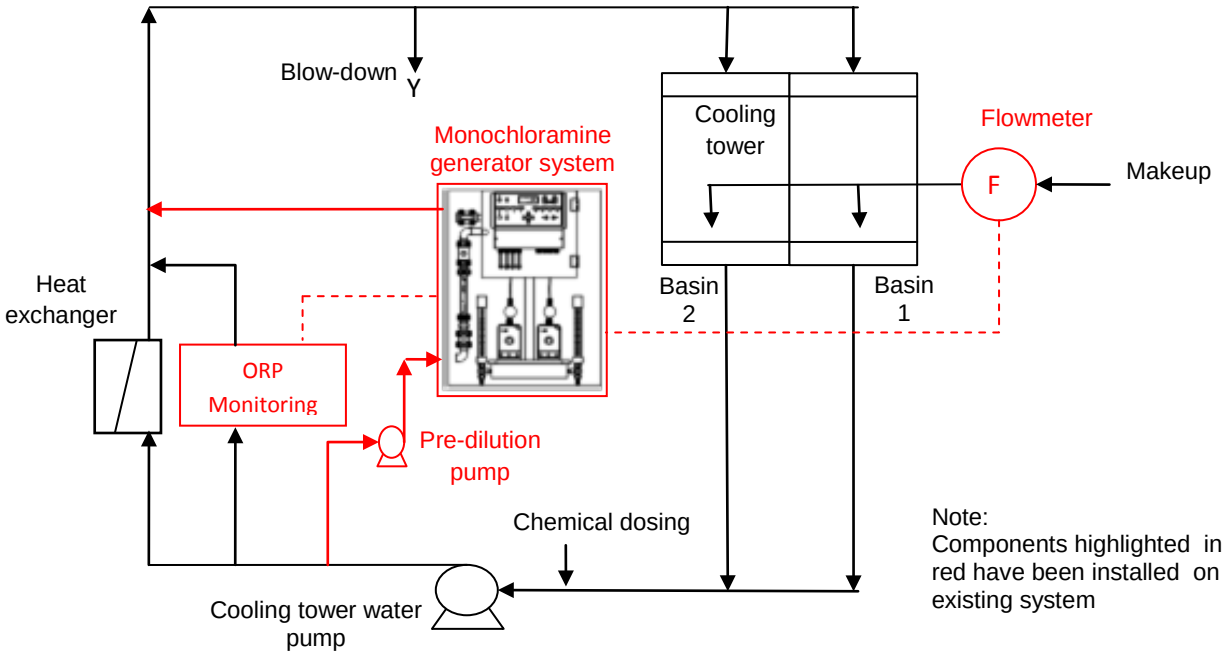

Figure 1: A drawing of the cooling system

Prior to the application of monochloramine, to minimize biofouling, the water of the cooling circuit was successfully decontaminated via continuous disinfection with bromine at low levels (assuring a residual concentration of free chlorine of ~ 0.1 ppm) added with a scale and corrosion inhibitor. To prevent legionellae growth additional periodic chlorine shock was made with 5 ppm free chlorine for 5h.

In order to verify the effectiveness of in-situ formed monochloramine for the control of *Legionella* growth in the cooling tower considered for the study, on July 2014 the injection of bromine was stopped and water samples were collected every 15 days till the detection of *Legionella* (> 100 cfu/L). When, on September 2014, *L. pneumophila* SG7-14 was recovered in the cooling tower (makeup water, the two collecting basins and the blow-down) at high concentrations (>10.000 cfu/L), a patented generator device continuously injecting in-situ-formed monochloramine into the cooling system was installed. A regular testing program for the detection of *Legionella* and heterotrophic plate count (HPC) at 22°C was carried out to check the efficacy of the water treatment with in-situ formed monochloramine.

The makeup water and water samples taken from the cooling tower collecting basins and the blow-down were collected weekly from September 2014 to March 2015. At the time of each sampling, the cooling system was operating. As shown on Table 1, for the makeup water and the blow-down physical and chemical parameters (DPD Free and Monochlor-F methods, Nitriver and Nitraver, HACH Company, USA) were determined. For *Legionella* determinations, 1L water samples were collected, taking care to gently resuspend the fluffy sediment at the bottom of the collecting basins. Isolation of *Legionella* was performed in accordance with standards procedures ISO 11731 (International Standard Organization 1988). Colonies suggestive for *Legionella* were confirmed on the basis of cultural testing and serogrouped by slide agglutination using commercial antisera (Oxoid and Biogenetics). Results were expressed in cfu/L and the counts referred

to water samples concentrated 100 times (1L in 10 ml of the water sample). The detection limit of the culture procedure was 10 cfu/L. The HPC at 22°C was detected in accordance with ISO 6222 (International Standard Organization 1988) to provide information on the disinfection process with monochloramine. For HPC, 100 ml of water were sampled. Sampling bottles for *Legionella* and HPC were steam sterilized and contained sufficient sodium thiosulfate to neutralize chlorine. All samples were stored at 4°C and analyzed within 12 h.

III. Results and Discussion

After the start of the cooling water in-situ monochloramination, a total of 32 water samples were monthly collected for 6 months from the same sites of the cooling tower: the makeup, the two collecting basins (named BASIN 1 and BASIN 2, respectively) and the blow-down.

An interesting phenomenon was observed when the response of monochloramine residuals was tracked over time. As shown on Table 1, at the beginning of the experimental period monochloramine had to be injected into the cooling water system at an average concentration of 4 mg/L for about 60 days in order to achieve a mean residual concentration of 0.145 mg/L in the blow-down. Over time, at the same pumping rates, a greater monochloramine residual could be achieved. For this reason, subsequently the dosage was regulated to obtain a continuous concentration of 2.5 mg/L monochloramine. We attributed this increase in residual to at least two main reasons: *i.* the monochloramine biocide effect towards *Legionella*, and *ii.* the monochloramine reaction with biofilm constituents that probably bromine could not get to.

Table 1: Physical and chemical parameters of the makeup water and the blow-down

	Makeup water	Blow-down				
	Nov 2014	Nov 14	Dec 14	Jan 15	Feb 15	Mar 15
Free chlorine (mg/l)	0.02	0.04	0.04	0.02	0.03	0.09
Total residual chlorine (mg/l)	0.03	0.33	0.11			
Monochloramine (mg/l)	0.00	0.35	0.23	0.17	0.11	0.38
Ammomium ion (mg/l)	0.00	0.08	0.13	0.09	0.06	0.08
Nitrite (mg/l)	0.011	0.121	0.234	0.066	0.138	0.217
Nitrate (mg/l)	15.4	26.6	100.8	21.3	26.8	31
Chloride (mg/l)				390	320	
pH	7.4	7.5		7.8	7.7	7.8
Conductivity (µS)	890	1727		1870	1790	
ORP* (mV)			174	180	160	152

**oxidation reduction potential*

The biocide effect of monochloramine towards *Legionella* and HPC is shown on Figure 2. At the beginning of the disinfection program, one week after the continuous injection of monochloramine, the load of *L. pneumophila* SG7-14 decreased at undetectable levels, with the exception of the makeup water, where *Legionella* was recovered at a concentration of 200 cfu/L.

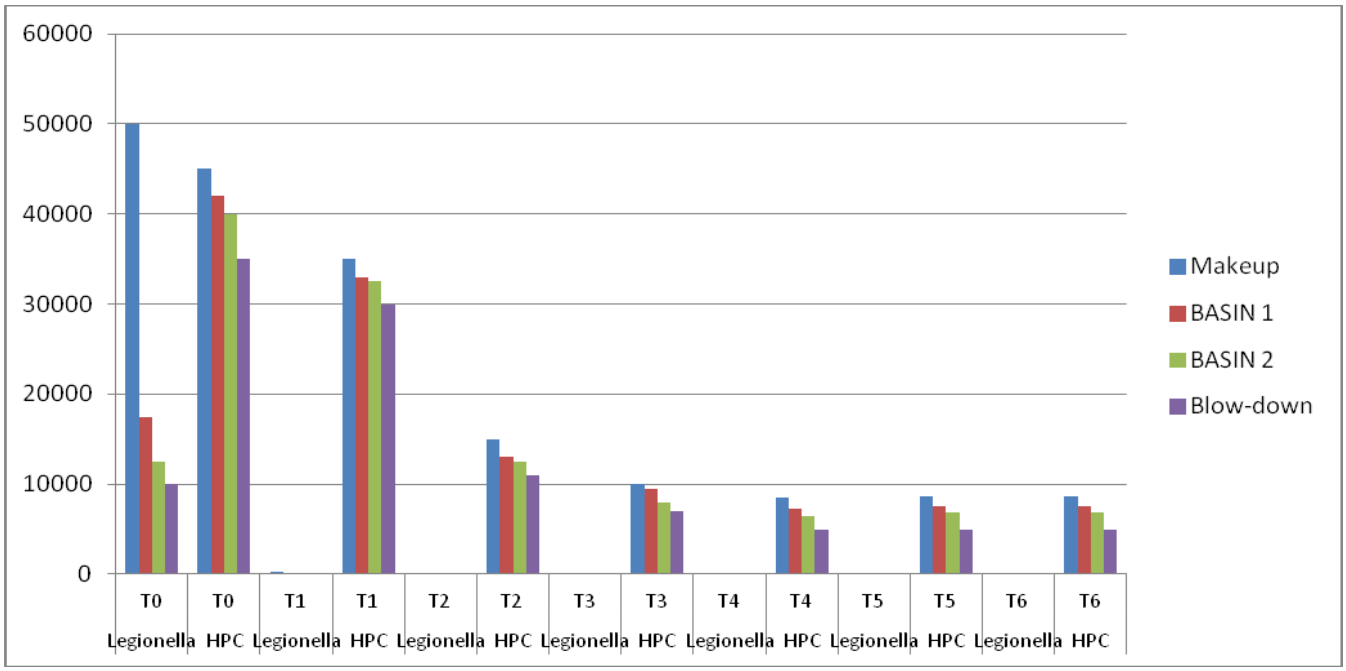

Figure 2 : The biocide effect of monochloramine towards *Legionella* and HPC

Further analyses showed that in the makeup water entering the cooling system *Legionella* was absent, while the bacterium was isolated by means of swabs in the tap from where the makeup water had been collected, showing that it was a local contamination instead of makeup water contamination. In fact, two weeks after the sanitization of the tap and the monochloramination of the entire cooling system, the load of *Legionella* decreased at undetectable levels also in the sampling site of the makeup water and remained stable in all the sampling sites till the end of the experimental period. On the contrary, during the entire experimental period the HPC load decreased slowly, with a mean count ranging lower than 10.000 cfu/ml after the first 60 days.

The interaction between monochloramine and the biofilm is probably confirmed by the minimal algae growth on the partially wetted structure of the cooling tower at the end of the experimental time. In fact, to get an idea of how well algae growth was being controlled, the cooling tower was visually inspected three times during the experimental time. As shown on Photographs 2 and 3, two months after the start of the disinfection program (Photograph 2) with monochloramine and at the end of the experimental period (Photograph 3) small amount of green algae growth was observed on collecting basins, much less than when bromine was used (Photograph 1).

Photograph 1 : Visual inspection of the collecting basin - September 2014

Photograph 2 : Visual inspection of the collecting basin - November 2014

Photograph 3 : Visual inspection of the collecting basin - January 2015

Finally, during the entire experimental period, makeup water flowmeter was used to control monochloramine dosage whereas continuous monitoring of oxidation reduction potential (ORP) was used to check it. The plot in Figure 3 shows the response of ORP with time during the entire experimental period. The monochloramine field trial and the continuous monitoring of ORP started on September 18th, 2014. On November 13rd, the probe was found incorrectly calibrated but it was recalibrated on November 20th. Anyway, from an initial value of 300-400 mV during the first 60 days, the ORP dropped to around 150 mV, which rather explains why monochloramine residuals in the blow-down increased at the end of the experimental time.

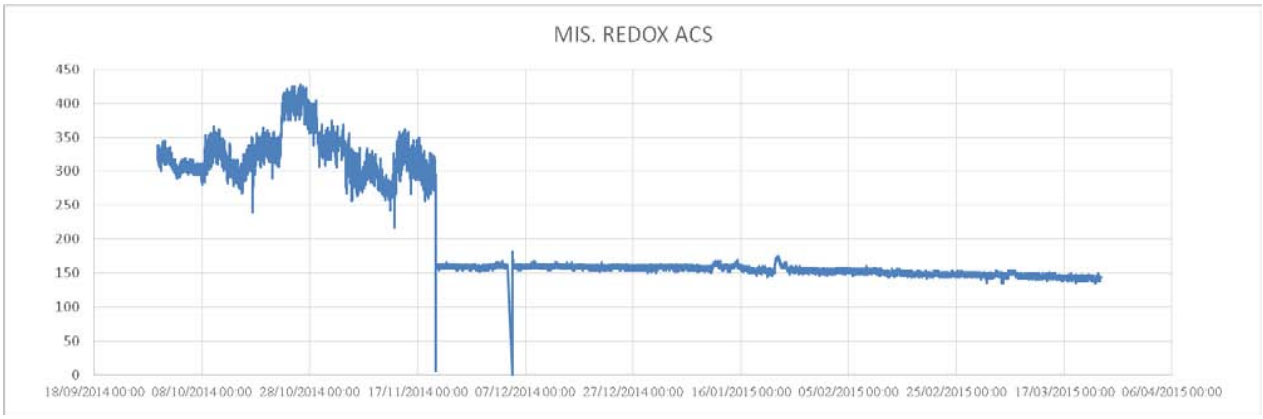

Figure 3 : The response of ORP with time during the entire experimental period

IV. Conclusions

The primary objective of this study was to investigate the effectiveness of in-situ-formed monochloramine as a biocide to control *Legionella* and HPC growth in a cooling tower system employing treated industrial water as makeup water. In particular, the HPC and continuous monitoring of ORP were determined to provide information on the disinfection process with monochloramine.

One week after the continuous injection of monochloramine, the load of *L. pneumophila* SG7-14 decreased at undetectable levels from an initial value >10.000 cfu/L and remained stable in all the sampling sites till the end of the experimental period. This data probably show that in-situ formed monochloramine can adequately control *Legionella* growth in industrial cooling towers using blended industrial raw water as makeup water. Nonetheless, the high load of HPC observed during the first 60 days, when residual concentrations of monochloramine were low and in turn ORP was high, probably suggests that at the beginning of the disinfection program some bacteria may require higher concentrations of the disinfectant to be completely killed. Anyway, our data suggest that ORP values and HPC measurements can play an important role in verification of treatment cooling tower procedures with monochloramine.

Finally, our data show that monochloramine was effective also at controlling algae growth. In fact, comparison of visual inspections of the collecting basins (Photographs 1-3) showed a decrease in green algae growth at the end of the experimental period. This could also explain why as time passed the residual monochloramine concentration that could be achieved in the blow-down increased.

Conflict of interest statement

Dr Stefano Melada, responsible for the Research & Development department of Sanipur Srl, contributed with a scientific and technical support necessary for the development of the management plan. He did not participate to the samplings of the water, isolation and identification of legionellae. No financial support was given to the authors.

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AIDS is the Disease of «Chain Reaction» Type

By Sergey Makarov

Abstract- Parasitic chain reaction is not visible under the microscope: it has no material carrier. However, the results of this reaction working can be seen in a microscope, this allows accurately diagnose AIDS.

Keywords: *AIDS, HIV, immune deficiency, parasitic program, T-helpers.*

GJMR-K Classification: *NLMC Code: WC 140*

Strictly as per the compliance and regulations of:

AIDS is the Disease of «Chain Reaction» Type

Sergey Makarov

«AIDS - not a problem of doctors and virologists...»
Luigi De Marchi

Annotation- This article describes an alternative approach to the problem of AIDS. The author does not consider AIDS as an infectious disease, and assigns it to a special group of diseases. For this group he offered a special term "diseases of chain reaction type".

Abstract- **Parasitic chain reaction is not visible under the microscope: it has no material carrier. However, the results of this reaction working can be seen in a microscope, this allows accurately diagnose AIDS.**

Keywords: AIDS, HIV, immune deficiency, parasitic program, T-helpers.

I. Introduction

I am a scientist and theorist. More than 25 years I have been studying the problem of AIDS. I published two scientific books: [1], [2] and published the article [3] in the scientific journal «World Journal of AIDS». Later was published also Russian version of this article [4].

I want to say that the English version of the article [3] is being downloaded by the specialists very actively: during one and half years it was already downloaded 720 times and viewed 1230 times. At this article is convincingly written how to act to end AIDS around the globe. It would seem, is not this the dream of mankind? It turns out that this is not so! On the endless searching the remedy against AIDS many scientists planned and built all their lifes. To date, humanity has spent against AIDS about $ 500 billion, and this amount is growing every day.

Specialists are downloading and downloading my article. But what they think about this article? I do not know it: nobody shared with me his opinion about my article, and in their writings yet no one wrote about my article. I began to analyze the situation and came to the conclusion that many of the statements of my article are so revolutionary, that they simply can not be adopted by the minds of many people. Even well-known opponents of the official theory of AIDS («rethinkers»), many of which are already acquainted with my theory, not have their opinion about it, although it seemed to me, that my theory is "grist for their mill."

Let's imagine that at the long bridge over the river are standing hand in hand several hundreds of people. These people formed a live chain. The first member of the chain got some information, for example, the word "Hello." He must pass this information down the chain. As a result, the last person in this chain will receive the message: "Hello." And what is interesting in it? Of course, nothing special, but I want to accent your attention at the analysis of "what has moved" from one riverbank to the other as a result of this experiment. Nothing material was not moved, was moved only information. What's the sense in it? If it is just hello, it is possible, sense and no. And suddenly this word is the key to open some important safe? Then the person on the other side of the river, having received this information, could easily open his safe and get from it something very important.

Another example: we make on some surface the pathway of gunpowder. Then we set fire to one end of the gunpowder. Naturally, the fire will move along this track and he will reaches the other end. Question: what was physically moved from one end of the gunpowder pathway to the other end of it? Transfer of a material object was not. From one end to the other one was moved only light and heat signal which is not material object. However, such movement of signal can have very tangible consequences. If we, for example, doused some house by gasoline and built toward this house a track from our gunpowder, and burned it at the other end... Such manner we remotely would have made a serious fire.

A third example. We set the dominoes vertically on the table. The distance between the dominos we do little - it is necessary to ensure that falling of one domino will cause the fall of the neighboring one. Such manner we can build very long way of dominoes. Having finished construction, we push the first domino by our finger... It is not difficult to guess that will take place further: along our track of dominoes will run some chain reaction: every previous domino will push the next one, etc. The same question arises: what moves along our track of dominoes? Transfer something tangible has not happened, but something, after all, was moved. The "strength pulse" was moved. However, even its movement could, in principle, lead to significant consequences.

Notice the title of this article. You, as I understand it, guessed why I mention these three examples of chain reactions. I affirm that AIDS - it is not an infectious disease, as is commonly believed. AIDS is an example of a completely new type of disease. It represents some parasitic chain reaction in human blood. The essence of this chain reaction is that it force the protective T-helpers, which are continuously produced by the thymus gland, to become pairwise

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interconnected. Then such interconnected T-helpers are simply excreted in the form of diarrhea. Since in real life T-helper cells are designed for catching in the blood of particles of various harmful infections followed by removing them from the body, then it is clear that tied each other T-helpers simply excluded from the process of fighting with any external infections. As a result, people often die from any accidental infection.

Earlier I wrote that HIV has no material carrier. I mean by this is that the reason of AIDS is not tangible. All AIDS-dissidents in unison claim that HIV does not cause AIDS. I thought: virologists, apparently so accustomed to the fact that the virus must be only alive and tangible, that they just can not understand which sense I put into the sentence: "HIV has no material carrier." To them, it sounds like this: "A loaf of bread has no material carrier." But a loaf of bread is namely a loaf of bread. It can exist only as a material object. It or exists or not, no middle ground. Let's leave HIV alone. The essence is the fact that the cause of AIDS is not tangible. The cause of AIDS is a parasitic chain reaction, which walks inside the human's organism. This chain reaction from one person to another is transmitted along the path of living blood. If you've had with someone a sexual relationship, but "the walkway of living blood" was not, then you do not have to worry about anything: even if the partner has AIDS, it will not be transmitted to you.

Luc Montagnier in 2008 received the Nobel Prize for the discovery of the virus, which in our time is called HIV. The official scientific world now believes that AIDS is an infectious disease that is transmitted from one person to another by contact with the help of HIV.

It seems to be: from the times of Louis Pasteur's clear to everyone that is a virus. If HIV was isolated in pure form, the appearance of drug against him is not far off. However, decades pass, and a cure for AIDS is still not found. What is the reason? The reason is that the source of AIDS has no material carrier - you will not see it in any microscope. But virologists can not fight against what is not visible in the microscope. So their fight against AIDS can be continued indefinitely.

I will not repeat: all the technology to overcome AIDS, I have already described in the previous article - see. [3], [4]. You can follow specified by me path or you can continue to spend billions of dollars for the purchase of condoms and for "further searching for a cure for AIDS." But really humanity no longer knows where to spend his money?

I accent your attention on the main my results:

1. The reason of AIDS has no material carrier. AIDS develops in the body due to dissemination of parasitic chain reaction in it. This chain reaction can not be seen through a microscope. In the emergence and spread of AIDS no virus does not participate.
2. Mentioned above chain reaction moves from one organism into another one through the walkway of living blood.
3. The chain reaction, which spreads in the human's body, obliges of T-helpers to become pairwise interconnected with each other. As a result, they become turned off from the process of combating external infections and removed from the body in the form of diarrhea.
4. If the rate of production of T-helper cells of the thymus gland is small, the body is exposed to external infections, possibly fatal.

The question is: can a person to fight against the enemy, whom he can not see? James Clerk Maxwell was once developed the theory of the electromagnetic field. Has anyone seen this field? No one saw! However, the mankind has long been actively using the electromagnetic field, in particular, for far communications. In doing so, such communication is actively used even in the vacuum of space. If we need defence from the electromagnetic field in a certain amount of space, we simply surround the volume, what we need, with solid metal housing. It turned out, that the shield from electromagnetic fields can be made also from the metal grid with little cells.

Robert Kirchhoff once wrote: "There is nothing more practical than a good theory." And it's true. If you have a really good theory, you can actively use it in practice, even in those cases, where the object of your theory is not seen for you in any microscope.

We can not see the parasitic reaction of AIDS. But this reaction is working. It causes that the T-helper become pairwise connected to each other and then they will be removed from the body. What follows from this? It follows that for the diagnosis of AIDS, we need to take the blood sample of the patient and carefully look at it under a microscope. If we see many single T-helpers, we can be confident: for this patient the diagnosis of "AIDS" is not confirmed. If we see many interconnected with each other T-helpers, then there is no doubt that we face - AIDS patient...

The term "the disease of chain reaction type" was introduced into the theory of medicine by me personally. If you are interested in more details, read them, please, in my monograph [1], chapter №6

Thank you for your attention!

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Unplanned Pregnancy: Prevalence and Associated Factors among Antenatal Care Attending Women in Bale Zone, Oromiya Region, Southeast Ethiopia: A Facility - based Cross Sectional Study

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Abstract- *Background:* Unplanned pregnancy is one of the major reasons that expose women for unsafe abortion in most developing countries. Unplanned pregnancies have negative consequences on the women themselves, for their children, siblings and the societies as a whole. So far, no study was conducted in the zone related to the prevalence and associated factors of unplanned pregnancy. Therefore, this study assessed the prevalence of unplanned pregnancy and associated factors among pregnant mothers attending antenatal care at Bale Zone Hospitals, Oromiya Region, Southeast Ethiopia.

Methods: A facility-based cross-sectional study design was employed among 362 randomly identified mothers visiting Bale Zone Hospitals for antenatal care in May 2014. Data were collected through interviewer-administered questionnaires and analyzed using SPSS version 16.0 software. Descriptive, bivariate and multivariate analyses were used to determine prevalence and identifying associated factors of unplanned pregnancy by considering p-value of 0.05. The results were presented in a narrative forms, tables and graphs.

Keywords: *unplanned pregnancy, unsafe abortion, associated factors.*

GJMR-K Classification: *NLMC Code: WQ 200*

Str ictly as per the compliance and regulations of:

Unplanned Pregnancy: Prevalence and Associated Factors among Antenatal Care Attending Women in Bale Zone, Oromiya Region, Southeast Ethiopia: A Facility - based Cross Sectional Study

Birhanu Darega [α], Nagasa Dida [σ], Ashebir Hirko [ρ], Temirat Bezu [ω], Mohammed Ibrahim [¥], Kemal Adem [§] & Aliye Mohammedamin [χ]

Abstract - Background: Unplanned pregnancy is one of the major reasons that expose women for unsafe abortion in most developing countries. Unplanned pregnancies have negative consequences on the women themselves, for their children, siblings and the societies as a whole. So far, no study was conducted in the zone related to the prevalence and associated factors of unplanned pregnancy. Therefore, this study assessed the prevalence of unplanned pregnancy and associated factors among pregnant mothers attending antenatal care at Bale Zone Hospitals, Oromiya Region, Southeast Ethiopia.

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Results: From the total respondents, 135(37.3%) faced unplanned pregnancy (97(26.9%) mistimed and 38(10.6%) were unwanted). The main reasons of facing unplanned pregnancy was forgetting taking contraceptive 35(25.93%), husband preference 31(22.96%) and religious prohibition 17(12.6%). Thus, forgot taking contraceptive, husband preference and religious prohibition were among the main reason for being unplanned pregnancy. Age of the respondents, educational status of the respondents and their husband, occupation of the respondents and their husband, decision making style in household, time elapsed to reach near health facility providing contraceptives, ever utilizations of any types of contraceptive methods, having child before and number of children they have were the independent variables that significantly associated with unplanned pregnancy.

Conclusions: Findings of this study indicate unplanned pregnancy is the major reproductive health problems in the study area. Educational status of the respondents and their husband, occupation of the respondents and their husband, decision-making style in household and time elapsed to reach near health facility providing contraceptives were some of the variables that need great considerations. Therefore, Town Health Offices, Bale Zone Health Department and Oromiya Health Bureau should have to work together on those and other variables to decrease the magnitude of unplanned pregnancy.

Keywords: unplanned pregnancy, unsafe abortion, associated factors.

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I. Background

Unplanned pregnancies have a negative consequence on the women themselves, for their children, siblings and the society as a whole. Because pregnancy exposes women especially, poor women to health risk, simply by increasing the numbers of pregnancies and the delivery in their lifetime (1). On the other hand, unplanned pregnancy is one of the major reasons that expose women for unsafe abortion that results about 125,000 – 200,000 female deaths annually in developing countries (2).

Globally, from 210 million pregnancies that occur each year, 38% were unplanned and out of this unplanned pregnancy, 22% end with abortion. From this abortion, 40% of them were done on women aged less than 25 years, and about 68 000 women die every year from complications of unsafe abortion (3). From the total eighty-five million pregnancies occur globally, 40% of all them were unintended in 2012. From these unintended pregnancies, 50%, 13% and 38% them ended in abortion, miscarriage and unplanned birth respectively (4). An estimated 50 million induced abortion were performed each year as result of unplanned pregnancies of which 95% of them were in developing countries (5). In most developing countries, about 20% - 60% of married women or about 120 million women that need to avoid pregnancy become pregnant (5).

Although several international declarations were passed on the problem, many women in sub-Saharan Africa are suffering from unwanted pregnancies (6). In Sub-Saharan Africa, where about 86 unintended pregnancies occur for every 1000 women, one third of them end with unsafe abortion (7).

In Ethiopia, the situation is not different from developing countries; women suffer from problem of unplanned pregnancy. According to the EDHS-2011, about 28.3 % of total last pregnancy were unplanned (19.5% and 8.8 % were unwanted and mistimed respectively) (8). The magnitude and main reasons for this problem had still not well known in Bale Ethiopia. Therefore, this study assessed the prevalence of unplanned pregnancy and associated factors among pregnant mothers attending antenatal care at Bale Zone Hospitals, Oromiya Region, Southeast Ethiopia.

II. Methodology

a) Study setting and participation

Facility based cross sectional study was conducted among three hundred sixty two women attending antenatal care in May 2014 in Bale Zone hospitals, Oromiya Regional State, Southeast Ethiopia. The Zone has four hospitals (Robe, Goba, Ginnir and Dalloo Manna hospitals) from which two (Robe and Ginnir Hospitals) of them were randomly selected. The sample was proportionally allocated for the hospitals based on their load of women who follows ANC services in that hospital. Finally, study subjects were addressed through systematic random sampling.

The sample was determined using single population proportion formula with an assumption of level of confidence of the study 95%, sampling error tolerated 5%, proportion of unplanned pregnancy (P) 34% used from the study done in Hosainna Town, South Nation Nationalities and population (SNNR), Ethiopia (9) and 10% non-response rate were considered.

b) Instruments and Data collection methods

Structured questionnaires, which address the objectives of the study, were adapted from pertinent literatures. The questionnaire was translated into the local language - Afan Oromo and retranslated back to English. Pre-test was done on 5% of sample size in Goba hospital before actual data collections were took place to made necessary amendment. Data collection was made through interviewer-administered questionnaire.

c) Data Processing and analysis

Data entered into EpiData version 3.1 and exported to SPSS version 16.0 for an analysis. Descriptive analysis was made to determine the prevalence of unplanned pregnancy. Bivariate and multivariate analyses were used to identify associated factors of unplanned pregnancy; accordingly, a p-value of 0.05 was considered to identify significantly associated variables.

d) Ethical Considerations

Ethical clearance and approval was obtained from the Ethical Review Committee of Madawalabu University. A supportive letter was obtained from University Research Directorate of the University to the Hospitals. Permission was obtained from Hospital manager to implement the study. Prior to discussion and interview, the objectives of the study were clearly explained to the participants and oral informed consent was obtained. Confidentiality and anonymity were ensured throughout the execution of the study as participants were not require to explain their name. Participants were informed that their participation were voluntary and can withdraw from the study at any time if they wish to do so.

III. Results

a) Socio-demographic Characteristics

The response rate of this study was 100%. From 362 study participants, 240 (66.3%) of them were in age group of 20-29 years that was followed by 30-39 age group 68 (18.18%). Nearly one third of respondents were 1- 8th grade 108(29.8%) and illiterate 71(19.6%). Concerning ethnicity of the respondent, majority of them were Oromo 280 (77.3%) and followed by Amhara 58(16%). Regarding their religion 214 (59.1%) of them were Muslim followed by Orthodox Christianity 109(30%). Majority of respondents were married and lives in Urban that were 342 (94.5 %) and 267(73.8%) respectively. From the total married respondents, 87(25.4%) of their husbands were 1-8th grade complete and followed by certificate and above 82 (23.9%). To the occupational status of their husbands 87(25.43%) of them were merchants.More than half 229 (63.3%) of the respondents can access the health facility within ≤ 30 minutes while 89 (24.6%) of them access the health facility within 30 – 60 minutes from their residence [Table-1].

Table 1 : Socio - demographic characteristics of pregnant women attending ANC services in Bale zone hospitals, Oromiya Region, Southeast Ethiopia, May 2014

Variables	Frequency	Percentage (%)
Age of the respondent		
1. 15-19 years	42	11.6
2. 20-29 years	240	66.3
3. 30-39 years	68	18.8
4. 40-49 years	12	3.3
Total	**362**	**100**
Marital status		
1. Married	342	94.5
2. Widowed	8	2.2
3. Divorce	12	3
Total	**362**	**100**
Educational level		
1. No formal education	139	38.4
2. Grade: 1-8	108	29.8
3. Grade: 9-10	69	19.1
4. 10+, certificate and above	46	12.7
Total	**362**	**100**
Educational status of the husband		
1. No formal education	84	24.6
2. Grade: 1-8	87	25.4
3. Grade: 9-10	62	18.1
4. 10+, certificate and above	109	31.9
Total	**342**	**100.0**
Ethnicity		
1. Oromo	280	77.3
2. Amhara	58	16.0
3. Somali	12	3.3
4. Other*	12	3.3
Total	**362**	**100.0**
Religion		
1. Muslim	214	59.1
2. Orthodox	109	30.1
3. Protestant	26	7.2
4. Others**	13	3.6
Total	**362**	**100**
Occupation		
1. Housewife	268	74.0
2. Employee	52	14.4
3. Merchants	20	5.5
4. Students	14	3.9
5. Daily labors	8	2.2
Total	**362**	**100.0**
Occupation of the husband		
1. Employee	141	41.2
2. Student	8	2.3
3. Daily labor	29	8.5
4. Merchant	87	25.4
5. Farmer	77	22.5
Total	**342**	**100.0**
Residence		
1. Rural	95	26.2
2. Urban	267	73.6
Total	**362**	**100**
Decision Makers		

1. Herself	25	6.9
2. Her husbands	44	12.2
3. Together	293	80.9
Total	362	100
Time respondents elapse to the near health facility providing contraceptives		
1. ≤ 30 minutes	229	63.3
2. 31-60 minutes	89	24.6
3. > 60 minutes	44	12.2
Total	362	100.0

*Gurage &Tigre **Wakefata & Catholic

Majority of the respondents [276 (76.2 %)] married at the age of 18 years and above. Two hundred seventeen (59.9 %) and 16 (4.4 %) were became pregnant for the first time at the age of less than 20 years and 25 years and above. One hundred thirty five (52.9 %) respondents have 1-2 children and 59 (23.1%) of respondents have ≥ 5 children [Table 2].

Table 2 : Obstetric factors of pregnant women attending ANC services in Bale zone hospitals, Oromiya Region, Southeast Ethiopia, May 2014

Age at first marriage		
1. <18 years	86	23.8
2. ≥18 years	276	76.2
Total	362	100.0
Age at first pregnant		
1. <20 years	217	59.9
2. 20-24 years	129	35.6
3. ≥ 25years	16	4.4
Total	362	100
Number of children of the respondents		
1. 1-2 children	135	52.9
2. 3-4 children	61	23.9
3. ≥ 5 children	59	23.1
Total	362	100

b) The Current Pregnancy Status of the Respondents

From the total respondents, 135 (37.5%) of their current pregnancy were unplanned. From these 135 unplanned pregnancy, 97 (26.9%) were mistimed and 38 (10.6%) were unwanted totally. The most reasons why they experienced currently unplanned pregnancy were husband preference 39(25%), forgetting taking contraceptives 35(22.4%), unprotected sexual intercourses 30 (19.2%) and religious prohibition 28 (12.6%) respectively [Figure – 1].

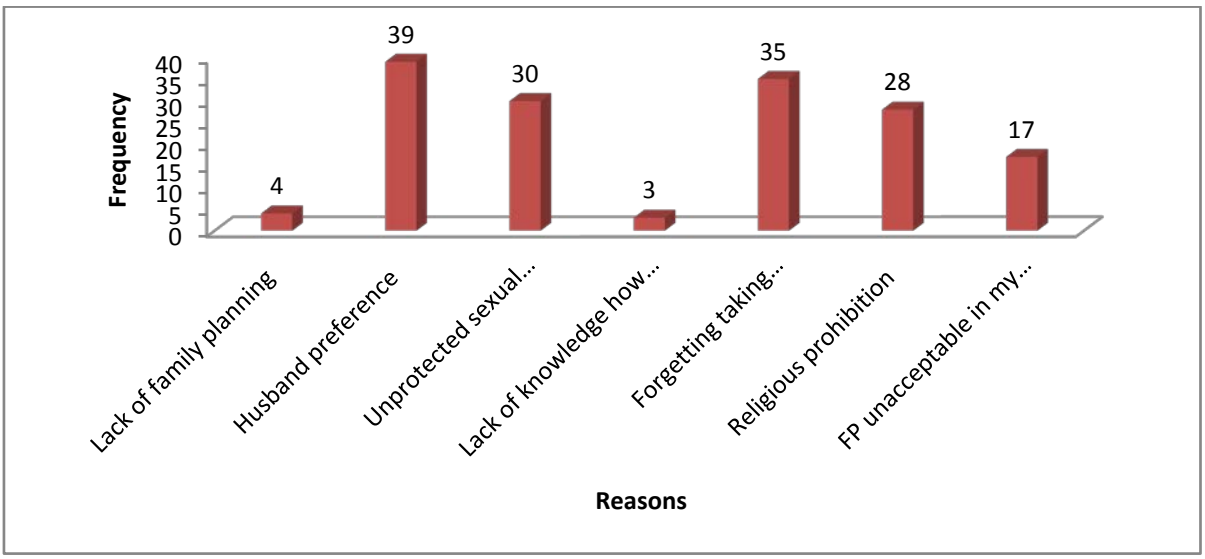

Figure 1 : The reasons for encountering unplanned pregnancy among pregnant mothers attending ANC services in Bale Zone Hospitals, Oromiya Region, Southeast Ethiopia, May 2014

c) Unplanned pregnancy and associated factors

Binary and multiple logistic regressions were done to analyze factors associated with unplanned pregnancy at P-value less than 0.05. Accordingly, age of respondents, marital status, educational status of respondents and their husbands, residence of respondents, occupation of respondents and their husbands, average monthly incomes and time taken to reach near health facility providing any types of contraceptives showed significant association with unplanned pregnancy. Similarly, decision-making style in households, being heard information about family planning methods, history of any types of contraceptive methods utilizations, being pregnant before, having child before, number of children, desire to have more children in future and history of abortion also identified as associated variables using bivariate analysis.

However, age of respondents, educational status of respondents and their husbands, occupation of respondents and their husbands, decision making style in households, time respondents elapse to reach near health facility providing contraceptives, history of any types of contraceptive methods utilizations, having child before and number of children were the predictor variables that significantly associated with unplanned pregnancy.

Women's age with 20 - 29 years were 0.2 times less likely to have unplanned pregnancy as compared to women with 40 - 49 years old (AOR = 0.235, 95% CI: 0.058, 0.954). Women that had educational level of 10+, certificate and above were also 0.3 times less likely to encountered unplanned pregnancy (AOR = 0.312, 95% CI: 0.259, 0.656). Again, women that become government employee were 0.7 times less likely to face unplanned pregnancy (AOR = 0.785, 95% CI: 0.287, 0.751). In similar way, women that took less than 30 minutes to reach health facilities were 0.6 times less likely to face unplanned pregnancy, when compared to those women that elapse more than 60 minutes to reach health facilities (AOR = 0.678, 95% CI: 0.559 , 0.804). Women that used any type of contraceptive method before were 0.6 times less likely to face unplanned pregnancy, when compared with women that no used contraceptives before (AOR = 0.632, 95% CI: 0.385, 0.831).

On other hand, those women whose husband made decision were almost 3 times more likely to have unplanned pregnancies as compared to those make decision together (AOR = 2.797, 95% CI: 1.377, 5.681). Similarly, women that had child before were also at high risk of developing unplanned pregnancy compared to those have no children (AOR = 3.905, 95% CI: 2.087, 7.307) [Table 3].

Table 3 : Association of Socio demographic factors, Obstetric factors, Institutional factors and behavioral factors of pregnant women with unplanned pregnancy at Bale Zone Hospitals, Oromiya Region, Southeast Ethiopia, May 2014

Socio demographic	Alternatives	Current Pregnancy Planned		COR [95%C.I]	AOR [95%C.I]
		Yes	No		
Age of respondent	15-19 years	27	15	0.185 (0.043 - 0.790) *	0.618 (0.114 - 3.356)
	20-29 years	165	75	0.152 (0.040 - 0.576) *	**0.235 (0.058 - 0.954) ****
	30 - 39 years	32	36	0.375 (0.093 - 1.507)	0.339 (0.079 - 1.461)
	40 - 49 years	3	9	1.00	1.00
Marital Status	Married	222	120	0.077 (0.009 – 0.635) *	0.340 (0.348 - 1.062)
	Divorce	4	8	0.286 (0.026 - 3.196)	0.608 (0.022 - 3.752)
	Widowed	1	7	1.00	1.00
Religion	Muslim	131	83	1.00	
	Orthodox	75	34	0.716 (0.438 - 1.168)	
	Protestant	15	11	1.157 (0.507 - 2.642)	
	Others	6	7	1.841 (0.598 - 5.669)	
Educational level of respondent	No formal education	80	59	1.00	1.00
	Grade 1-8	64	44	0. 932 (0.560 - 1.553)	1.874 (0 .374 - 9.386)
	Grade 9-10	46	23	0.678 (0.371 - 1.239)	1.625 (0 .333 - 7.926)
	10+, certificate and above	37	9	0.330 (0.148 - 0.736) *	**0.312 (0.259 - 0.656) ****
Educational level of husband	No formal education	47	37	1.00	1.00
	Grade 1-8	57	30	0.669 (0.361 - 1.239)	0 .958 (0 .471 - 1.949)
	Grade 9-10	37	25	0.858 (0.441 - 1.670)	1.676 (0 .719 - 3.907)
	10+, certificate and above	81	28	0.439 (0.239 - 0.807) *	**0.529 (0.255 - 0.894) ****

Residence of respondents	Rural	52	43	0.636 (0.395 - 0.724) *	1.037 (0. 814 - 2.361)
	Urban	175	92	1.00	1.00
Occupation of respondents	House wife	161	107	1.00	1.00
	Employee	40	12	0.451 (0.226 - 0.900) *	**0.785 (0.287 – 0.751)** **
	Merchant	11	9	1.231 (0.493 - 3.071)	1.738 (0.587 - 5.149)
	Student	9	5	0.836 (0.273 - 2.563)	1.440 (0.319 - 6.508)
	Daily labor	6	2	0.502 (0.099 - 2.532)	1.194 (0.500 - 2.852)
Occupation of Husband	Employee	103	38	0.443 (0.247 – 0.793) *	**0.542 (0.217 - 0.973)** **
	Student	7	1	0.171 (0.020 - 1.461)	1.190 (0.239 - 5.936)
	Daily labor	18	11	0.733 (0.306 - 1.757)	0.795 (0.232 - 2.719)
	Merchant	52	35	0.808 (0.434 - 1.502)	1.373 (0 .402 - 4.692)
	Farmer	42	35	1.00	1.00
Average monthly income	≤ 1000ETB	46	28	1.230 (0.573 - 0. 919) *	0.951 (0.104 - 1.417)
	> 1000ETB	181	107	1.00	1.00
Decision making style	Wife	7	18	1.00	1.00
	Husband	20	24	0.467 (0.162 - 1.341)	**2.797 (1.377 - 5.681)** **
	Both together	200	93	0.181 (0.073 - 0.448) *	1.503 (0.239 - 3.229)
Time respondents elapse to the near health facility providing contraceptives	≤ 30 Minutes	152	77	0.507 (0.264 - 0.972) *	**0.678 (0.559 - 0.804)** **
	31- 60 Minutes	53	36	0.679 (0.328 - 1.405)	0.960 (0.639 - 2.016)
	> 60 Minutes	22	22	1.00	1.00
Ever heard information about FP method	Yes	222	126	0.315 (0.103 - 0.961) *	0.742 (0.691 - 2.767)
	No	5	9	1.00	1.00
Ever used any type of contraceptive method	Yes	149	80	0.852 (0.539 - 0.947) *	**0.632 (0.385 - 0.831)** **
	No	73	46	1.00	1.00
Husband allow to use contraceptive method	Yes	161	75	0.718 (0.437 - 1.179)	
	No	57	37	1.00	
Had pregnancy before	Yes	146	114	3.012 (1.757 - 5.162) *	1.264 (0.176 - 9.075)
	No	81	21	1.00	1.00
Having child before	Yes	142	113	3.075 (1.810 - 5.223) *	**3.905 (2.087- 7.307)** **
	No	85	22	1.00	1.00
Number of children in the household	1-2 children	79	56	0.486 (0.261 - 0.906) *	0.862 (0.319 - 3.284)
	3-4 children	39	22	0.387 (0.185 - 0.808) *	0.584(0.091 - 1.524)
	≥ 5children	24	35	1.00	1.00
Want any more children in future	Yes	137	59	0.510 (0.331- 0.785) *	**0.583 (0.357- 0.953)** **
	No	90	76	1.00	1.00
Experienced abortion before	Yes	48	39	0.660 (0.404- 0.937) *	0.936 (0.120 - 1.990)
	No	179	96	1.00	1.00

*, ** *P-value < 0.05*

IV. Discussions

This study has assessed prevalence and associated factors of unplanned pregnancy among pregnant women attending antenatal care in Bale Zone Hospitals, Oromiya regional state, Southeast Ethiopia. Accordingly, 135 (37.5%) of their current pregnancy were unplanned. From these unplanned pregnancy, 97 (26.9%) of them were mistimed and 38 (10.6%) were unwanted.

In contrary to this study results, a study done in Senegal showed that, 14.3% of ever-pregnant women reported having a recent unintended pregnancy (10). The difference may be due the both population have different background and at different locations. Study done in Amhara Region, Ethiopia, also showed lower magnitude of unintended pregnancy which was 26.0 % of which 13.7% were mistimed and while 12.3% were unwanted (11). The difference may be due to both study done on different background communities.

In similar to this study results, a study done in West Wollega, Ethiopia, 225 (36.5%) of pregnancy was unintended that156 (25.3%) wants to have baby later while other 69(11.2%) wants no more birth (10). The similarity may be due to both studies done nearly in the same years. The study done in SNNR Hossaina, Ethiopia also became concurrent with this study. Out of three hundred eighty five pregnancies, 131 (34%) were unintended, which have some difference with this study finding that resulted due to the study period difference and background of both community (9).

The most reasons why they experienced currently unplanned pregnancy were husband preference to had more children 39(25%), forgetting taking contraceptives 35(22.4%), unprotected sexual intercourses 30 (19.2%) and religious prohibition 28 (12.6%) respectively. In this study, age of respondents, educational status of respondents and their husbands, occupation of respondents and their husbands, decision making style in households, time respondents elapse to reach near health facility providing contraceptives, history of any types of contraceptive methods utilizations, having child before and number of children were the predictor variables that significantly associated with unplanned pregnancy.

Similarly, study done in Amhara Region, Ethiopia reflected, lack of knowledge, disapproval by husband, and method failure were major reasons mentioned for failure to avoid unintended pregnancy. Differences in educational status of women and family size were the variables that significantly associated with unintended pregnancy (11). In West Wollega, Ethiopia, also age of respondents, total birth, ideal number of children, husband's disagreement to limit family size, family planning health worker visit and knowledge level of respondents were significantly contributing to unintended pregnancy (12).

In a study done in SNNR Hossaina, Ethiopia, the husband not wanting to limit family size, a desire for at least two children, the number of pregnancy 3 - 4 and parity of 5 and above were factors significantly associated with unintended pregnancy (9).

a) Strengths and limitations

The study had 100% respondent rate and health professionals collected the data that able to decrease uncertainty while collection of the data. Out of the three administrative towns of the Zone, two of them were included in the study. Therefore, these findings can be generalized to entire population that lives in the all-administrative towns. Since the data were collected only by quantitative methods, it not addresses the information that possible to address only by qualitative methods. Therefore, in future it is better if both qualitative and quantitative methods of data collections is considered while conduction of investigation on similar study.

V. Conclusions

Findings of this study indicate unplanned pregnancy is the major reproductive health problems in the study area. Age of respondents, educational status of respondents and their husbands, occupation of respondents and their husbands, decision making style in households, time respondents elapse to reach near health facility providing contraceptives, history of any types of contraceptive methods utilizations, having child before and number of children were the predictor variables that significantly associated with unplanned pregnancy.

The Town Health Office, Bale Zone Health Department, Oromiya Health Bureau and other stakeholders should disseminate information on reproductive health service considering the identified factor through health institutions, school, mass media and community levels discussions.

Competing interests

None of the authors has any competing interest.

Authors' contributions

BD, AH, TB, MI, KA and AM conceived and designed the study. BD & ND analyzed the data and interpreted the results. BD & ND prepared and critically reviewed the manuscript. All authors have read and approved the manuscript.

VI. Acknowledgments

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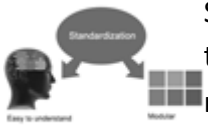

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- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

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27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

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- Please note the criterion for grading the final paper by peer-reviewers.

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- Reason of the study - theory, overall issue, purpose
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Approach:

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	A-B	**C-D**	**E-F**
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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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