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Photos top to bottom: (1) Aloe Vera, a herbal medicinal plant for cancer treatment, (2) Maasai mother breastfeeding a baby and, (3) A trainee welder in Uganda



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Aloe and its Effects on Cancer: A Narrative Literature Review

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ABSTRACT

Many years ago, *Aloe Vera* was cited to have a lot of therapeutic properties including; anti-microbial, anti-viral, anti-cancer, anti-oxidant, anti-inflammatory, skin protection, wound healing, and regulation of blood glucose and cholesterol. However, Aloe could present some side effects. This review focused on the latest discoveries regarding the therapeutic role of Aloe plant or its compounds on the acquired biological capabilities for tumour growth and progression namely; evading growth suppressor, avoiding immune destruction, enabling replicative immortality, tumour promoting inflammation, activating invasion and metastasis, inducing angiogenesis, genome instability and mutation, resisting cell death, deregulating cellular energetics and sustaining proliferating signalling. It clarified the anti-cancer activities it exerts on different types of cancer and also highlighted some pro-oncogenic pathways that can be disrupted by different compounds of Aloe.

BACKGROUND

Around 420 species of Aloe are inventoried worldwide, but the most popular and widely used is *Aloe Barbadensis Miller* (also called *Aloe Vera* Linne, commonly referred to as *Aloe Vera*).^{1,2} For many years, Aloe is known to have many therapeutic properties which include; anti-microbial, anti-viral, anti-cancer, anti-oxidant, anti-inflammatory, skin protection, wound healing, and regulation of blood glucose and cholesterol.³

Several studies have illustrated the role of Aloe in cancer prevention and treatment, around 75 active compounds could potentially be of therapeutic value in cancer treatment.⁴ Even though Aloe or its compounds is known play anti-cancer activities in many cancer types in vitro, few studies have reported this evidence. Furthermore, many in vitro studies have demonstrated the effectiveness of the whole Aloe or its compounds in inhibiting the proliferation or growth of tumours.

Whole Aloe could have an inherent anti-tumour activity because of its many compounds and could be involved in the disrupting of tumour growth and progression signalling pathways. This mechanism of action could invariably inhibit the growth of cancer cells and lead to good prognosis. However, there are some controversies about toxicities of Aloe given the recent review which reported the side effects of Aloe especially for *Aloe Vera* on neoplastic and non-neoplastic cells.¹

Many acquired capabilities are necessary for tumour growth and progression, namely; Evading growth suppressor, Avoiding immune destruction, enabling replicative immortality, tumour promoting inflammation, activating invasion and metastasis, inducing angiogenesis, genome instability and mutation,

resisting cell death, deregulating cellular energetics and sustaining proliferating signalling.⁵ In its anti-cancer activities, the aloe could act on one or more of these capabilities for tumour growth and progression.

Therefore, this narrative literature review aimed to present the effectiveness of Aloe or its compounds on cancers taking into account the acquired capabilities of Cancer.

Identification of Relevant Studies and Research Method

We systematically searched on PubMed and google scholar databases. The combination of key words were Aloe and cancers, Aloe and tumours, Aloe and tumours suppressors, Aloe and cancer cytotoxicity, Aloe and cancer apoptosis, Aloe and tumour growth, Aloe and tumour proliferation, Aloe and tumour inflammation, Aloe and tumour and immune, Aloe and cancer metastasis, Aloe and cancer angiogenesis, Aloe and DNA cancer cells, Aloe and normal cells.

Through identified studies, we systematically identified any compound of Aloe which has any anticancer activity. To perform deeply our research, every time the item Aloe was replaced by the identified compound in the above combination. Other studies were identified through references.

The Biological Capabilities of Cancer and Aloe Antigrowth activity of Aloe on cancer cells

Aloe Vera proved its anticancer effect when it was administered to rats with pleural tumour from hepatoma cells.⁶ The dichloromethane (CH₂Cl₂) extract of cape aloe (concentrated and dried leaves of various species of Aloe, mainly *Aloe ferox*) caused growth inhibitory effect in Ehrlich ascites tumour cells, a decrease in DNA synthesis and an accumulation of cells in the G₁ phase.⁷

Cytotoxicity of Aloe on cancer cells

The Aloin is a natural anthracycline and it is known that anthracycline class medication such as doxorubicin is used in treatment of various types of cancer namely breast carcinoma, osteosarcoma and cancer of soft tissues, Hodgkin lymphoma, non-Hodgkin lymphoma, Solid tumour of children, lung cancers, acute and chronic leukaemia, bladder cancer, ovarian cancer and gastric cancer.^{8,9} Aloin's cytotoxicity effect was found and more marked in breast cancer cells without ErbB-2 than those with ErbB-2.⁸ The Emodin, a natural anthraquinone found in Aloe^{10,11} and in other plants was involved in a cytotoxic activities in human myeloma.¹²

Apoptosis and antiproliferative activities of Aloe

When murine myeloma cells were treated by leaf extract of *Aloe arborescens*, the antiproliferative activity was very high while in the control group of cells, the reverse activity was observed.¹³ Moreover, the anti-proliferative effect of total extract from leaves of *Aloe arborescens* (8%) was very high than the one of Aloe-emodin (natural hydroxyanthraquinone present in the leaves of *Aloe Vera*) in glioblastoma cells.¹⁴

Aloe-emodin showed its efficacy to inhibit proliferation and to induce apoptosis in many types of cancerous cells by various mechanisms (Table 1). They include human colon carcinoma cells, human oral squamous cell carcinoma, human gastric carcinoma cells, human colorectal cancer cells, human cervical cancer cells, human lung squamous carcinoma, human malignant glioma cells, human tongue squamous cancer cells, prostate cancer cells, human colon cancer cells, human nasopharyngeal carcinoma cells, human bladder cancer cells, and hepatocellular carcinoma cells.¹⁵⁻³⁰

Furthermore, Aloe-emodin inhibited the proliferation of Merkel Cells Carcinoma to a significant degree and has also anti-neuroectodermal tumour activity in vitro and in vivo.^{31,32} Anthraquinones are involved in induction of death of human cancer cells in many studies.³³⁻³⁶ In Egypt, it was demonstrated that the extracts of *Aloe Vera* could have anti-hepatocarcinogenic effect through modulation of apoptosis.³⁷

For hematologic cancer, it was reported that Aloe-emodin has an anti-proliferative activity in leukemia cells and in lymphoma cells.^{38,39} Moreover, it was found to have anticancer activity in multidrug resistant leukemia cells.⁴⁰ Aloin has been reported to have an antiproliferative effect in human cervix carcinoma cells by enhancing the apoptosis⁴¹ and has an anti-tumour effect in gastric cancer in vitro and in vivo.^{2,42}

The Emodin exerts its anti-cancer activities in pancreatic cancer cells through declining the mitochondrial membrane potential.⁴³ The Emodin Azide Methyl Anthraquinone Derivative (AMAD) was found to effectively block phosphorylation of Her2/neu, suppress growth, transformation and metastasis as a tyrosine kinase inhibitor, and increase the susceptibility of Her2/neu-over expressing cancer cells to standard cytotoxic therapeutic agents. This could be a potential therapeutic strategy that may block disease pathway and improve pathology in Her2/neu-over expressing cancers.⁴⁴ It also has an anticancer activity on prostate cancer cells.⁴⁵

Alomicin was isolated from *Aloe arborescens* and exerted an anticancer activity in vivo for sarcoma 180 and Ehrlich ascites cancers. In mice, it inhibited 100% of sarcoma 180 at a concentration of 100mg/kg by the IP route (intraperitoneally) in DDS (Dorsal Dark Stripe) while 60% of EAC were inhibited at a concentration of 2.5mg/kg twice by the IP route. Alomicin efficiently inhibited the growth of hepatoma cells.²

Aloesin is an active compound of *Aloe Vera* which could arrest the cell cycle, induce apoptosis in vitro and inhibit tumour growth of ovarian cancer.⁴⁶

The Di(2-Ethylhexyl) Phthalate (DEHP) extracted from *Aloe Vera* exerted an anti-leukaemic and anti-mutagenic effects and induced apoptosis in-vitro.^{47,48}

It was reported that Aloe mannan is a polysaccharide extracted from *Aloe arborescens* which inhibited the growth of sarcoma implanted in mice.⁴⁹ Administered to mouse inoculated sarcoma 180, *Aloe Vera* prolonged the life span of mouse.⁵⁰

The mannan is extracted from Aloe Saponaria. It could inhibit tumour cell activation and proliferation and does not interfere with normal lymphocyte activation.⁵¹

The administration of the active compounds of *Aloe Vera* to tumour transplanted animals prolonged significantly their life. Relatively, aloe-emodin was less effective than Aloesin, Aloesin less effective than Octapeptide and Octapeptide less effective than Barbaloin. The inhibition of cells growth depended on the compounds and the type of cancer. Indeed, the growth inhibition of Ehrlich ascites carcinoma cell number when compared to the control group followed this sequence: Aloesin < Octapeptide < Aloe-emodin < Barbaloin.⁵²

Angiogenesis of Aloe Extracts and Compounds

Aloe-emodin was identified to have an anti-angiogenic effect.⁵³ Indeed, oral administration of 150µl daily dose of *Aloe Vera* gel to mice for 3 days after L-1 sarcoma cell grafting decreased significantly the number of newly-formed blood vessels when compared with the control group.⁵⁴ Aloe-emodin could target multiple molecules responsible for angiogenesis in colon cancer cells.⁵⁵ Moreover, Aloin could inhibit tumour angiogenesis by blocking STAT3 activation in colorectal cancer.⁵⁶

Anti-Inflammatory Activity of Aloe

It has been demonstrated that inflammation is linked to various steps involved in tumorigenesis by supplying bioactive molecules to the tumour micro-environment such as growth factors that sustain proliferative signalling, survival factors that limit cell death, proangiogenic factors, extracellular matrix-modifying enzymes that enable angiogenesis, invasion, metastasis, and inductive signals that lead to stimulation of Epithelial Mesenchymal Transition (EMT). Moreover, inflammatory cells can release substances, especially Reactive Oxygen Species (ROS), that are actively mutagenic for nearby cancer cells which accelerate their genetic evolution toward states of intensified malignancy.^{5,57} On the other hand, several studies demonstrated the anti-inflammatory activity of Aloe or its compounds in inhibiting edema in vivo.⁵⁸⁻⁶¹

TABLE 1: The Compounds of Aloe and Mode of Action on Cancers

Compounds	Country	Experiments	Effects	Type of cancer	Mode of action	References
Whole Aloe						
Aloe Vera	Italy	Vivo	Anticancer	Pleural tumour from hepatoma	Not described	6
Aloe Vera	Egypt	Vitro	Anticancer & apoptosis	hepatocellular carcinoma	Increase P53 and decrease Bcl-2 genes expressions	37
Aloe Vera	Poland	Vivo	Anti-angiogenesis, phototoxicity	Sarcoma	Not described	54
Aloe Vera	Japan	Vitro	Suppression cell proliferation	Neuroblastoma	Probably by suppressing CCND2 transcript levels	65
Aloe Vera	UAE	Vitro	Inhibition of cancer cell growth	Breast and cervical cancer	Apoptotic pathway	95
Aloe Vera	USA	Vivo	Inhibition of tumour	Ocular Surface Squamous Neoplasia	Not described	105
Aloe Vera extract	Korean	Vitro	Induction of apoptosis	Hepatocellular carcinoma	ATP depletion-related impairment of mitochondria, which is caspase-independent	109
Aloe arborescens Miller	Japan	Vivo	Anticancer & ant-proliferative	Duodenal tumour	Not described	110
Aloe arborescens	Italy	Vitro/Vivo	Tumour growth inhibition	Glioblastoma	Not described	14
Aloe-emodin						
Aloe-Emodin	Taiwan	Vitro	Antiproliferative	Colon carcinoma	Inhibition of casein kinase II activity, The release of apoptosis-inducing factor and cytochrome c, Caspase-3 activation	15
Aloe-emodin	China	Vitro	Antiproliferative, increase apoptosis	Oral squamous carcinoma	Activation of caspase-9 and caspase-3 proteins	16
Aloe-emodin	Taiwan	Vitro	Induction of apoptosis	Gastric carcinoma	Release the apoptosis-inducing factor and cytochrome c from mitochondria, Activation of caspase-3	17
Aloe-Emodin	China	Vitro	Suppression of cell viability induction of apoptosis, endoplasmic reticulum stress	Colorectal	Activation of factor C/EBP homologous protein and caspase-12	18
<i>Continued</i>						

TABLE 1: Continued

Compounds	Country	Experiments	Effects	Type of cancer	Mode of action	References
Aloe-Emodin	Poland	Vitro	Induction of apoptosis	Cervical Cancer	Mitotic catastrophe, inhibition of cell division in the G2/M phase, reduction of viability	19
Aloe-emodin (Nano)	China	Vitro/Vivo	Antiproliferative induction of cell cycle arrest & apoptosis, anti-tumour growth	Lung squamous cell carcinoma	Cleavage of Caspase-3, poly (ADP-ribose), polymerase (PARP), Caspase-8 and Caspase-9, Enhanced reactive oxygen species (ROS) production	20
Aloe-emodin	Italy	Vitro/Vivo	Tumour growth inhibition	Glioblastoma	Reduction pAKT phosphorylation, block of cell cycle in S and G2/M phase	14
Aloe-emodin	Malaysia	Vitro	Induction of apoptosis and cell cycle arrest in S phase	Malignant glioma	Promotion of the loss of mitochondrial membrane potential	21
Aloe-emodin	China	Vitro	Induction of cell death through S-phase arrest and apoptosis	Tongue squamous carcinoma	Promotion of p53, p21 and p27, Promotion of the release of apoptosis-inducing factor, endonuclease G, pro-caspase-9 and cytochrome c	22
Aloe-emodin	Korea	Vitro/Vivo	Suppression of cancer progression	Prostate cancer	Binding with mTORC2 and inhibit its kinase activity	23
Aloe-emodin	India	Vitro	Induction of cell cycle arrest in G2/M phase & apoptosis	Colon cancer	Activation of Caspase-6	24
Aloe-emodin	Taiwan	Vitro	Induction of cell cycle arrest in G2/M phase & apoptosis	Nasopharyngeal carcinoma	Caspase-8-mediated activation of the mitochondrial death pathway	25
Aloe-emodin	China	Vitro	Induction of cell cycle arrest in G2/M phase & apoptosis	Bladder Cancer	Activation of p53, p21, Fas/APO-1, Bax and caspase-3.	26
Aloe-emodin	China	Vitro	Induction of-growth inhibitory through cell cycle arrest in G2/M phase	Cervical cancer	Cell cycle arrest in G2/M phase	27
Aloe-emodin	Taiwan	Vitro	Induction of cell cycle arrest in G1 phase and apoptosis	Hepatoma	Induction of p53 and p21 expression	28

Continued

TABLE 1: Continued

Compounds	Country	Experiments	Effects	Type of cancer	Mode of action	References
Aloe-emodin	USA	Vitro	Inhibits proliferation, and induces apoptosis	Glioma	Delaying S phase progression, reduction of poly (ADP-ribose) polymerase and protein kinase C, cleavage of caspase 7	29
Aloe-emodin	Taiwan	Vitro	Induction of apoptosis	Lung squamous cell carcinoma	Activation of caspase-3, caspase-8, and caspase-9	30
Aloe-emodin	Italy	Vitro/Vivo	Induction of apoptosis	Neuroectodermal Tumours	Not well described	31
Aloe-emodin	Israel	Vivo	Inhibition of cells proliferation	Merkel cell carcinoma	Not described	32
Aloe-emodin	Italy	Vitro	Cells antiproliferative and differentiation	Leukaemia	Not described	38
Aloe-emodin	Taiwan	Vitro	Induction of cell cycle arrest in G2/M phase & antiproliferative	Promyelocytic leukaemia	Not described	39
Aloe-emodin	Italy	Vitro	Anticancer	Multidrug resistant leukaemia cells	Not described	40
Aloe-emodin	Spain	Vivo	Anti-angiogenesis	Not specific	Inhibits endothelial cell proliferation	53
Aloe-emodin	India	Vitro	Inhibition of cell migration/angiogenesis	Colon cancer	Down-regulating of Matrix Metalloproteinase (MMP-2/9), RhoB and VEGF by reducing DNA binding activity of NF-kB	55
Aloe-emodin	China	Vitro	Suppression of the metastasis	Breast cancer	Inhibition of the capabilities of invasion and migration of cells probably	63
Aloe-emodin	Italy	Vitro	Anticancer and anti-proliferation	Melanoma	Decreasing the secretion of matrix metalloproteinase-9	66
Aloe-emodin	China	Vitro	Arrest the cell cycle in G2/M phase	Gastric cancer	Inhibition of the expressions of protein kinase C and c-myc	67
Aloe-emodin	Taiwan	Vitro	Induction of cells death	Lung non-small cell carcinoma	Decreasing Cyclic adenosine monophosphate (cAMP)-dependent protein kinase, protein kinase C, Bcl-2, caspase-3 and p38	111

Continued

TABLE 1: Continued

Compounds	Country	Experiments	Effects	Type of cancer	Mode of action	References
Aloe-emodin	Taiwan	Vitro	Induction of DNA damage and apoptosis	Lung carcinoma	Production of generation of reactive oxygen species and decrease in the mRNA of DNA repair enzymes	69
Aloe-emodin	China	Vitro/Vivo	Antineoplastic (cell proliferation was blocked in G1 phase)	Oral mucosa carcinoma	Reactive oxygen species (ROS) generated and up-regulation of Caspase-3	99
Aloe-emodin	China	Vitro	Inhibition of tumour	Gastric cancer	Not described	100
Aloe-emodin	Serbia & Montenegro	Vivo	Anticancer, induction of apoptosis	Glioma	Inhibition of extra cellular signal-regulated kinases 1 and 2 (ERK1/2) independent induction	112
Aloe-emodin	Singapore	Vitro	Induction of apoptosis and cell cycle arrest in G2/M	Hepatocellular carcinoma	Induction of higher caspase-3-like activity	68
Aloe-emodin	China	Vitro	Anticancer	Tongue Cancer	Induction of DNA damage and inhibition of DNA repair gene expression	71
Aloe-emodin	Taiwan	Vitro	Suppression of breast cancer cell proliferation	Breast Cancer	Targeting estrogen receptor protein stability through distinct mechanisms	113
Emodin						
Emodin	Taiwan	Vivo	Cytotoxicity	Lung squamous cell carcinoma	Activation of caspase-3, caspase-9 and caspase-8, induction of cell death by Bax death pathway and Fas pathway	114
Emodin	China	Vitro	Induction of apoptosis	Hepatocellular carcinoma	Mitochondrial apoptosis pathway through cell cycle arrest and ROS generation	115
Emodin	China	Vitro	Induction of cells death	Osteosarcomama	Initiation of ROS-dependent mitochondria-induced and ROS-independent endoplasmic reticulum stress-induced apoptosis	116
Emodin	China	Vitro	Induction of apoptosis	Lung cancer	Endoplasmic reticulum stress and the TRIB3/NF-κB pathway	117
<i>Continued</i>						

TABLE 1: Continued

Compounds	Country	Experiments	Effects	Type of cancer	Mode of action	References
Emodin	China	Vitro/ Vivo	Induction of apoptosis	Hepatocellular carcinoma	Mitogen-activated protein kinase (MAPK) and phosphoinositide 3-kinase (PI3K)/AKT signalling pathways	118
Emodin	China	Vitro/ Vivo	Anticancer and antiproliferative	Pancreatic cancer Liver metastasis of pancreatic cancer	Inhibition of epithelial mesenchymal transition by raising increasing the content of miR-1271	119
Emodin	China	Vitro	Promotion of the arrest of cell proliferation	Lymphoma	Increase in the UHRF1D-NMT3A-TAp73/ Δ Np73 pathways.	120
Emodin	China	Vitro	Induction of apoptosis	Colon cancer	Induction of autophagy, during which ROS generation is of the essence.	121
Emodin	China	Vitro	Induction of growth inhibition and apoptosis	Breast cancer	Reduction of the level of Bcl-2 and increased levels of cleaved caspase-3, PARP, p53 and Bax	122
Emodin	China	Vitro	Induction of cells growth inhibition and apoptosis	Acute myeloid leukaemia	Inhibition of the PI3K/Akt signalling pathway by activation of caspase cascades	123
Emodin	China	Vitro	Induction of apoptosis	Colon cancer	ROS is a trigger of emodin inducing apoptosis and p53 expression increases under oxidative stress, leading to Bax-mediated mitochondrial apoptosis	124
Emodin	China	Vitro	Triggers apoptosis	Neuroblastoma	Mechanism involving both reactive oxygen species and nitric oxide	125
Emodin	China	Vitro	Induction of apoptosis	Cervical cancer	Intrinsic mitochondrial and extrinsic death receptor pathways	126
Emodin	India	Vitro	Induction of apoptosis	Hepatocellular carcinoma	Blocking activation of STAT3 (Signal transducer and activator of transcription 3)	127
Emodin	China	Vitro	Induction of cells growth inhibition and apoptosis	Breast carcinoma	Modulation of the expression of apoptosis-related genes	128
Emodin	China	Vitro	Induction of apoptosis	Liver cancer	A multifaceted complex cascade of events	129

Continued

TABLE 1: Continued

Compounds	Country	Experiments	Effects	Type of cancer	Mode of action	References
Emodin	China	Vitro/ Vivo	Induction of apoptosis and inhibition of cells proliferation	Pancreatic cancer	Declining the mitochondrial membrane potential	43
Emodin	China	Vitro	Inhibition of cells proliferation and induction of apoptosis	Prostate cancer	Androgen receptor and p53-p21 pathways and the mitochondrial pathway.	45
Emodin	China	Vitro	Inhibition of cell growth and induction of apoptosis	Leukaemia	Inhibition of phosphorylation of P210 protein, down-regulation of P210 protein expression and activation of caspase-3	130
Emodin	China	Vitro	Induction of cells growth inhibition and apoptosis	Leukaemia	Inhibition of Akt [Protein kinase B (PKB)] signal pathway	131
Emodin	Japan	Vitro	Induction of apoptosis	Multiple myeloma	Inhibition of interleukin-6-induced JAK2/STAT3 pathway	12
Emodin	Taiwan	Vitro	Induction of apoptosis	Lung adenocarcinoma	Reactive oxygen species-dependent mitochondrial signaling pathway	132
Emodin	Taiwan	Vitro	Induction of apoptosis	Promyeloleukemia	Activation of caspase 3 cascade but independent of reactive oxygen species production	133
Emodin	Indian	Vitro	Induction of apoptosis	Cervical cancer	Caspase-dependent and presumably through the mitochondrial pathway, by the activation of caspases-3, -9 and cleavage of poly (ADP-ribose) polymerase	134
Emodin	Japan	Vitro	Induction of apoptosis	Hepatocellular carcinoma	Enhancement of generation of ROS, DeltaPsim disruption and caspase activation	135
Emodin azide methyl anthraquinone derivative	China	Vitro	Inhibition of cell growth and induction of apoptosis	Breast cancer and lung adenocarcinoma with over expression of HER2/neu	Disruption of the PI3K/Akt-dependent pathway	44
Aloin	Serbia	Vitro	Antiproliferative, Cell cycle arrest in the S phase, Apoptosis	Cervical uterine carcinoma	Changes in the activity of almost all anti-oxidant enzyme	41

Continued

TABLE 1: Continued

Compounds	Country	Experiments	Effects	Type of cancer	Mode of action	References
Aloin						
Aloin	China	Vitro Vivo	Inhibit of tumour angiogenesis growth	Colorectal cancer	Suppression of activation of VEGF receptor (VEGFR) 2 and STAT3 phosphorylation in endothelial cells	56
Aloin (Barbaloin)	China	Vitro/ Vivo	Reduction of gastric cancer cell viability & induction of apoptosis	Gastric cancer	Induction of autophagy and ROS generation	42
Aloin	Italy	Vitro	Antineoplastic & antimetastatic	Melanoma	Induction of melanoma cell differentiation	97
Acemannan						
Acemannan	USA	Vivo	Anticancer	Fibrosarcoma	Macrophage activation and release of tumour necrosis factor, interleukin-1 and interferon	88
Acemannan	USA	Vivo	Infiltration of tumour by immune system cells, became necrotic & regressed	Sarcoma	Stimulation of synthesis of monokines resulted in the initiation of immune attack, necrosis, and regression of tumour	91
Aloemannan	Japan	Vivo	Inhibition of tumour	Sarcoma	Not described	49
Others						
Dichloromethane	Japan	Vitro	Cells growth inhibition	Ehrlich ascites tumour	Decrease of cells in the S and G2/M phase of the cell cycle; inhibition of DNA synthesis	7
Aloesin	China	Vitro/ Vivo	Induction of apoptosis, inhibition of tumour growth, migration and invasion	Ovarian cancer	Inhibition of the mitogen activated protein kinase (MAPK) signalling pathway	46
Di (2-ethylhexyl) phthalate (DEHP)	Korea	Vitro	Growth inhibition	Leukaemia	Not described	47
Diethylhexylphthalate	Korea	Vitro	Induction of apoptosis	Leukaemia	Not described	48

Effects of Aloe on Regulating Glucose Metabolism

Cancer cells are able to reprogram their glucose metabolism by up-regulating glucose transporters, especially GLUT1, which significantly increases glucose import into the cytoplasm. These have been demonstrated by many studies.⁵ Recently, it was proven that aloe-emodin, one of the compounds of Aloe inhibited glucose metabolism by reducing GLUT1 expression in cervical cancer Cells.⁶²

Effects of Aloe on Cell Metastasis

Aloe-emodin could suppress the metastasis of breast cancer cells. The mechanisms is not clearly elucidated and may be related to the inhibition of invasion and migration of cells.⁶³ It could also decrease protein levels of tumour metastasis-related proteins in human tongue cancer cells.⁶⁴ *Aloe Vera* could suppress the cells proliferation in human neuroblastoma cell.⁶⁵ Aloe-emodin was involved in inhibition of key regulatory molecules in colon cancer cell migration.⁵⁵ The antiproliferative activity of Aloe-emodin was also found in-melanoma and gastric cancer cells.^{66,67} In human hepatocellular carcinoma cells, Aloe-Emodin and its homologue emodin were able to decrease cell migration.⁶⁸

Effects of Aloe on Deoxyribo Nucleic Acid (DNA Of Cancer Cells

Aloe-emodin could induced DNA damage in human lung carcinoma cells through generation of reactive oxygen species.⁶⁹ It was also observed in leukemia cells, breast cancer cells, colon cancer cells, glioblastoma multiform cells and human embryonic kidney cells⁷⁰. In human tongue cancer cells, this DNA damage by Aloe-emodin was followed by inhibition of DNA repair of cancer cells.^{64,71}

Effects of Aloe on Normal Cells in Patients with Cancer

There is no cytotoxic activity towards the normal cells caused by Aloe-emodin⁷⁰. The analysis of some studies revealed that chemotherapy is substantially better tolerated in patients concomitantly treated with Aloe.⁷² The IC₅₀ of the extract of the leaf of *Aloe Vera* against breast cancer cell line was almost 15 times lower than that of *Aloe Vera* leaf extract against non-cancerous cell line.⁷³ One randomised study found that oral *Aloe Vera* gel can reduce radiation-induced mucositis in head-and-neck cancer patients but did not improve tolerance to head-and-neck radiotherapy, decrease mucositis, reduce soreness, or improve patient well-being.⁷⁴ However, it was a potential choice, for palliative treatment for patients undergoing treatment of head and neck cancer and prevent oral complications as well as oral *Aloe Vera* juice.^{75,76}

On the other hand, *Aloe Vera* gel did not significantly reduce radiation-induced skin side effects. However, aqueous cream was useful in reducing dry desquamation and pain related to radiation therapy in breast cancer.⁷⁷ In neuroectodermal tumours, *Aloe Vera* does not inhibit the proliferation of normal fibroblasts nor that of hemopoietic progenitor cells.³¹ The molecules in fluid fractions from leaf of *Aloe Vera* were found to markedly promote attachment and growth of non-neoplastic human cells, but not tumour cells. This attachment and growth of human cells is evident in natural *Aloe Vera* more than in commercial preparations may be owing to sub-

stances introduced during commercial processing.⁷⁸

It has been reported that *Aloe vera* preparations could cause diarrhoea, hypokalemia, pseudomelanosis coli, kidney failure, phototoxicity, hypersensitive reactions and its whole leaf extracts were considered as carcinogenic in rats.¹

Effects of Aloe on Telomerase Activity

Telomerase is an enzyme in control of the synthesis of telomeres and is activated in many types of cancers. In cancer cells, it promotes the replication, proliferation and metastasis of cancer cells.⁷⁹

G-quadruplex formation might inhibit telomerase activity in most cancer cells by locking the single-stranded telomeric substrate into an inactive conformation, which is neither recognized nor elongated by telomerase. The anthraquinones were one of the first ligands found capable of stabilising G-quadruplexes and inhibiting telomerase. Aloe-emodin, Aloe-Emodin Derivative 3 (AED3) and emodin could play the same role as long as they belong to anthraquinones. Moreover, Emodin, Aloe-emodin and AED3 induced strong fluorescence quenching of 12C5TG-AgNC which indicate that they are G-quadruplex-interactive ligands.^{80,81} Furthermore, it has been reported that the Di-2-Ethylhexyl Phthalate should decrease telomerase activity and increase TNF in the rat testis.⁸² In the recent study, it has been demonstrated that Aloe-emodin is a competitive inhibitor of telomerase and a G-quadruplex structure stabiliser in breast cancer cells. It decreases the telomerase activity by competing with dNTP for binding to the enzyme active site and stabilising the telomeric G-quadruplex structure.⁸³

Aloe and Cellular Immunity

A randomised study assessing chemotherapy alone versus chemotherapy plus *Aloe arborescens* in patients with metastatic cancer have been performed. It was reported that the lymphocyte mean number observed after therapy in patients concomitantly treated with aloe was significantly higher than that observed in the group treated with chemotherapy alone.⁷² It was also reported that aloe-emodin increased the levels of interleukin (IL)-1beta and tumour Necrosis Factor (TNF)-alpha.⁸⁴

Aloctin A (Alo A) is an active substance of *Aloe arborescens* Miller. The treatment effects of this compound have been described in vivo and in vitro on the immune response of murine and human lymphoid cells.⁸⁵ Alo A was also involved in inhibiting the growth of induced fibrosarcoma in mice and was not directly cytotoxic to tumour cells in vitro.⁸⁶ Aloctin A is one of lectin plant found in Aloe. Lectin were identified to have cytotoxic effects on the tumour cell surface augments tumour-specific by enhancing immunity through activation of T cells.⁸⁷

Acemannan is the most active polysaccharides found in *Aloe Vera*. It has been reported that this compound should exert its antitumor activity through macrophage activation and the release of tumour necrosis factor, interleukin-1, and interferon.^{88,89} The same substance Acemannan, was involved in increasing immunity in mouse whose immune systems had been damaged by radiation.⁹⁰

Another study indicated that intraperitoneal treatment with Acemannan stimulate synthesis of monokines resulted in the initiation of immune attack (includ-

ing interleukin-1 and tumour necrosis factor), necrosis, and regression of implanted sarcomas in mouse.⁹¹ Moreover, Acemannan (CarraVet Acemannan Immunostimulant) has been approved as a biologic treatment of fibrosarcoma in cats and dogs by the USDA.²

Aloe in combination with other cancer therapies

Aloe-emodin enhanced the activities of tamoxifen, cisplatin, doxorubicin, cyclophosphamide and 5-fluorouracil⁹²⁻⁹⁴ and Aloe Vera acts synergistically with cisplatin to inhibit proliferation of human breast and cervical cancer cells.⁹⁵ Furthermore, some specific compounds extract from the leaf of *Aloe Vera* (such as Aloe-emodin, 7-hydroxy-2,5 dimethyl chromone, Beta-sitosterol, etc.) possess higher binding affinity toward estrogen alpha receptor than standard tamoxifen.⁷³ Aloe-emodin increased the radio-sensitivity of human cervical cancer cells in vitro, inhibited their proliferation and, in combination with radiation, it induced the apoptosis.⁹⁶ Aloin, another compound of Aloe enhanced the antineoplastic activity of cisplatin in melanoma cells⁹⁷ and the emodin sensitised the hepatocellular carcinoma cells to the anti-tumour activity of Sorafenib (tyrosine kinase inhibitor).⁹⁸

Aloe-emodin induced cell apoptosis and leads to cell death in vitro and in vivo while associated with photodynamic therapy it enhanced killing effect of human oral mucosa carcinoma, human gastric cancer cells and breast cancer cells.⁹⁹⁻¹⁰¹

In their study, Lissoni P. and his colleagues compared chemotherapy alone with chemotherapy associated with Aloe. The complete response was achieved in 3% (4/121) of patients treated with chemotherapy alone versus 10% (12/119) of patients treated with chemotherapy + Aloe while partial response was achieved in 16% (19/121) of patients treated with chemotherapy alone versus 23% (28/119) of patients treated with chemotherapy + Aloe. The disease stability was observed in 31% (37/121) for patients treated with chemotherapy alone and in 34% (40/119) for patients treated with chemotherapy + Aloe. The disease progression was significantly higher in the patients treated with chemotherapy alone than in the group treated with chemotherapy + Aloe [50% (61/121) vs. 33% (39/119)].⁷²

One randomised study found that oral *Aloe Vera* gel did not reduce radiation-induced mucositis in head-and-neck cancer patients.⁷⁴ The *Aloe Vera* had no positive effect on prevalence or severity of radiation dermatitis in breast cancer patients treated with radiation therapy.¹⁰² However, it was considered as an alternative agent in the treatment of mucositis induced by radiation in patients with head and neck cancers.¹⁰³

Another study compared the administration of melatonin (hormone primarily released by the pineal gland that regulates the sleep-wake cycle) alone versus melatonin + *Aloe Vera* in patients suffering from various advanced solid tumours and for whom no effective standard anticancer therapies are available. It found a partial response achieved in 2/24 patients treated with melatonin plus Aloe and in 0/24 patients treated with melatonin alone. The disease stability was achieved in 12/24 for patients treated with melatonin plus aloe and in 7/26 for patients treated with melatonin alone. The percentage of stabilised patients was

significantly higher in the group treated with melatonin + aloe than in the melatonin group (14/24 vs. 7/26). The 1-year survival patients was significantly higher in patients treated with melatonin plus aloe (9/24 vs. 4/26).¹⁰⁴

It has been reported, a 64-years-old woman treated with topical *Aloe Vera* for ocular surface squamous neoplasia.¹⁰⁵

In combination with surgery and radiation therapy, the Acemannan was administered to canine (dog-like mammals) and feline (member of the cat family) suffering from fibrosarcoma and the results were impressive. While these animals had recurring disease failing previous treatment, a poor prognosis for survival, or both; the Acemannan treatment modified the tendency.¹⁰⁶

Aloe Vera given concomitantly with honey can modulate tumour growth by reducing cell proliferation and reducing tumour weight. In fact, *Aloe Vera* may reduce tumour mass and metastasis rates, while honey may inhibit tumour growth.¹⁰⁷

Emodin enhanced the antitumour effect of gemcitabine in pancreatic cancer and it could contribute to reduced chemo-resistance.¹⁰⁸

CONCLUSION

Whether the whole Aloe or its compounds are considered, we found through different articles that Aloe is a medicinal plant that has acted well against many types of cancer, namely cervix carcinoma, breast carcinoma, osteosarcoma, cancer of soft tissues, Hodgkin lymphoma, non-Hodgkin lymphoma, solid tumour of children, lung cancers, acute and chronic leukaemia, bladder cancer, ovarian cancer, gastric cancer, colon carcinoma, oral squamous cell carcinoma, colorectal cancer, lung squamous carcinoma, malignant glioma, tongue squamous cancer, prostate cancer, nasopharyngeal carcinoma, bladder cancer, hepatocellular carcinoma, Merkel cells carcinoma, leukaemia and in lymphoma, pancreatic cancer, prostate cancer, myeloma, sarcoma, hepatoma, ovarian cancer, neuroblastoma, melanoma, lung carcinoma, glioblastoma multiform, fibrosarcoma, ocular surface squamous neoplasia, pleural tumour from hepatoma, duodenal tumour, glioblastoma, hepatoma, neuroectodermal tumours, promyelocytic leukaemia, non-small cell lung carcinoma, oral mucosa carcinoma, pancreatic cancer, liver metastasis of pancreatic cancer, lymphoma, acute myeloid leukaemia, liver cancer, multiple myeloma, lung adenocarcinoma, promyeloleukeamia, breast cancer and lung adenocarcinoma with overexpression of HER2/neu, Ehrlich ascites tumour and fibrosarcoma.

Moreover, this review points out the fact that Aloe or at least one of its compounds could interrupt the pro-growth signalling pathways of cancer and this is the first time to show the therapeutic effect of Aloe on cancer based on biological capabilities of cancer. This can lead to development of a drug based on the whole Aloe or their compounds

In fact, a part from whole Aloe, 9 different compounds of different Aloe have been identified to have anticancer activities involving many pathways. Anticancer activity depended variably on compounds types, time and type of cancer. Given the anticancer effects of its compounds taken separately or the whole leaf, Aloe exerts the anticancer effects through many mechanisms which

could act synergistically. There is a high potential that whole Aloe or the combination of some of its compounds could be a chemotherapy based treatment which could have a therapeutic value in chemotherapy of different types of cancers with no or minimum side effects.

However, we realised that there are few studies conducted on Aloe illustrating its molecular suppressive activity of cancer. It is for instance the role of Aloe on inflammation, regulating glucose metabolism in cancer cells. Only 2 databases were explored and moreover many of these studies were conducted on *Aloe vera* despite the fact that there are many species of Aloe and this is one of the weak points of this review. There is the need for more studies especially in vivo to be undertaken to examine the molecular activities of the different species of Aloe so that more effective therapeutics could be designed.

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Bilateral Subdural Hematoma following Ventriculoperitoneal Shunt Insertion in a Ten-month Old Tanzanian Female with Congenital Hydrocephalus: An Uncommon Presentation

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ABSTRACT

There is an unmet need for the treatment of hydrocephalus in Tanzania. Thousands of newborns each year in the region are affected by this condition and access to care remains a challenge. While treatment options like cerebrospinal fluid diversion through ventriculo-peritoneal shunting are within the skill set of general surgeons, the potential complications represent an additional challenge. We present a 10-month-old Tanzanian female who developed bilateral-subdural hematomas after insertion of a ventriculoperitoneal shunt.

INTRODUCTION

It is estimated that more than 100,000 newborns each year in Sub-Saharan Africa (SSA) are affected by hydrocephalus.¹ Various methods of managing this condition are in practice worldwide, the most common ones being insertion of a Ventriculo-Peritoneal (VP) shunt and Endoscopic Third Ventriculostomy with Choroid Plexus Cauterisation (ETV/CPC).

Our centre – Kilimanjaro Christian Medical Centre (KCMC) situated in Northern Tanzania provides a surgical service run entirely by general surgeons. Surgical Intensive Care Services (SICU) are capped at 8 beds and usually run at capacity thus several ICU candidates are often rejected due to lack of space.

Patients presenting with Congenital Hydrocephalus are exclusively managed by insertion of a VP shunt. While it is a relatively simple procedure, failure rates within the first year of up to 25% have been reported.² Shunt failure is a life-threatening emergency and thus access to emergency neurosurgical care is very vital.

The collection of a subdural hematoma following drainage of Cerebro-Spinal Fluid (CSF) via VP shunt insertions has been studied mainly in adult patients presenting with normal pressure hydrocephalus.^{3,4} It's occurrence in SSA following VP shunt insertions in paediatric populations is unreported to the best of our knowledge. We present a case report of a 10-month-old Tanzanian female who presented with

a bilateral subdural collections 2 months after insertion of a VP shunt system.

CASE PRESENTATION

History

A 10-month-old Tanzanian female presented to our centre with a 1-week history of progressively worsening bulging of her anterior fontanelle. Her past medical history was suggestive of congenital hydrocephalus and insertion of a VP shunt when the child was 8 months old; 2 months prior to the current presentation. Before the shunt insertion, she had a head circumference of 51 centimetres (above the 97th percentile for her age⁵) and a ventricular index of 42%. The mother reported that despite regular pumping of the shunt, the bulging did not subside. She denied any history of convulsions, vomiting, high-pitched cry or fevers.

The child's history was otherwise unremarkable; she was born at term by normal vaginal delivery, her immunisations were up-to-date with Tanzania's immunisation guidelines and she was exclusively breastfed until the age of 3 months and then supplemented.

Examination

Upon initial examination, an active child was observed with hemodynamically stable vitals. The anterior and posterior fontanelles were tense and bulging, with the edges of the sagittal sutures wide apart. The occipitofrontal circumference was 52 centimetres-

(above the 97th percentile for her age⁵). There was no neck stiffness, no opisthotonos posturing and the tone of the limbs was normal. Sunset phenomenon of the eyes was not observed and the cardiovascular, abdominal, musculoskeletal and genitourinary examination was otherwise normal.

Diagnosis

The working diagnosis was a blocked VP shunt manifesting with bulging of the fontanelles. The physical examination did not provide clues for the definitive cause of the shunt blockage.

Laboratory and Radiology investigations

A complete blood count demonstrated normal parameters. A Computer Tomography (CT) scan of the head demonstrated a bilateral acute-on-chronic subdural hematoma with the shunt system in situ (Figure 1).

course was stable and the child recovered well from anaesthesia with neurological examination post-surgery conforming with pre-operative findings. The child was nursed in General Surgical Ward with a stable progress over 48 hours post-surgery. We would ideally have preferred post-op care in a High Care Unit. However, such services are not available at our hospital due to limited resources.

Unfortunately, on day 3, there was a sudden deterioration of the child’s status while in the ward from an undetermined cause. Cardiopulmonary resuscitation was immediately initiated by the General Surgical Ward team, however it was unsuccessful and the child succumbed.

The child’s rapid deterioration may have been due to various conditions. Possibilities considered by the treating team were; raised intracranial pressures secondary to subdural recollections with subsequent herniation or a seizure complicated by aspiration and hypoxia. Due to the family’s preferences, a post-mortem was not conducted and an exact cause of death could not be identified.

DISCUSSION

We present a 10-month-old child with congenital hydrocephalus who developed a relatively uncommon complication following insertion of a VP shunt.

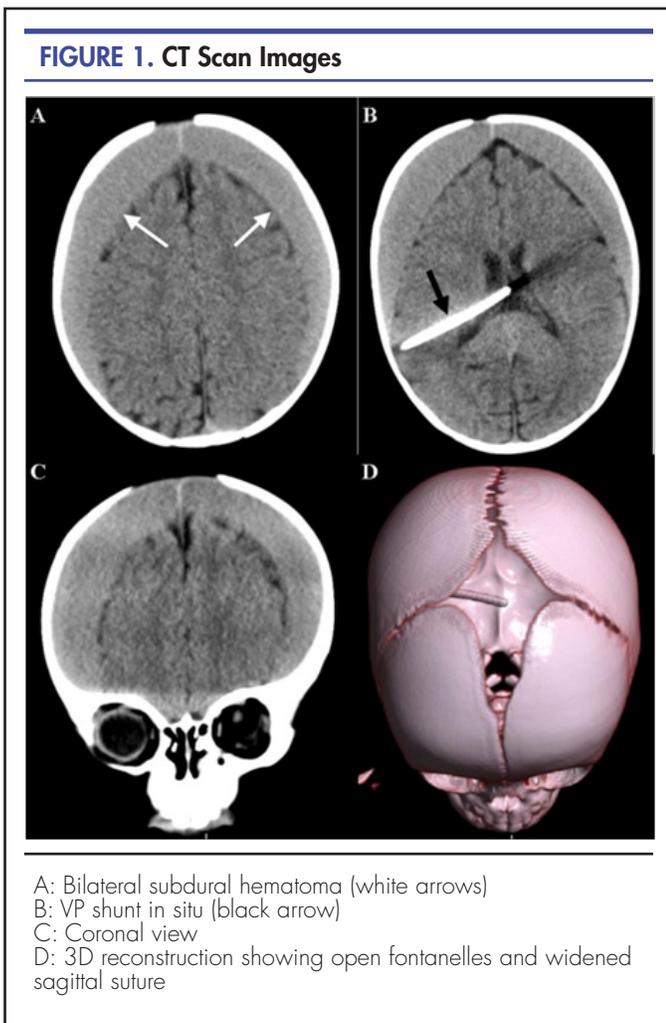
VP shunting is a procedure for diverting Cerebro-Spinal Fluid (CSF) to a compartment in the body which has absorptive capacity. It involves subcutaneous tunnelling of a catheter from the scalp to the abdomen in a sterile fashion, securing the proximal tip to a ventricular catheter and burying the distal tip under direct vision in the peritoneal cavity. The CSF flow towards the distal end is absorbed in the distal cavity thus resulting in lowered intracranial pressure with values closer to normal.

In patients with idiopathic normal pressure hydrocephalus, it is proposed that the collection of subdural blood is most likely due to the sudden decrease in intracranial pressure following drainage which allows the brain matter to fall away from the calvarium.⁶ It is a complication linked to high opening pressures of the CSF likely leading to drainage of large volumes of CSF during shunt insertion and subsequent high-volume drainage.⁶

Studies in high and middle-income countries have reported variable rates (11 to 25%) of shunt complications during the first year post-surgery.^{2,7} There are no exact figures describing the burden of congenital hydrocephalus and associated treatment complications within SSA. It is largely from data extrapolated from centres within the region managing this condition that estimates have been put forward.⁸

Warf et al.’s work defined the economic burden of congenital hydrocephalus in infants in SSA; they determined that the long-term benefit of managing hydrocephalus in infants for one-year can amount up to \$56 billion.⁹ These figures highlight the need to manage this condition in a timely and appropriate manner while also anticipating possible complications.

Various complications following VP shunting are reported in literature including shunt obstruction, shunt migration, bowel perforation, abdominal pseudocyst formation and infection.^{10,11} Subdural hematoma collection followi-



Management and Clinical Course

The child was initiated on acetazolamide and planned for bilateral decompression burr hole surgery to allow for drainage of the hematoma. Intraoperatively, one burr hole was made on each side and a total of 200 millilitres of haemolysed blood was evacuated. The intraoperative-

ng shunt insertion has largely been reported in patients who Various complications following VP shunting are reported in literature including shunt obstruction, shunt migration, bowel perforation, abdominal pseudocyst formation and infection.^{10,11} Subdural hematoma collection following shunt insertion has largely been reported in patients who were shunted for idiopathic normal pressure hydrocephalus with an incidence of 10% over 12 years in a Swedish study.³

Illingworth's series of patients who developed subdural hematomas after drainage of a hydrocephalus had all been managed by a ventriculocaval shunt.¹² Subdural hematoma collection following ventriculoperitoneal shunting for congenital hydrocephalus has not been commonly reported in literature.

The lack of neurosurgical services at our centre – the Northern Zone Referral Hospital in Tanzania - has required general surgeons to develop proficiency in the insertion of VP shunts for patients with hydrocephalus. Investment in neurosurgical services and expertise in our region will contribute towards lessening the incidence of complications in patients post VP shunt placement. Currently, at our centre, this condition is managed entirely by general surgeons and it is the most common procedure in children under 6 months of age. Before discharge from hospital care, mothers and caregivers are counselled on the signs of increased intra-cranial pressure as well as techniques of pumping the shunt system to allow for adequate drainage.

It is clear that the allocation of human and financial capital to the health care systems in SSA is required for addressing the burden of hydrocephalus in the paediatric population and investing in access to neurosurgery care for these patients.

CONCLUSION

Infant hydrocephalus in Tanzania represents a major Public Health challenge. The gap in adequate short and long-term post-operative care and follow-up also needs to be addressed to minimise morbidity and mortality. There is an un-met need for care resulting in immense loss of Disability Adjusted Life Years. While management is possible even by personnel who are not specialised in neurosurgery, the possibility of complications following VP shunt insertion should always be acknowledged.

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Assessing Knowledge and Practices of the Community towards Corona Virus Disease 2019 in Mbale Municipality, Uganda: Across Section Study

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ABSTRACT

Background: The Corona virus disease, first identified in Wuhan city, Hubei province of China, is a respiratory illness caused by Novel Corona Virus also known as Severe Acute Respiratory Syndrome Corona Virus 2 (SARS Cov.2). The disease is characterised by; dry cough and shortness of breath with difficulty in breathing and at least 2 of the following; fever, chills, muscle pain, headache, sore throat and loss of test and smell. Uganda in general and Mbale in particular has people of diverse culture, religion and ethnic background as well as diverse socio economic activities with various practices. This multi-cultural environment creates differences in perception of information and practices. Most cultures encourage socialisation through social functions like attending weddings, funerals, work places and gatherings and Muslims who have to go for congregation prayers in the mosques 5 times a day among others. This puts such communities at risk of spreading the disease very fast and slow in adapting to control measures

Aim: In this study, we aimed at assessing knowledge and practices of the community towards COVID 19 in Mbale municipality.

Methods and Materials: A cross section study was used; Data was obtained using a Questionnaires to a sample of 355 respondents and an observation tool was also used to observe behaviour patterns and practices of 776 participants towards the control measures of COVID-19.

Results: There was a total of 355 respondents with 208 /355 (58.59%) male and 147/355 (41.4%) female. 149/355(42%) possessed good knowledge, 131/355(36.9%) had moderate knowledge and 75/355(21%) had a little knowledge on COVID-19. Participants who were single and aged between 21-30 years were found to be more knowledgeable than other groups (P value=.001 and P value=.003 respectively).The source of COVID 19 information was mainly from television and radios 124/248 (50%) and social media 34/248 (21.8%) and the least source of information being 14/248(5.6%) and 9/248(3.6%) from health workers and Religious leaders respectively. 496/776 (64%) of the respondents observed, washed their hands and only 124/776 (16%) of the respondents wore face masks. 98/776 (12.6%) were seen shaking hands and 15/776(2%) were seen hugging.

Conclusion: Use of appropriate and well-designed Health education materials on radios, televisions and social media platforms like Facebook and twitter among others can be effective means of communication since they can reach the highest number of people. Ministry of Health should design ways for systematically integrating both political and religious leaders in Health Education Campaigns. Government should provide facemasks and enforce their use. A study to assess the ability of both political and religious leaders in health promotion campaigns should be carried out.

BACKGROUND

The Corona virus (COVID-19) disease first identified in Wuhan city, Hubei province of China, is a respiratory illness caused by the Novel Corona Virus also known as Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV 2).¹ The disease is characterised by dry cough and shortness of breath with difficulty in breathing and at least 2 of the following; fever, chills, muscle pain, headache, sore throat and loss of taste and smell.^{4,5}

It was declared a public health emergency of interna-

tional concern and a global pandemic by the World Health Organization (WHO) on 30th January 2020 and 11th March 2020 respectively.^{2,3,4}

There is still no known specific cure for COVID-19 apart from the vaccines for Immunisation. The World Health Organization (WHO) and the local authorities have guided on a number of infection control measures among Communities including; hand washing, hand sanitising, physical distancing, observing respiratory hygiene, avoiding hand shaking and hugging among others.¹¹ Many communities tend to live a us-

ual life which puts their lives at risk of contracting the disease. There are different sources of information about COVID-19 within communities. In Uganda, the sources of information includes Main stream media, politicians, religious leaders, cultural leaders, celebrated personalities and Social media platforms among others. There has also been installation of measures based on their known public health impact, majorly social distancing, wearing facemasks and hand washing in public places as well as a total country lockdown to increase on the social distancing. These same measures have been instituted in other African countries.⁸

These Non-Pharmaceutical Interventions (NPI) are very impactful strategies in delaying disease transmission and they reduce the impact of the disease on the country's health care systems, especially in resource limited settings like Uganda.⁷ In such circumstances, the success in controlling the spread of disease largely depends on how the community responds to and observes the public health measures put in place by the government's respective authorities. This is also largely dependent on the knowledge and attitude towards the disease, the source of health information and the rationale behind the measures put in place.

Uganda has people of diverse culture, religion and ethnic backgrounds with various practices. This multi-cultural environment creates differences in perception of information and practices. Most cultures encourage socialisation through social functions such as weddings funerals, work places, attending sports gatherings and Muslims have to go for congregation prayers in the mosques 5 times a day.

This Diversity is seen in Mbale District due to its unique and strategic location. Mbale district is located along the high way that joins Kenya to South Sudan and the Democratic republic of Congo through Uganda, this therefore, attracts many business people as well as administrative offices in the region. In addition, the traditional cultural dance known as "Kadodi" that brings people together during the tradition cultural public circumcision ceremony known as "Imbalu" puts the people of Mbale and other neighbouring districts at a higher risk than other districts. Such practices put the community at risk of not only spreading the disease, but also being slow on adopting to infection control measures.

Behaviours and perceptions in communities are drivers of spread, control and management of Infections.¹² It is noted that during a public health crisis, like COVID-19, misinformation spreads faster than the Disease itself.⁹ For instance, most people in western Uganda largely believed in myths and rumours like; COVID-19 only affects the whites and not Africans. They also believed that taking of alcohol can prevent the spread of COVID-19.^{9,10} Such beliefs, myths and misinformation can affect the efforts by the Government authorities to control the spread of COVID-19. The effectiveness of such measures depends on an individual's degree of involvement and adherence to control measures.^{13,14} The willingness to adopt to new changes in their day-today behavioural activities (like hand shaking, hugging, etc.) largely depends on people's perceived risk of contracting the disease in question severity or impact of the disease on their lives. This also de-

pends on people's level of awareness and knowledge about the disease. To date, there is no documented study about the level of knowledge, practices and responses of Ugandan Communities towards COVID-19.

Appreciating the role of human behaviour in mitigating the spread of communicable diseases, in this study we therefore assessed the level of knowledge of COVID-19, the Practices and responses of the Community towards COVID-19 and the source of information. Our Findings will enable government through the Ministry of Health (MoH) to design appropriate message for Health Education through mass media and social media, design programs for training of different leaders to Health educate communities and appropriate implementation of the control measures especially in the Post Lockdown period.

METHODOLOGY

Study Setting and Study Design

This was a cross-sectional study conducted between 1st April and 30th May 2020 within villages and towns of Mbale municipality, Mbale district. Mbale district is located in the Eastern region of Uganda in East Africa, approximately 225km (140miles) North East of the capital Kampala.^{15, 16}

By 2019, the district was estimated to have 568,000 people, 52.3% being females.^{15,16} The main economic activities being farming and trade (business).

The district has 12 Government dispensaries (Health Centre level II), 17 health centres (level III) at county, 4 health centres (level IV) at sub-district with 2 hospitals. More so, it has 4 private/NGO dispensaries (level II), 7 health centres (Level III) and no hospital. There is Regional Referral Hospital with 332 beds.¹⁹

Unlike other towns in Uganda, Mbale Municipality specifically and Mbale District in general have a unique location being on the high way joining Kenya to south Sudan and the democratic republic of Congo through Uganda. The district hosts a number of administrative offices and businesses and thus brings a large population of people together. This puts the people within the district at a higher risk of contracting the disease.

Study Population Inclusion criteria

All adult male and female who consented to participate in the study were included in the study.

Exclusion Criteria

During the process of the study, all those who declined at the beginning or during the process of data collection to participate were excluded from the study. Children below the age of 16 years were excluded from the study

Sample Size

A total of 350 participants were enrolled into the study. This sample size was obtained using the formula for calculating sample size.

$$N = \frac{Z^2PQ}{\delta^2}$$

Where N is the sample size that we are looking for. Z is the standard normal deviation at 95% Confidence equal to 1.96

P is estimated Prevalence or Proportion of people informed about the disease, for our case we used a conservative value of 50%, because no study has estimated a prevalence in Uganda and other countries with the same socio demographic area like Uganda.

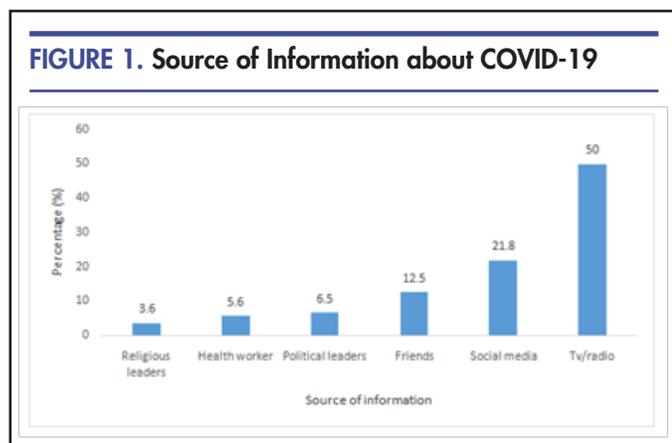
Q is 100% - P will be equal to 100-50 equal to 50%
 E is the maximum acceptable error and was taken as 0.05
 Required sample size is 392.

This was obtained mathematically as follows

$$2ZPQ = (2 \times 1.96 \times 50/100 \times 50/100) = 0.98 \dots\dots (a)$$

$$\delta^2 = (0.05 \times 0.05) = 0.0025 \dots\dots\dots (b)$$

$$(a) / (b) = 0.098 / 0.002 = 392 \text{ Participants}$$



Sampling Procedure

Participants were randomly sampled using the convenient sampling method. A pre-tested Questionnaire was used. Pre-testing was done on 16 participants at Islamic University in Uganda (IUIU), Health Centre, IUIU department of Mass communication, IUIU main gate entrance and at IUIU Mosque.

Research Assistants were IUIU health Centre staff and Mass communication final year students. Participants were mad to sign consent forms, taken through the questions using either English, Luganda or lumsaba (Lugisu languages) which are the local languages in the area to enable participants give their appropriate responses. The whole process could take 15 to 25 minutes on average.

For the observations a data collector made observations and recorded behavioural patterns of the participants in the community.

Observations took place at key areas where large concentrations of people are expected, these included; Nkoma Market Main entrances, Kikindu Market Main entrances, Abrah Shopping Centre, Bam Shopping Centre, Mbale taxi park station, Mbale Bus Park station and Islamic university In Uganda (IUIU) main entrance, all located in Mbale Municipality.

Observers could spend between 2 to 3 hours at each point for 3 alternating days in a week.

Variables

Dependent variables included; knowledge, attitude and practices of the community towards Novel Corona Virus. The independent variables included; Socio-demographic variables, like Age, Sex, marital status, education, occupation, and income.

TABLE 1: Social Demographic Characteristics and Comparison with Knowledge Score

	n(%)	Knowledge score mean±sd	P value
Age (years) n=249			
21-30	111(44.5)	3.81± 0.84	
31-40 years	75(30.1)	3.47± 0.65	
41-50 years	33(13.2)	3.37± 0.89	.001
above 50	30(12)	3.35 ±0.89	
Marital status n=349			
single	167(47.9)	3.84±0.86	.003
married	159(45.6)	3.56±0.78	
others	23(6.6)		
Education level =350			
not educated	45(12.9)	3.51± 0.88	
primary level	109(31.1)	3.60 ±0.87	.082
secondary level	121(34.6)	3.75 ±0.81	
tertiary institution	75(21.4)	3.85± 0.79	
Religion n=354			
Muslim	134(37.9)	3.64 ±0.88	
catholic	93(26.3)	3.77± 0.76	
Anglican	67(18.9)	3.67 ±0.85	.368
Born again	47(13.3)	3.80 ±0.76	
others	13(3.7)	3.35 ±1.05	
Occupation n=266			
farming	42(12.1)	3.56± 0.85	
business	115(33.1)	3.65 ±0.75	.181
employed	81(23.3)	3.6±4 0.78	
others	109(31.4)	3.8±3 0.95	

Data Analysis

Descriptive statistics of the variables were computed as Mean ±SD and frequencies (n, %). The relationships between the categorical variables were investigated by using Pearson’s Chi-Square test. Also, independent-samples, t-test were used to investigate the difference between groups with regard to numerical variables. In all calculations, P<.05 was considered as the level of statistical significance. Statistical analysis was performed using SPSS 20 (IBM SPSS statistics, Somers, NY)

Anonymity

Participants’ identification information was not included anywhere in the data collection tool

Informed consent

All participants were made to sign an informed consent document before participating in the study and were allowed to withdraw from the study at stage of data collection. Permission to conduct the research was given by the Research Coordination Committee (RCC) of the Islamic University in Uganda with reference number **RCC/FHS/20/001**

TABLE 3: Knowledge of Mbale Residents towards COVID-19

Statements	N	Mean	Std. Dev
S1. I know the causes-of COVID-19	354	3.35	1.307
S2. I can differentiate-the symptoms of-COVID- 19 from flue	350	3.37	1.355
S3. COVID-19 can-spread from one-person to another	342	3.81	1.191
S4. COVID-19 can-spread from one-person to another -through hand shake	346	3.85	1.186
S5. COVID-19 can-spread from one-person to another	347	3.90	1.135
S6. COVID-19 can-be spread from one-person to another-by staying in close-contact or gatherings	349	3.95	1.126

Study Limitations

355 of the required 392 participants were recruited. This was because of the restrictions of movements and transport as a result of the country wide lockdown during the process of data collection.

RESULTS

Socio-Demographic Characteristics of the Study Respondents

There was a total of 355 respondents, with 208 (58.59%) males and 147 (41.4%) females. More than half, 292 (82.25%) of the respondents were below 40 years old and 121/350 (34.57%) had Secondary Education, 109/350 (31.14%) had primary Education 75/350 (21.42%) had Tertiary education and the rest 45/350 (12.86%) were not educated at all. Majority of the respondents 134/354 (37.85%) were Muslims followed by 93/354 (26.27%) Catholics and 67/354 (18.92%) Anglicans. 115/347 (33.14%) of the respondents had businesses, 42/347 (12.10%) were involved in farming, and 81/347 (23.34%) had employment. (Table 1).

Knowledge of the Mbale Residents towards COVID-19

Table 2 shows knowledge of Mbale residents towards COVID-19. Majority of the respondents, 70.9% agreed that they can differentiate between the symptoms of COVID-19 from flu. Knowledge score was at 3.37 ± 1.355 , and 250 (72.0%) agreed that COVID-19 can spread from one person to another with mean of 3.81.

Fifty three percent (53%) of the respondents agreed that they know the causes of COVID-19, 23.4% did not know and the rest were not sure. Regarding COVID-19 disease transmission, 250 /355 (72.1%) of the respondents agreed that COVID-19 could be spread from one person to another, 14.7% disagreed and 13.3% were not sure that COVID-19 could be spread from one person to another.

COVID-19 can spread from one person to another through handshake. 70.8% agreed, 13.6 were not sure and 15.6% of the respondents disagreed that COVID-19 can spread from one person to another through handshake. 70.8% agreed, 13.2 were not sure and 15.6% disagreed that COVID-19 can be spread from one person to another by staying in close contact or gatherings.

Majority of the respondents agreed on whether COVID-19 can spread from one person to another through hand shake with a mean of 3.85 ± 1.186 , COVID-19 can spread from one person to another with mean 3.9 ± 1.135 and COVID-19 can be spread from one person to another by staying in close contact or gatherings with mean 3.95 ± 1.126 .

Comparison of Knowledge Score according to the Participants' Age, Marital Status, Education, Religion and Occupation

We grouped level of knowledge into; high level of knowledge if a respondent scored mean ≥ 4 , moderate level if score is mean ≥ 3.1 and mean ≤ 3.9 and low level if a respondent scored mean ≤ 3 .

Table 2 shows that most of the respondents 149/355 (42.0%) possessed good knowledge, a considerable number 131/355 (36.9%) had moderate knowledge, while some of them 75/355(21.0%) had little knowledge on COVID-19.

Bivariate analyses of the level of knowledge was performed in relation to several independent variables: gender, age, education, occupation and marital status. Knowledge score was found to be statistically significant (P value=0.001) with Age group between 21-30 years being more knowledgeable than other age groups. Also, the knowledge score of those who are single was found to be significantly different from those who were married with (P value=0.003).

Source of Information about COVID-19

Figure 1, shows that among the participants who had knowledge about COVID-19, 24/248 (50%) got the information through Televisions and radios, 54/248 (21.8%) through social media, 16/248 (6.5%) from political leaders, 9/248 (3.6%) from religious leaders, 14/248 (5.6%) from health workers and 31/248 (12.5%) from friends.

Practices of Mbale Residents towards COVID-19

To ascertain whether the guidelines for controlling COVID-19 were being implemented, 776 people were observed. The observations took place at key areas where large concentrations of people are expected, these included; Nkoma Market Main entrances, Kikindu Market Main entrances, Abrah Shopping Centre, Bam Shopping Centre, Mbale taxi park station, Mbale Bus Park station and Islamic university in Uganda (IUIU) main entrance, all located in Mbale Municipality.

While 496/776 (64%) of the people observed washed their hands or used a sanitiser, only 124/776 (16%) wore a mask. On the other hand, wearing a mask is someone's free will and not many officers are there to remind people. 15/776 (2%) of the people were seen hugging and 98/776 (12.6%) were observed to be shaking hands. Figures are summarised in table 3.

TABLE 2: Knowledge of the Mbale Residents towards COVID-19

Question	agree	Not agree	Don't know	Mean Knowledge score
Q1. I know the causes of COVID-19 n=354	188 (53.1%)	83(23.4)	83(23.4%)	3.35±1.307
Q2. COVID-19 can spread from one person to another n=347	250 (72.0%)	51(14.7%)	46(13.3%)	3.90±1.135
Q3. I can differentiate the symptoms of COVID-19 from flue n=350	199 (70.9%)	93(26.6%)	58(16.6%)	3.37±1.355
Q4. COVID-19 can spread from one person to another through handshake n=346	245(70.8%)	54(15.6%)	47(13.6%)	3.85±1.186
Q5. COVID-19 can be spread from one person to another by staying in close contact or gatherings n=349	257(73.7%)	46(13.2%)	46(13.2%)	3.95±1.126

DISCUSSION

The purpose of this study was to determine the level of knowledge, attitude and practices of the community towards COVID-19 in Mbale Municipality.

Since the initial outbreak of COVID-19 disease in China, the disease has spread widely to various countries. According to the Uganda Ministry of Health (MoH) update on the 20th of April 2020, the number of COVID-19 cases rose to 10,484 in Uganda with the majority of cases being in Elegu district in Northern Uganda.

Many studies have reported the importance of knowledge and practice of community towards reducing the spreading rate of diseases during epidemics and pandemics.¹⁷ Lack of Knowledge contributes to undesirable attitudes and practices which leads to negative impacts on infection-control.

In this current study, majority of the respondents 173/355 (48.7%) and 114/355(32.1%) had moderate and good knowledge about COVID-19 respectively.

During the Middle East Respiratory Syndrome (MERS) Coronavirus outbreak, a similar level of knowledge was detected among health care providers in Uganda¹⁵ and United Arab Emirates (UAE).¹⁶ This can partly explain why Uganda was among the best country to contain the COVID-19 pandemic at the time. Unlike a study in Saudi Arabia¹⁸ where participants' education, occupation, gender, were significantly associated with the level of knowledge of COVID-19. Also, a study conducted in Jordan found women to have less knowledge about COVID-19 than male.¹⁸ In the current study, singles and those aged between 21-30 years were found to be more knowledgeable.

Whereas a good number of observed participants 496/776 (64%) practiced hand washing and sanitising, only 124/776 (16%) were observed putting on Face masks, despite the fact that both measures are equally import-

ant in controlling the spread of COVID-19 and therefore, there is need for this to be re-emphasised.

The motivation for hand washing could have been the need for business owners to protect their businesses from being closed by government authorities. Businesses such as public transport, shopping malls, markets and academic institutions had installed hand-washing facilities at their premises.

On the other hand Facemasks were scarce and a bit expensive at the time, thus the majority of the people in the community could not afford to procure them. Thus, the need by the Governments' Ministry of Health to provide free Face Masks to the citizens. The current study showed that the main source of information about COVID 19 was radio, television and social media and the least being religious leaders and health workers. Therefore, the Ministry of Health should design good health education messages for both Social Media and mainstream media so as to reach to the highest number of people in the community. The Ministry of Health should design programs of utilising both political and religious leaders in health promotion campaigns.

CONCLUSION AND RECOMMENDATIONS

This study provides baseline data to the government for preventive measures and areas of emphasis especially in the control measures if the good results of containing the pandemic are to be maintained and consolidated.

Use of appropriate and well-designed Health education materials on radios, televisions and social media platforms like Facebook and twitter among others can be effective means of communication since they can reach the highest number of people. Ministry of Health should design ways of systematically integrating both political and religious leaders in Health Education Campaigns. Government should provide facemasks and enforce their use. Since the government responded to the COVID-19 outbr-

eak by providing immediate preventive activities to Ugandans, there is need for a follow up study to assess whether the preventive measures and guidelines are still being followed. Another study to assess the ability of both political and religious leaders in health promotion campaigns should be carried out.

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The Influence of Employee Empowerment on Competitive Advantage in Hospitals within Nairobi, Kenya

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ABSTRACT

Background: The study examined the influence of implementation of employee empowerment on competitive advantage in hospitals within Nairobi. The study looked at the following aspects of employee empowerment; competence, teamwork, motivation, reward and recognition. Employee empowerment is derived from the Total Quality Management (TQM) principles bringing forth competitive advantage that results from high customer satisfaction levels, employee satisfaction and operations efficiency.

Methods: A descriptive correlational research design that applied positivism philosophy. Data was collected from both private and public hospitals within Nairobi targeting patients who were admitted in these hospitals for more than three days during the study period and senior employees of the respective hospitals. There were 308 participants, 154 hospital employees and 154 patients from 31 hospitals within Nairobi. After institutional and individual consent was obtained, participants filled a self-administered questionnaire. The collected data was coded into SPSS Version 23 software and the analysis was done using descriptive and inferential statistics.

Results: The findings illustrated that employee empowerment significantly predicted competitive advantage. High responsiveness and good attitude, being reliable, empathy and assuring the patients of their state best enhance patients' and employee satisfaction.

Conclusion: This brings out the importance of realigning the staff inputs towards improving patient experiences, as well as considering employees' performance as individual instead of considering them as teams.

BACKGROUND

Employee empowerment involves the application of Total Quality Management (TQM). TQM requires a combination of a set of management principles with the right tools and techniques to enable the employees to carry out those management principles in their day to day operation so as to amount to continuous quality improvement.¹ Competitive advantage is defined as an organisation's ability to attain market superiority.² Competitive advantage is the core concept of strategic management that every firm seeks to retain. Porter provided a framework that models an industry as being influenced by 5 forces.² Porter advised strategic business managers to work towards developing a competitive advantage over the organisations' rival. This in turn acknowledges that human capital is a key component of an organisation that leads attaining competitive advantage. This is further echoed by the World Health Organization (WHO) which has championed and supported the growing interest in healthcare quality, through supporting projects that address aspects of quality such as service delivery, training, management and technical guidance and spreading awareness of healthcare

quality issues.

Numerous studies have been conducted in Kenya to determine the influence of employee involvement on competitive advantage in other sectors other than the health sector.³ There are studies to assess the existence of employee involvement conducted in two private hospitals in Nairobi to assess the performance and effectiveness of the quality systems.⁴ These studies focused on various aspects of TQM within Kenya; however, there is little evidence of research and literature on employee empowerment and its influence on competitive advantage in the Kenyan healthcare sector. This study therefore sought to determine the influence employee empowerment has on competitive advantage within the hospitals in Nairobi.

The study was based on the Deming's Theory of profound knowledge and the Resource Based View (RBV). Total Quality Management (TQM) is a people focused management system that aims at continual increment in competitive advantage at a sustainable, affordable cost and an integral part of high-level strategy that operates horizontally across all departments while ensuring that all employees are involved extending to customer and supply chain.

The Deming theory of profound knowledge is a management philosophy grounded on system theory. The application of such theory within the organisational systems, that lead to learning the implementation processes that contribute to the continuous improvement of the processes, services, products, employee fulfilment that would result to customer satisfaction.⁵ The foundation of TQM is philosophically based on scientific methods, since they involve people, tools, systems, and methods. These systems allow change while the philosophy is unchanged.² Therefore, total quality management is the durable and persistently improving effort by every person in an organisation to understand, meet and surpass the expectation of the customer while involving the employees.

To have satisfied customers, organisations are learning that they must have a satisfied workforce first. Simply put, empowerment means giving employees authority to assess and make decisions on what they consider is right to do, to take control of the day to day work, to take risks and learn from their mistakes.⁵ It is the process of delegating decision-making power and authority. It is noted that employee empowerment is the missing piece of the puzzle that has been occasioned by the growing global competition, institutional restructuring and the importance placed on service quality and customer satisfaction.⁶

While workforce is referring to everyone who is actively involved in accomplishing the work of an organisation. Workforce engagement is defined as the employee commitment both intellectually and emotionally towards accomplishing the organisational work, vision and mission. This is translated to mean that employees find personal motivation in what they do that strengthens the emotional bond to their employment.⁷ Suggesting that the high level of engagement has proved to generate higher levels of employee satisfaction and increases organisational performance. All organisations that have high staff engagement are characterised by high performers who are committed to give the utmost best for the benefit of the customer and organisational success.²

Motivation has been defined as the art of creating conditions that allow each employee get the work done at the highest level of performance with maximum efficiency.⁸ This is an individual's reaction to a felt need. Motivational theories are categorised as process, content, and environmental theories. These theories are applied to boost high performance within an organisation.⁹ Observing that if managers are keen on improving workplace performance, they must actively manage the motivational process and change the work environment. Since within motivational theory, there is a positive view of the humanity believing in individual growth potential.

Customer satisfaction is the degree to which a customer responds to fulfilment of goods or services.¹⁰ In hospitals, patient satisfaction is an indicator obtained to compare the patients' expectation of products or services with the perceived performance.¹¹ This is made possible by conducting surveys that measure the average satisfaction level of the patients and their relatives. This could be through courteousness of the employees, time spent waiting for appointment or diagnostic tests, likelihood of return visits, adverse events and clinical outcomes.¹² Customer

satisfaction has risen as a distinct area of inquiry since the 1970s.¹³ Businesses, both big and small have realised the strategic importance of service quality and customer satisfaction as competition become more intense and global. The accomplishment of customer satisfaction has transformed into a good business practice that businesses strive to achieve.¹⁴

Teamwork is defined as the cooperation or/and coordination of the members of hospital towards achieving and sustaining quality improvement initiatives.¹⁴ Employee empowerment is by no mean guarantee of employees' total participation to quality improvement initiatives. While initiating quality improvement agenda, the employee input is critical after all improvement of techniques and modern technology cannot supplement what the employees are capable of doing. Implementation of quality techniques such as quality circles, creation of quality improvement teams, initiating quality hit squads and installation of suggestion teams can be used to foster employee involvement and participation.¹⁵

The employees in the service sector are involved in both production and selling of products in contrast to employees in the manufacturing who have either the role of production or the role of distribution. Since employees in the service sector, are involved in the operations, marketing the service and are being continuously judged by the customers, therefore, the employees must be in a position to control the services they deliver¹⁶. In summary, employees have a very critical role within the production and marketing of services because they are simultaneously producing and delivering the services. Therefore, employee involvement within quality improvement initiatives is crucial for TQM implementation, as a means to increasing customer satisfaction.¹⁶

In a study that looked at the effects of human resource management on the implementation of TQM within high technology organisation and their effects on customer satisfaction.¹⁷ The study showed that there is significant and positive association between human resource involvement TQM and customer satisfaction. This eventually translated to higher competitiveness of the firm. Hence agreement that human resource management involvement has a direct and positive relationship with competitive advantage.²³

In another study that looked at the link of appropriate human resource management and customer satisfaction in Malaysian small service businesses, it was concluded that human resource involvement did not show any significant effects on customer satisfaction.¹⁸ One possible reason that contributes to such unconstructive results could be due to the measurement of human resource focus. Human resource focus may refer to teamwork. Too much focus on teams makes the individual employee less responsive to their jobs as they always depend on team performance.¹⁹

The value of gratifying the psychological needs of the employees. This they argued that just as customers seek services with expectations, the employees too, join the organisation with psychological needs. Therefore, only when the employees are satisfied with the organisations ability to meet their needs, are they likely to fulfil the expectations of the customers.²⁰ Humans direct their abil-

ities, vitalities and competencies largely toward the rewards they value as precious. Hence, leaders must ascertain that rewards promote those actions that enhance the concurrent achievement of multiple organisational preferences. Rewards are defined as those items that enable the employee to feel recognised and appreciated such as motor vehicles or decent office space, not just pay and promotion.⁶

In another study to examine the effects of human resource involvement on client satisfaction in the nursing and care industry, 8 human resource management activities were tested during the study, namely personal development plan, job-related training, annual performance review, employee involvement, protocol for labour-shortage, predictable work schedules, transparent management style, and supportive management style. Contrariwise, employee satisfaction was significantly related to the unit manager style of management and to some extent it had an effect on performance reviews and predictable work schedules.²¹ Another study revealed the association between attitudes of the employee, customer satisfaction and the performance of the department, concluding that the magnitudes of employee attitudes, specifically participation of the team and attention to performance evaluation had positive association with customer satisfaction.²² In another study, it was observed that the act of training and development of employees has significant and positive association with financial operational performance, employee performance, and customer satisfaction²³. This concluded that resource allocation for organisations to train on quality initiative agenda pays off, as professional employees understand various quality implementation tools and concepts of quality, making it possible to positively influence the structure and processes of the organisation. Moreover, when employees are treated as a valuable resource there is a chance of increasing their loyalty to the organisation, increases their motivation level as they take pride in the jobs they do.²³ These attributes leads to improved performance on employees' jobs, reduced absenteeism, and lower employee turnover. When employees are educated they will improve quality, reliability, and timeliness in delivering the products or services, this will directly and positively influence customer satisfaction of the organisation¹⁶.

Furthermore, effective training on quality also increases employees' skills to work effectively and efficiently, hence reducing complaints and increasing customer satisfaction.²⁴ Employee satisfaction is a state fulfilling or exceeding the employees' emotional state that arises from the positive feedback of job performance and its' effects on the organisational outcome. Employee satisfaction is acknowledged as an employee's assessment of the overall quality of his or her current job assignment and the effects that result from positively impacting on the organisational input.²⁵

In a study on the nature of the service quality and satisfaction relationship, it was observed that there is a positive relationship between appraisal of job performance and the service of employees' delivered to their customers.²² This indicates the need to have a satisfied workforce in order to deliver quality services to the customer. In a study set out to explore those factors that influence employee satisfaction, it was observed that the main factors-

that have positive influence on employee satisfaction were; conducive working environment, equitable wage structures, quality of supervision and the nature of work.²⁶ Supervisory is further expounded as support, impartiality and autonomy, image of the company, connection and employee development affect employee satisfaction.²⁰ Staff involvement, motivation to carry out assigned tasks, employee learning and salary components such as stability of the job and wage complements contribute to the levels of employee satisfaction.⁶ Employees also consider organisations that support training and career development as good to work for.²⁷ Finally it was noted that work life balance plays a very important role in employee satisfaction. Thus, when employees perceive these stated requirements as met, consequently, the level of employee satisfaction is enhanced.

From a practical point of view, motivated and satisfied employees are more likely to remain within an organisation since they perceive themselves as gaining higher benefits through continuing to work for such organisations.²⁵ Additionally, satisfied employees are likely to provide better services to a firm's customers and improve its performance resulting to firms competitive edge²⁰. For this reason, the employees of an organisation have an important role in providing service and should be considered as strategic partners by the leadership in order to deliver quality services, retain satisfied employees and customer that improve the organisation's competitive advantage.²⁸

METHODS

Study Design and Setting

The study was a mixed research design conducted among the employees and patients of hospitals within Nairobi from whom data was collected through self-administered questionnaire to establish the influence employee engagement has on competitive advantage.

Study Population

The target population was the hospital employees and patients of level 4, 5 and 6 public and private hospitals within Nairobi.

Sampling Technique

A census of all 46 registered level 4, 5 and level 6 hospitals in Nairobi was done. Simple random sampling was used to select hospital employees while Stratified random sampling was used to select the patients from the same hospital.

Data Collection

Data was obtained from the participants using self-administered questionnaires with both open ended and closed ended questions. The close-ended questions allowed the respondent to choose from a list of pre-determined options/ answers. That is to say, the respondents were asked to select from a list of options provided on a 5-point Likert scale 1; (strongly disagree), 2(disagree), 3(Neutral), 4 (Agree) and 5 (strongly agree). The questionnaire for hospital employees was used to test the variability of every independent variable and consisted of 3 parts one (1), two (2) and three (3). Part one (1) consisted of questions on the hospital and employee characteristics while part (2) consisted questions on the study objectives, and

part (3) consisted of open questions. The patients' questionnaire was used to measure their satisfaction levels.

Data Management

The data was entered into excel, edited, and coded. The was then analysed using both descriptive and inferential statistics. The cleaned data was moved from Microsoft Excel® sheet to the SPSS version 23, data analytics software for processing. Each response was assigned a unique identifier that collaborated with the study variables. Each of the ordinal, nominal and scale variables were entered with numeric expressions to create a platform for executing the different types of analyses. Data was entered into 2 different spread sheets, for descriptive statistics. The data was then cleaned by checking for missing variables. The 2 sets of data (from employees and from patients) were measured independently using descriptive statistics for demographic information. Data from employees tested the variability in the independent variables. Under inferential statistics, the 2 sets of data (employees and patients) were triangulated in SPSS and the relationship between the first set of data compared to the second set of data that measured patient satisfaction (dependent variable). This was achieved by moving the patients' data to the employee SPSS spread sheet by forming additional variables after the employee variables. Constructs of the independent and dependent variables were then computed for correlation and regression analysis. Of the 46 hospitals, 31 (67.4%) responded. One hundred and fifty-nine (159) questionnaires were administered to the hospital employees out of which 134 (87.3%) were properly filled and returned. Further, 134 out of 159 patient's questionnaires were properly filled and returned representing a response rate of 83.7%.

The data was analysed and results presented in table forms. The study used the factor analysis, descriptive statistics and inferential statistics to analyse and present the results. The descriptive statistics used were frequencies, mean and standard deviation. The inferential statistics used were Correlation Coefficients, Chi-squared, one-way ANOVA, and regression analysis.

The following assumptions were made in order to make it necessary for a successful regression: Normality Test, Linearity Test, Multicollinearity Test and Homoscedasticity test.

Data analysis formula

$$Y = \beta_0 + \beta_1 X_1 + \epsilon_i;$$

Where:

α denotes the y intercept where x is zero;

β_i is regression weight attached to the exogenous variables:

ϵ is the error term.

Y= Competitive Advantage

X_1 = Employee Empowerment

Ethical Consideration

The research proposal was first approved by United States International University Africa information policy which concerns itself with the maintenance of ethical standards and protection of research subjects. Approval was sought from National Commission for Science Technology and

Innovation (NACOSTI). Furthermore, permission was obtained from each of the participating hospitals. The researcher weighed the sensitivity of the topic in designing the data collection instruments and determining what was permissible. The participants were asked to give their consent; hence the study was guided by the principle of informed consent. The respondents were free to decide whether to participate or not (voluntary participation). Each respondent was assigned a unique identifier making all the collected data source anonymous.

RESULTS

The study sought to examine the extent to which employee empowerment influence competitive advantage within the hospitals in Nairobi. Employee empowerment was measured using 4 parameters namely; competence, teamwork, motivation, and rewards and recognition. The measures for competitive advantage were; patient satisfaction, employee satisfaction and operational effectiveness.

Results for Factor Analysis on Employee Empowerment

The parameter of employee empowerment was measured using fifteen (15) items to produce appropriate measures. Factor analysis was conducted upon the items to ascertain any correlated parameters with the intention of reducing any unnecessary and redundant data. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value associated with employee empowerment was 0.965. The KMO test is used to measure sampling adequacy. When the result shows the KMO value greater than 0.6, this means that the sample is considered adequate. The value for the Barlett's test was χ^2 (136, N= 268) = 1240.499, $p < .05$.

Results for Descriptive Statistics on Employee Empowerment

The descriptive statistics for employee empowerment are presented in table 1. Percentage (%) distributions, mean (M) and standard deviations (S.D) were the descriptive statistical analysis carried out.

Correlation between Employee Empowerment and Patients' Satisfaction

Table 2 illustrates that the constructs for employee empowerment statistically and significantly correlate with competitive advantage. The results revealed that competitive advantage significantly correlated with competence, r (268) = 0.454, $p < .05$, and teamwork, r (268) = 0.456, $p < .05$. The study also showed that competitive advantage significantly correlated with motivation, r (268) = 0.420, $p < .05$, and reward and recognition, r (268) = 0.437, $p < .05$. The findings also indicated that employee empowerment significantly correlated with competitive advantage, r (268) = 0.453, $p < .05$.

Chi-Squared Test on Employee Empowerment

The results in Table 3 showed that there was enough evidence to conclude that there is a statistical significant association between employee empowerment and competitive advantage χ^2 (2730, N = 268) = 3848.172, $p < .05$.

One-Way ANOVA on Competitive Advantage for Employee Empowerment

This study sought to conduct a one-way ANOVA test to

ascertain whether there were significant differences between the means for competitive advantage for employee empowerment and the demographic variables of this study; age of the respondents, number of hospital beds, and type of hospital. The findings of this study showed that there was significant differences in the means across respondents' age, $F(4, 129) = 2.096, p < .05$. The study also showed that there were no significant differences in the means across respondents' number of hospital beds, $F(4, 129) = 0.957, p > .05$, and type of hospitals, $F(4, 129) = 1.272, p > .05$. This is shown in Table 4.

Regression Analysis and Hypothesis Testing for Employee Empowerment

This study used the regression model to observe whether employee empowerment explained changes in competitive advantage. A variety of assumptions for regressions were carried out before conducting the regression analysis.

Assumptions for Regression Analysis Employee Empowerment

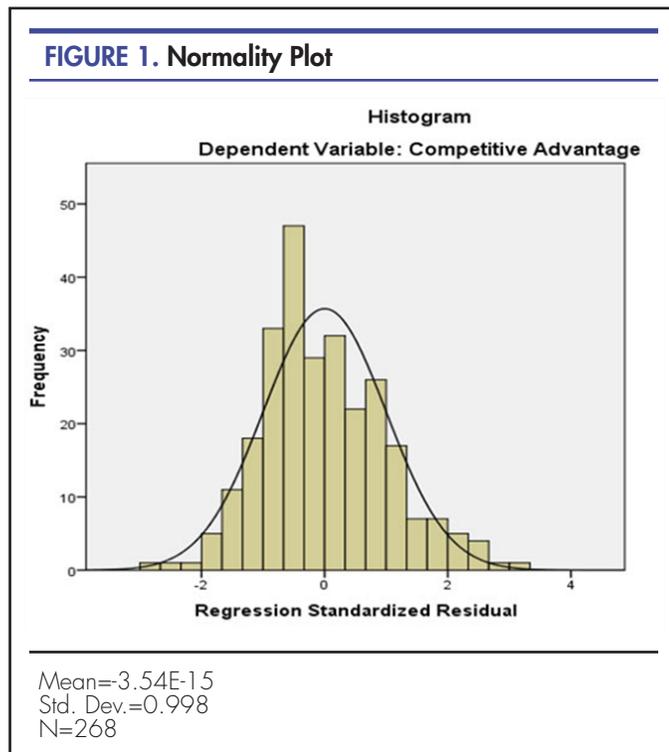
The below assumptions for linear regression were tested and they all met the assumption criteria.

Linearity: In the scatter plot, the results showed the deviation from linearity, p value above 0.05

Multi-collinearity: Variance Inflation Factors (VIF) of 2.708

Homo-scedasticity: results indicated the value of the Levene Statistic was $F=1.006, P\text{-value } 0.186 > .05$.

Normality: Figure 1, depict a histogram of the distribution of the residuals plotted and inspected for the normality test



Regression Analysis and Hypothesis Testing

A statistical tool that is carried out to examine if one or more independent variables predict the changes in the dependent variable is known as a regression analysis. This study used multiple linear regression analysis to examine the influence of employee empowerment on competitive advantage within the hospitals in Nairobi. This study tested the null hypothesis:

H_{04} : Employee Empowerment does not have a significant influence on competitive advantage within the hospitals in Nairobi.

Regression Model Summary

The findings in Table 5 illustrated that employee empowerment explained 22.2% variation in competitive advantage within the hospitals in Nairobi, $R^2 = 0.222$. The results established that 22.2% of the changes in competitive advantage within hospitals in Nairobi could be explained by the employee empowerment.

Regression ANOVA

The regression ANOVA shows the variability levels in a regression model and tests the significance of the model. Table 6 presents the results of the regression ANOVA for employee empowerment and competitive advantage. The findings showed that the model was statistically significant in linking employee empowerment with competitive advantage within the hospitals in Nairobi, $F(5, 262) = 2.615, p < .05$. According to the results, the influence of employee empowerment on patients' satisfaction was significant. The model was critical in explaining the relationship and considering the importance of F-statistic. The null hypothesis was rejected.

Regression Coefficients

A regression coefficient is a statistical tool that predicts how the dependent variable changes as a result of a unit change in the independent variable. The multiple linear regression was conducted with an aim of determining the magnitude and direction of the relationship between employee empowerment and competitive advantage within the hospitals in Nairobi. The findings of this study are demonstrated in Table 7.

The results from this study showed that competence, motivation, and reward and recognition significantly predicted patients' satisfaction, $\beta = 0.174, t(268) = 2.848, p < .05$, $\beta = 0.205, t(268) = 2.730, p < .05$, $\beta = -0.121, t(268) = -2.680, p < .05$ respectively. The findings of the study showed that teamwork has no significant relationship with competitive advantage, $\beta = 0.078, t(268) = 1.942, p > .05$. From a general point of view, employee empowerment significantly predicted competitive advantage, $\beta = 0.073, t(268) = 7.792, p < .05$. The implication of the results is that a unit change in employee empowerment would lead to significant increase in competitive advantage within the hospitals in Nairobi by 0.073 units. This study, therefore, concluded that employee empowerment significantly predicted competitive advantage within the hospitals in Nairobi.

Conclusion of Regression Analysis and Hypothesis Testing

The findings of the multiple linear regression analysis established that employee empowerment positively and-

significantly predicted competitive advantage within the hospitals in Nairobi, $R^2 = 0.222$, $F(5, 262) = 2.615$, $p < .05$; $\beta = 0.073$, $t(268) = 7.792$, $p < .05$. This meant that 22.2 percent of the variance in competitive advantage within the hospital in Nairobi would be explained by employee engagement. The regression model was also found to be statistically significant in predicting the relationship between employee engagement and competitive advantage, $F(5, 262) = 2.615$, $p < .05$.

The multiple linear regression coefficient for employee empowerment implied that every unit change in employee empowerment predicted 0.073 units change in competitive advantage. Pearson value of $p \leq .05$ was adopted by the study and the regression coefficient showed that the p-value of the regression coefficient (β) was $p < .05$. This study, therefore, rejected the null hypothesis and concluded that employee empowerment positively and significantly influences competitive advantage within the hospitals in Nairobi.

DISCUSSION

The study provides an insight of the influence instituting employee empowerment has on competitive advantage within the hospitals in Nairobi. In general, the findings of this study indicated that; for employee empowerment and competitive advantage, significant differences existed between the means across respondents' gender, age, number of hospital beds, type of hospitals, and ISO certification. This showed that irrespective of demographic information of the respondents, they perceived private hospital employees as more approachable and responsive than their colleagues in the public sector. This concurred with the findings from a study conducted in Singapore that showed patients who are admitted in private hospitals seem to have higher expectations from their care givers in comparison to those patients who are admitted in public hospitals due to the difference in cost of care incurred by private patients. These hospitals are more concerned about meeting the needs of their customers so as to ensure that their customers (patients) keep coming back to them.³⁰ Furthermore, those few who can afford private hospitals belong to a higher social class and have higher expectations from their caregivers. Further, it is noteworthy to consider that this study was carried out among small hospital in developing country, and the fact that small organisations do not seem to leverage staff role as a strategy tool to aid in improving customer satisfaction but focuses on the delivery of each staffs' job role¹⁹. In contrast, in another study it was observed that human resource focus correlates positively with customer satisfaction.²⁴

This study suggests that, employee empowerment characteristics such as motivation constitute a positive factor in improving competitive advantage. This is in agreement with other studies that showed that enhancing motivation, impacts on the performance of the organisations and enables them to gain public interest making them more popular.³² As observed contrary to manufacturing industry, employees in the service industry are not only linked in the production process but also in the selling of the services, hence, close interaction with the customers that require the staff involvement calls for a vast understanding of quality initiatives of the hospital. The employ-

ee results indicated that working in teams did not significantly affect patient satisfaction, on the other hand, patient results indicated that the staff worked well in teams as they handle patients equally and with courtesy at all time. This creates room for further discussion as to whether working in teams really has an impact on patient satisfaction.

In general, the study revealed that there are some high initial positive responses to the questions relating to the facets of employee empowerment through training and competitive advantage. This concurs with another study conducted to determine whether employee empowerment improves organisational effectiveness within South African Universities.³¹ The study revealed that training and development is an important facet of employee empowerment. Information sharing, training and trust seem to be the main contribution to the overall job satisfaction when employees are empowered. Further, agreeing with other studies which also found a positive relationship between employee empowerment and patients' satisfaction and attributed this to the mode of measurement applied to training and education, since the expectation is that training and education practiced in the service industries are more focused on the practice of the technical skills and not that of the delivery of service by itself.^{16,24} This is supported by the fact that both private and public hospitals should plan to provide effective training to clinical and nonclinical people to enhance their skills in communication and motivation for them to provide premier services to their patients.¹⁷ This guides on the emphasis on the need for training programs on patient relationship management as a strategy to enhance employees' performance that is geared towards impacting patients experiences.

Further, the study found that employee competence had a positive influence on competitive advantage. This finding agreed with the findings of another study which revealed that managers involved their staff in critical decision making.²⁵ The author studied the effects of human resource management within the nursing and care delivery industry and observed that employee performance was related primarily to management style of the unit head and the ability to empower the employees to make critical decisions. As good corporate citizens, organisations must work to achieve long-term sustainability for themselves and their customers through a team of well skilled and experienced team.³³

However, the study revealed that teamwork did not significantly influence competitive advantage. The findings of the study agreed with other studies which found that employee involvement in quality management can take various forms, including: extrinsic involvement, where employees' participation and contribution to continuous quality improvement is linked with a system of collective TQM oriented rewards, comprising extrinsic monetary and/or nonmonetary rewards and recognition. These results however contradict another study that attributed these findings to measurement of employee involvement that refers to teamwork that could lead to individuals being less responsive as the job outcomes are dependent of team performance^{19,32}. However, the findings of this study indicated that these factors had insignificant influence on patient satisfaction. This could be explained by-

TABLE 1: Mean and Standard Deviation for Employee Empowerment

Descriptive Statistics	N	Mean	Std. Deviation
All staff are trained and qualified to perform their duties.	134	3.87	1.088
Managers involve their staff in critical decision making	134	3.40	1.111
The hospital clinical staff's all meet the minimum requirements of the licensing/regulatory bodies.	134	3.78	1.113
Our hospital has the right mix of people and skills to do its work.	134	3.76	1.077
The staff have developed technical skills that make the delivery of their job easy	134	3.75	1.031
The staff exhibit a win-win attitude towards company work	134	3.86	1.005
There is a policy/protocol that encourages and enables our staff to develop their job skills so they can advance in their careers.	134	3.70	1.164
The staff cooperate and work well as a team.	134	3.62	1.082
The staffs are recognised for their work as teams. E.g. "The best performing ward"	134	3.58	1.057
The hospital has a process of awarding high achievers in their field of duty.	134	3.37	1.168
There are training programs for the staff in the field of quality improvement	134	3.44	1.160
The hospital and the managers care about the workforce.	134	3.61	1.182
The staff are committed to the hospital's success.	134	3.39	1.201
The staff performance is evaluated based on the quality of work	134	3.67	1.024
All staff believe our hospital is the best place to work	134	3.61	1.232

TABLE 2: Correlation between Measures of Employee Empowerment and Competitive advantage

		Patient Satisfaction	Employee Satisfaction	Efficiency	Competitive Advantage
Competence	Pearson Correlation	.384**	.424**	.459**	.454**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	268	268	268	268
Teamwork	Pearson Correlation	.390**	.433**	.449**	.456**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	268	268	268	268
Motivation	Pearson Correlation	.351**	.394**	.428**	.420**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	268	268	268	268
Reward and Recognition	Pearson Correlation	.361**	.412**	.445**	.437**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	268	268	268	268
Employee Empowerment	Pearson Correlation	.381**	.426**	.457**	.453**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	268	268	268	268

** . Correlation is significant at the 0.01 level (2-tailed)

the fact that majority of the staff respondent indicated that employees were recognised for their work as teams that is to say, as the best performing ward as opposed to the best performing staff member. This could have created a sense of lack of individual appreciation even when the employee understood the job role and exhibited competence in performing such duties.

The study also found that reward and recognition significantly predicted competitive advantage. Indicating that employee perceptions of reward and recognition include not only pay and other financial rewards, but also procedural justice in the form of performance appraisal systems, career and promotion opportunities, superior subordinate relations, and job assignments. Therefore, when

TABLE 3: Chi-Squared Test on Employee Empowerment

	Employee Empowerment
Pearson Chi-Square	3848.172a
Df	2730
Asymp. Sig. (2-sided)	.000

** Correlation is significant at the 0.05 level (2-tailed).

TABLE 4: One-Way ANOVA on Competitive Advantage for Employee Empowerment

ANOVA		Sum of Squares	Df	Mean Square	F	Sig.
Age in Years	Between Groups	52.164	4	1.373	2.096	.002
	Within Groups	62.224	129	.655		
	Total	114.388	133			
Number of Hospital beds	Between Groups	59.918	4	1.577	.957	.548
	Within Groups	156.478	129	1.647		
	Total	216.396	133			
Type of hospital	Between Groups	9.795	4	.258	1.272	.175
	Within Groups	19.257	129	.203		
	Total	29.052	133			

** Correlation is significant at the 0.05 level (2-tailed)

TABLE 5: Regression Model Summary for Employee Empowerment

Model Summary	R	R Square	Adjusted R Square	Std. Error of the Estimate
Model 1	.471a	.222	.210	.28056

a. Predictors: (Constant), Employee Empowerment, Teamwork, Competence, Motivation

TABLE 6: Regression ANOVA for Employee Empowerment

ANOVA ^a		Sum of Squares	Df	Mean Square	F	Sig.
Model 1	Regression	5.917	4	1.479	18.792	.000b
	Residual	20.702	263	.079		
	Total	26.619	267			

a. Dependent Variable: competitive advantage

b. Predictors: (Constant), Employee Empowerment, Teamwork, Competence, Motivation

**Correlation is significant at the 0.05 level (2 tailed)

TABLE 7: Regression Coefficients for Employee Empowerment

Coefficients ^a		Un-standardised Coefficients		Standardised Coefficients		Sig.
Model		B	Std. Error	Beta	T	
1	(Constant)	1.434	.024		59.900	.000
	Competence	.174	.061	1.087	2.848	.005
	Teamwork	.078	.040	.471	1.942	.053
	Motivation	.205	.075	1.212	2.730	.007
	Reward and Recognition	-.121	.045	-.706	-2.680	.008
	Employee Empowerment	.073	.009	.431	7.792	.000

a. Dependent Variable: Competitive Advantage

dealing with employees within service industries such as hospitals, the procedural facades of organisational reward systems requires greater sensitivity on the part of the management while dealing with reward and recognition issues.

This is so since employees consider fair treatment at work as not merely good pay but also other aspects such as genuine and timely performance appraisal, recognition, supervisor-employee relationship, career development, and promotion opportunities.^{6, 8, 13} These aspects of employee rewards to a greater extent, determines the effectiveness of an organisation especially in terms of the customer satisfaction levels. However, another study conducted in South Africa indicated all aspects of employee empowerment except rewards also portray moderately high scores that could result to higher performance of an organisation.³¹

Strengths and Limitation of the Study

The findings of the study offer a number of insightful observations that healthcare providers could utilise to differentiate and/or compare the outcome of service (patient satisfaction, employee satisfaction and operations efficiency) from competitors, as an important tool for assessing the levels of competitive advantage in respect to the quality of healthcare services delivered by the competitors while implementing the Total Quality Management principles.

The scope of the study was limited to hospitals within Nairobi. We suggest that further studies be carried out within other industries, sectors and geographical area.

CONCLUSION

The findings of this study provides a strong signal to the hospital leaders that the practice of empowerment at work is important in bringing satisfaction to both the employees and the patients hence improving their hospitals' competitive edge. The study concluded that the best performing employees are those that are well trained and qualified to perform their duties. Through training, staff gain technical skills that make the delivery of their job easy and enhance competitive advantage levels. From a general point of view, the study concluded that when employees are competent, they work as a team, they are

motivated and thus leading to enhanced competitive advantage.

With the purpose of improving competitive advantage of the hospital, policy makers and the regulating agencies could utilise the study findings to develop policies and guidelines that help to improve and sustain the high-level quality services through empowered employees. The information generated from the study could be used for public education so that the patients are able to make informed decision on the choice of hospitals to go to.

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Infection Prevention Performance among Hospital Staff during Vaginal Birth: Results from a Criterion-Based Audit at a Zonal Referral Hospital in Tanzania

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ABSTRACT

Background: Healthcare associated infections is a global burden and is one of the main causes of maternal and neonatal morbidity and mortality during the time of labour when admitted to the hospital. Healthcare workers' hands are in most cases the vehicle for transmission of microorganisms from patient to patient. Good hand hygiene practices at the bedside are a simple way of reducing healthcare associated infections. The objective was to assess the impact of a criterion-based audit on infection prevention performance and knowledge during vaginal delivery at a hospital in Tanzania. The quantitative findings were discussed with staff to identify barriers and solutions to quality improvement.

Methods: A mixed-method uncontrolled, before and after intervention study by criterion-based audit was performed at the labour ward at Kilimanjaro Christian Medical Centre. Criteria for best practice were established together with key staff based on national and international guidelines. Sixty clean procedures during vaginal birth were observed and assessed by a structured checklist based on the audit criteria. Baseline findings were discussed with staff and an intervention performed including a short training and preparation of alcohol-based hand rub. Hereafter another 60 clean procedures were observed, and performance compared to the care before the intervention. Furthermore, a knowledge test was performed before and after the intervention.

Results: Hand washing increased significantly after a procedure from 46.7% to 80% (RR=1.71 95% CI; 1.27 to 2.31), the use of alcohol-based hand rub before a procedure from 1.7% to 33.3% ($p<.001$), and the use of alcohol-based hand rub after procedure from 0% to 30% ($p<.001$). After the intervention the mean score for the knowledge test increased insignificantly from 59.3% to 65.3%, (mean difference = 6.1%, 95% CI; -4.69 to 16.88).

Conclusion: The criterion-based audit process identified substandard care for infection prevention at the labour ward. An intervention of discussing baseline findings and a short training session and introducing alcohol-based hand rub resulted in improvements on infection prevention performance.

BACKGROUND

HealthCare Associated Infections (HCAI), also referred to as “nosocomial” and “hospital infections” are infections not present at the time of admission that affect patients in a hospital.¹ Although the risk of acquiring HCAI is universal, the global burden is unknown. It is estimated that hundreds of millions of people worldwide are afflicted by infections acquired in hospitals.^{2,3} Healthcare associated infections is more prevalent in low- and middle-income countries than in high-income countries, in particular for patients admitted to intensive care and neonates.^{1,3} An estimated 11% of maternal deaths (more than 30,000 per year) and 36% of the neonatal deaths (800,000-900,000 per year) are due to infectious causes.^{4,5} Some of the factors that put women and neonates at risk of infection in health-

care settings are; prolonged and inappropriate use of invasive devices and antibiotics, overcrowded hospitals, poor knowledge on application of basic infection control measures, understaffing and insufficient equipment.^{2,6} The most frequent maternal HCAI are; urinary tract infections, endometritis, chorioamnionitis and infections due to caesarean sections.⁷ Foetuses and newborns are at risk of acquiring HCAI in utero which can lead to preterm labour and spontaneous abortion. Infections can also be acquired, intrapartum as well as postpartum. Conditions during labour and childbirth such as prolonged labour, rupture of membrane, multiple vaginal examines and manual removal of the placenta are further risk factors.^{1,2,6,8} The World Health Organization (WHO) recommends implementing standard precautions, particularly best hand hygiene practices at the bedside and improve st-

aff education and accountability.²

A systematic review and network meta-analysis⁹ found improvements in hand hygiene was associated with reductions in HCAI such as *methicillin* resistant *Staphylococcus aureus* infection ($p=.02$). A study from a hospital in Rwanda found increased hand hygiene compliance to be associated with a significant decrease in post-caesarean wound infection ($p<.001$).¹⁰ Tanzania has a maternal mortality ratio of 524 per 100,000 live births.¹¹ It is among the countries with the highest maternal mortality in the world, and infections accounts for an estimated 20% of neonatal¹² and 11% of maternal deaths.¹³ Several studies at Kilimanjaro Christian Medical Centre (KCMC) in the northern part of Tanzania confirm that infections are a major contributor to morbidity and mortality.¹⁴⁻¹⁶ From 2003 to 2012, it was estimated that 11% of maternal deaths were caused by sepsis. At 14 different departments of KCMC, the prevalence of HCAI was 14.8% on average¹⁴ and surgical site infections were observed in 19.4% of surgical patients.¹⁵

Criterion Based Audit (CBA) is a well-established tool for quality assurance with specific focus whereby clinicians can describe and reflect upon their performance compared to agreed criteria for good practice.¹⁷⁻²² Compared to other interventions, it is cost-effective and a change in performance is often seen within a short time of implementation. A specific and focused baseline observation is used for a targeted intervention with a following re-evaluation of practice. The objective of this mixed methodology study was to assess the impact of a CBA on Infection Prevention Performance (IPP) by direct structured observations during vaginal birth at KCMC and knowledge of proper IPP. The quantitative findings were discussed with staff to identify barriers to quality improvement.

METHODS

Study Area

This study was conducted at KCMC. Kilimanjaro Christian Medical Centre is a zonal referral hospital located in Moshi town, the regional headquarter of Kilimanjaro region in the northern part of Tanzania. The department of Obstetrics and Gynaecology is divided into 3 units; an Obstetric unit with 59 beds, a Gynaecological unit with 52 beds and a labour ward with 4 beds for delivery and 2 operation theatres.^{23,24} In 2016, there were 3,234 births, 42% by caesarean section.

Study Design and Participants

This study was a mixed-method uncontrolled, before and after intervention study assessing the impact of CBA for IPP during vaginal birth by structured, direct real time observations and a knowledge test within the framework of a CBA. To triangulate the quantitative findings, these findings were discussed with staff, adding qualitative findings to help identify barriers to quality improvement. The study was carried out between February and June 2017.

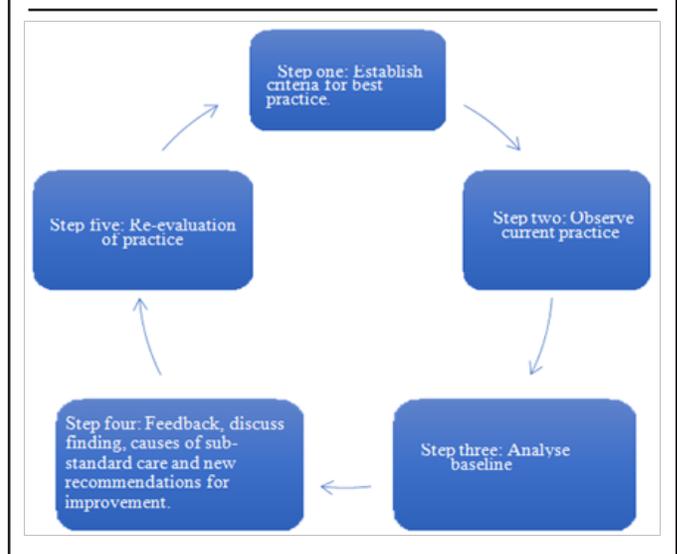
All midwives, nurses and doctors attending vaginal birth during the observation period were eligible for inclusion and were asked for informed consent. If participation was accepted, they were asked to fill out a short background information questionnaire and a knowledge test by a Key Feature Questionnaire (KFQ). Out of 49 eligible staff me-

mbers at the labour ward, 22(45%) were included. Of the 22 participants, 1 (4.55%) refused to answer the knowledge test before the intervention and 7 (31.82%) did not answer the knowledge test after the intervention. All participants accepted to be observed during procedure.

Study Procedures
Criterion-Based Audit

The aim of a CBA is to include staff in reflecting on best practices compared to their actual performance; “like holding up a mirror”¹⁷ The CBA has 5 steps that are described as audit cycle (Figure 1).

FIGURE 1. Criterion-Based Audit Presented as a Circle Showing the Steps in the Process



Step One: Establishing Criteria for Best Practice

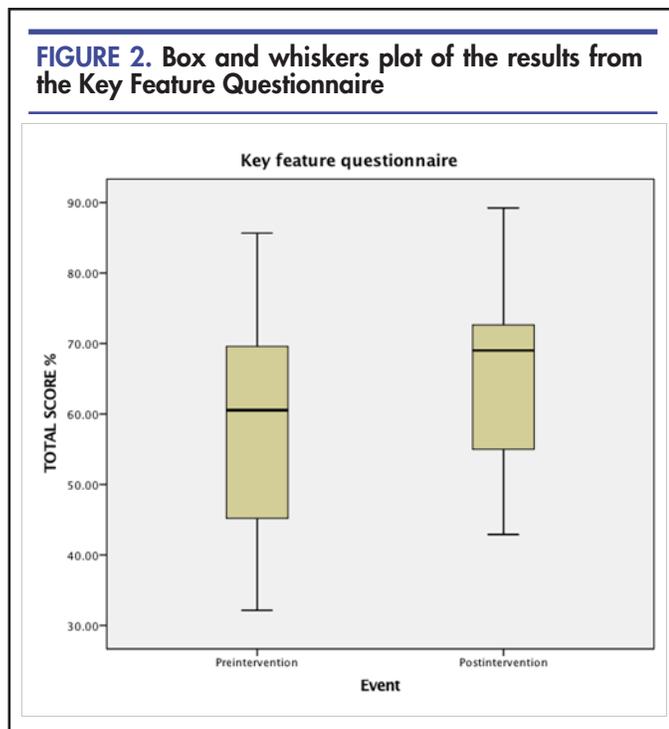
In step one, specific audit criteria of key relevance for best realistic practice, considering the resources available, regarding IPP were agreed upon in collaboration with 2 midwives and 2 consultants in obstetrics from KCMC. Criteria were based on national guidelines for hospitals in Tanzania²⁵, guidelines by the WHO² and Centers for Disease Control (CDC).²⁶

Step Two: Observe Current Practice

The second step was a 3-week baseline data collection between 1st and 31st of March 2017. The primary outcomes were key procedures for IPP during vaginal labour by a structured checklist including hand wash and the use of Alcohol-Based Hand Rub (ABHR). Secondary outcomes were scores from the KFQ knowledge test. As part of the CBA, staff were discussing barriers to improve quality of IPP and suggestions to overcome them. This qualitative data was included to triangulate the quantitative findings. Observations were un-blinded in real-time using an Objective Structured Observation of Technical Skills (OSATS) developed by the authors based on the audit criteria established in step one. Infection prevention performance was observed in relation to each “clean procedur-

e” defined as vaginal examination, insertion of urinary catheter, insertion of intravenous line, or at birth. Observations were performed at different work-shifts (day, evening and night).

Furthermore, a knowledge test of staff was performed using a validated KFQ developed for the Safe Delivery Application with 7 case-based questions related to IPP.²⁷ The structured KFQ for the staff was performed before and after the intervention (step four.)



Step Three: Analyse Baseline Data

The third step was to analyse the baseline performance as fulfilment rates of each criteria.

Step Four: Feedback, Discuss Finding and Causes of Sub-Standard Care and New Recommendations for Improvement

Step four was a presentation of baseline findings to the participating staff followed by a discussion of causes of sub-standard care and suggestions for improvements. A short training intervention lasting 2 hours was prepared focusing on the most aggravating substandard care identified at baseline performance. The Safe Delivery application was part of the training.²⁷ It is an education aid for skilled birth attendants to improve emergency obstetric care. It has a chapter about Infection Prevention (IP) which was integrated in the session in both English and Kiswahili²⁸ with an instruction cartoon video lasting 7 minutes. All participants were invited to the session conducted by the first and second author and notes were taken from the discussion of causes of sub-standard care and suggestions for improvements. Based on the Safe Delivery application, instructions on hand rub was produced by the hospital’s pharmaceutical school and distributed at

the labour ward ready for use. Posters on how to perform hand hygiene were posted on the wall in the theatre, labour room and triage area.

Step Five: Re-Evaluations of Practice

The fifth step in the audit circle was a re-evaluation of the practice for another 3 weeks of observations similar to step 2. The findings were compared to the baseline findings. Finally, the results were presented to the staff at the labour ward.

Statistical Analysis Power Analysis

The global score of IPP was assumed to be 50% at baseline and 75% after the intervention, 59 observations before and after the intervention were thus needed to demonstrate a significant change within a 95% confidence interval with a power of 80. We assumed that on average, 3 observations could be made at each vaginal birth; consequently, 20 vaginal births were to be observed.

The data was entered directly into the statistical software package IBM SPSS 24 (SPSS, Inc., Chicago, IL) and was used for data analysis. Scores for OSATS and KFQ were calculated and presented as percentages of maximum achievable score. All categorical data is presented as fulfilment rates at baseline and after the intervention. Scores were compared by Chi-square test and presented as relative risk scores with 95% Confidence Intervals. At Chi-square test at cells less than 5, a 2-tailed Fisher exact test was used and significance presented by a *p-value* below .05. OSATS global scores were compared by Student’s t-test, knowledge scores by paired T-test.

Ethics Approval and Consent to Participate

This study was approved by the ethical review board at KCMC (No. 2025 date of approval 17.02.17). Participants were given verbal and written information about the study. If staff agreed to participate, a consent form was signed. All information was kept anonymous so that poor performance would not influence any individual’s employment or relation with superiors.

RESULTS

The study included 22 out of 49 doctors and midwives at KCMC who were observed during clean procedures before and after the intervention. Their working experience ranged from 2 weeks to 5 years (Table 1). A total of 120 observations were performed, equally divided between before and after the intervention. Two thirds (80 of 120) of the procedures observed were of midwives (Table 2).

IPP procedures observed showed remarkable substandard care at baseline, some of them improved significantly after the intervention. Hand washing before a procedure was low at 38.3% before increasing insignificantly to 48.3% after the intervention, RR 1.26 (95% CI; 0.83 to 1.91). Hand washing after a procedure increased significantly from 46.7% to 80%, RR 1.71 (95% CI; 1.27 to 2.31). The use of ABHR increased from 1.7% to 33.3% (*p*<.001) before a procedure and 0% to 30% (*p*<.001) after a procedure (Table 3).

15 participants answered the KFQ before and after the intervention. The mean score of their results increased insignificantly from 59.3% to 65.3%, (mean difference =

6.1%, 95% CI; -4.69 to 16.88) (Figure 2). A box and whiskers plot illustrates the results in percentage from the KFQ (Figure 2). Before intervention, the minimum score was =32.1%, Q1=45.2%, median= 60.5%, Q3=69.6 and maximum score was = 85.7%. The interquartile range box represents the middle, 50% of the data and indicate that 50% of the total score is within 45.2% and 69.6%. After intervention, the minimum score was = 42.9%, Q1=55.0%, median=69.0%, Q3=73.6%. In the answers collected after intervention, there are both larger maximum total score and larger minimum total score than before intervention.

TABLE 1: Characteristics of Participants

Background data	N = 22 (%)
Age	
25-29	10(45.5)
30-34	8(36.4)
≥ 35	1 (4.5)
Missing value	3 (13.6)
Sex	
Female	8 (36.4.)
Male	12 (54.5.)
Missing value	2(9.1)
Time at an obstetrical department	
<12 Months	11(63.5)
≥ 12	3(13.6)
Months Missing value	8(36.4)
Profession	
Midwife/Nurse	7(31.8)
Doctor	13(59.1)
Missing value	2(9.1)

All participants were asked to fill out a short background information questionnaire, but some of the collected questionnaire had missing data, which explains the missing values

15 doctors and midwives participated in the presentation of baseline findings and discussion. Notes were taken from the discussion and divided into 2 main focuses; Suggested reasons for non-compliance of IPP (Table 4) and suggested solutions to overcome non-compliance in IPP (Table 5). Some of the reasons for non-compliance of IPP mentioned by the participants was lack of adequate equipment and lack of accessible hand rub. The staff mentioned that they were convinced that their performance and hand hygiene would improve at the labour ward if hand rub was available (Table 5).

The participants wished to acquire more knowledge regarding correct IPP and wished for a supervisor who could be helpful in situations where standard procedures are forgotten. Due to a high frequency of change of staff in the labour ward, participants suggested that the hospital should employ a hygiene nurse who should orient new staff on IP standards. They also wished to make it legitimate to tell and remind each other about correct IPP.

TABLE 2: Characteristics of Observations among Profession and Specific Procedures

Variable	Frequency n = 120	Percentage n=100%
Profession		
Doctors	40	33.3
Midwives	80	66.7
Name of procedure		
Vaginal examination	52	43.3
IV catheter	19	15.8
Urine catheter	20	16.7
Vaginal birth	29	24.2

Data are presented in frequency and percentage.

DISCUSSION

This CBA identified several fundamentally important IPP to be low at baseline and with improvement after the discussion of findings with staff and a short training session. The knowledge test demonstrated moderate average scores that did not change significantly after the intervention suggesting that knowledge is not necessarily enough to change performance.

The findings for hand hygiene are similar to findings in other studies which indicate that health workers’ hand hygiene in labour wards at baseline is low with ample room for improvement.^{10,29-32} Hand hygiene was observed more often after procedure than before procedure. These results were similar to findings in several other studies.^{22,29,31-33} A recent review suggests that it is often hand hygiene procedures before patient contact and clean/aseptic procedures, where it is possible to prevent pathogen transmission, that are being neglected.³⁴ In a quasi-experimental study at 43 hospitals in 5 low- and high-income countries, the study revealed that IP was performed significantly less often before procedures than after. It is discussed as if health providers conceive themselves as “clean” and patients as “unclean”, and that IPP are mainly to protect the health provider not the patient.^{29,32} Another study asked the nurses to give a reason for their behaviour for not washing hands before wearing gloves, they replied back “it was unnecessary to clean hands because they would be wearing gloves that would prevent microorganism transmission”.³¹ Whether this is the same belief in the labour ward at KCMC is not possible to say and further studies are needed to shed light on this aspect. Patterns of hand hygiene and behaviour change in healthcare settings are complex therefore studies suggest that multi-level as well as multi-modal strategies are needed.^{35,36}

It is mentioned in 2 international guidelines^{2,26} that lack of knowledge on IP has a negative impact on IPP. In this study, a knowledge test was distributed among staff to get an insight on the level of knowledge regarding IP and to identify strengths and weaknesses. The results showed a slightly insignificant improvement after the intervention. Results from a randomised controlled trial study in Indonesia³² also investigated the knowledge of the healthcare-

TABLE 3: Direct observations on Infection Prevention Performance

Observation	Baseline n (%) N=60	After intervention n (%) N=60	RR (95% CI) or p-value
Hand wash before procedure	23 (38.3)	29 (48.3)	1.26 (0.83 – 1.91) *
Hand wash after procedure	28 (46.7)	48 (80.0)	1.71 (1.27 – 2.31)
Alcohol-based hand rub before procedure	1 (1.7)	20 (33.3)	p-value 0.00* **
Alcohol-based hand rub after procedure	0 (0)	18 (30.0)	p-value .00* **
Use clean “single-use paper towel” or air-dry	23 (38.3)	22 (36.7)	.96 (.60 – 1.52)
Wear bracelets/rings/watch	15 (25.0)	23 (38.3)	1.53 (.89 – 2.64)
Not wearing long sleeves	57 (95.0)	60 (100)	1.05 (.99 – 1.12)
Not wearing closed footwear	51 (85.0)	40 (66.7)	.78 (.64 – .97) **
At IV catheter	N=8	N=11	
Wears non-sterile, clean gloves	6 (75.0)	11 (100)	1.33 (.89 – 1.99)
Use of Sterile gloves	N=52	N=49	
Wears sterile gloves	52 (100)	49 (100)	
Are sterile gloves applied in the correct way, so sterility is maintained?	32 (61.5)	39 (79.6)	1.29 (1.00 – 1.67) **
Gloves remains sterile until exploration	39 (75.0)	45 (91.8)	1.22 (1.03 – 1.46) **
At sterile procedure	N=23	N=22	
Was the instrument sterile when used?	21 (91.3)	22 (100.0)	1.10 (0.97 – 1.24)
At cleaning	N=21	N=18	
At urine catheter or IV line: Is cleaning performed appropriately?	14 (66.7)	18 (100)	1.50 (1.11 – 2.03) **

Data are presented in numbers and frequencies and analysed by chi-square test. * Fishers Exact Test are used when numbers <5. **Significant result.

TABLE 4: Suggested Reasons for Non-Compliance in Infection Prevention Performance

Discussion issue	Notes from the discussion with staff
Suggested reasons for non-compliance	<ul style="list-style-type: none"> - Lack of equipment e.g., goggles and aprons. - Not enough lockers in the changing room to lock away values. - Absence of handrub. - Forgetfulness. - Lack of knowledge. - Absence of supervision. - Uncomfortable equipment e.g. goggles that doesn't fit or are difficult to see through during procedures.

staff with the use of WHO’s tool.² Their results showed a significant improvement in their knowledge test but concluded that good knowledge cannot alone lead to high hand hygiene compliance.

Alcohol-based hand rub was produced locally at the nearby pharmaceutical school by using WHO-recommended recipes. Local production is recommended as it is at low cost and easy to do and can replace commercial products-

TABLE 5: Suggested Solutions to Overcome Non-Compliance in Infection Prevention Performance

Discussion issue	Notes from the discussion with staff
Suggested solution to overcome non-compliance	<ul style="list-style-type: none"> - Wish to be supervised by a nurse specialised in hygiene. - Wish for more knowledge about how to practice IP. - Wish for more supervision. - Wish that a hygiene nurse in charge of IP can go through IP procedures with every new coming staff. - It must be possible to remind each other about IPP. - It should be possible to talk to each other about hand hygiene. - Better changing rooms to be able to lock away values as watches and jewellery in a safe place. - Hand hygiene would improve if hand rub was available. - Comfortable equipment.

as well as support local community.² Although ABHR is advised as a cost-effective and effective method for preventing HCAI^{2,34,37,38}, it was not accessible for staff at the labour ward. After implementing ABHR in the labour ward, it resulted in a significant increase before and after procedure. A similar increase is found in a pre- and post-intervention study from Rwanda.¹⁰ Alcohol-based hand rub was introduced at the maternity unit to measure the pre- and post-intervention post-caesarean wound infection rate and hand hygiene compliance.

The intervention of ABHR, involving a half day training session using WHO's tool² and wall mounting visual reminders around ward resulted in a significant increase of hand hygiene compliance for both midwives and doctors from 38.2% to 89.7% as well as a non-significant decrease of post-caesarean wound infections, 6.2% to 2.5%. The authors suggest that the non-significant decrease may be a result of a small sample size studied and short follow-up time.¹⁰ An uncontrolled before and after interventions study from Tanzania also introduced ABHR at the maternity unit to improve hand hygiene practice during caesarean section. Their findings show that provision of ABHR has contributed to the improvement of hand wash with alcohol hand rub practices especially after the procedure.²²

The impact of the CBA did not improve the quality of IPP convincingly on all outcomes. One of the factors might be the relatively short period of time compared to other studies that lasted between 16 weeks and 16 months.^{10,20,21,30-33} Another factor could be duration or design of education sessions or the use of a single strategy. A Cochrane review evaluating methods to improve hand hygiene concludes that introducing ABHR, accompanied by education is not enough, multiple strategies are needed.³⁹ The observations were carried out during day, evening and night shift over 8-12 hours at a time by the same person, making findings more likely to be representative for the staff at the labour ward. At each procedure, the observer was only observing one staff at a time which decreased the risk for under-recording.

Strengths and limitations

An uncontrolled study has its limitation as we cannot be

sure that the effect we see is due to the intervention and not due to the effect of a confounding variable. Although during the study period we didn't notice any major changes at the labour ward or any other studies that could have had an effect other than our own intervention. The Hawthorne effect, can lead to overestimation of compliance as staff might improve their performance more as they are partaking in a research project, this is likely to have influenced the study somehow, though the poor baseline performance and only little improvement after the intervention makes it less likely to have had a large influence.⁴⁰

Another limitation is the lack of blinding of the principal investigator. In the second data collection, observations could have been biased towards better outcomes, subconsciously wishing to see positive effects of the intervention. All observations were done without any interruption from the observer making the data comparable and the estimated effect of the intervention reliable. When doing a hypothesis test, there are 2 types of possible errors: Type 1 and Type 2. To avoid Type 1 error, a level of significance was set at 0.05 which mean we were willing to accept a 5% change of being wrong in rejecting the null hypothesis. To avoid Type 2 error, we did a power calculation and ensured that our sample size was large enough.

Compared to other studies, when multiple observers are observing the same phenomena (inter-observer variation), it causes a threat to the variation of observations. This was avoided by using only one observer, who was using the OSATS which made it possible to do structured observations and limit the threat of intra-observer variation.

Another strength was the minimal risk of selection bias. The study had few inclusion criteria as all midwives and doctors were expected to have a basic knowledge of IP through their education and therefore were eligible for participation. Few staff members refused to participate in the study, which might have had an effect on our results toward better or worse outcome.

The CBA is a cost-effective tool for quality improvement in settings with low resources. It permits the staff to learn-

how often best practice is really followed and by using the CBA compared to other studies, it can help find barriers to good practice. As part of the audit cycle, providing feedback on quality of performance is a way to improve health care workers' performance.

Criterion based audit in this study, is found to be a useful strategy to improve professional performance in settings with limited resources where baseline of recommended performance is low. The CBA allows the participant to come together and solve the problem as part of the audit cycle. The participants become an important part of formulating practical solutions that improve the quality of care they provide within their setting and thereby finally enriching and improving their professional performance.

CONCLUSION

In conclusion, the CBA process identified substandard care for IP at the labour ward. An intervention, involving discussion of baseline findings, a short training session and introduction of ABHR resulted in improvements on IPP. Based on the results, it is recommended to Head of Department, health administrators and policy makers that priority is given to the quality of IPP at the labour ward and that CBA might have a place in these efforts as a comparatively cost-effective quality assurance tool that can lead to change relatively fast. However, multi-modal, long lasting strategies are probably more likely to be more effective. It is recommended that ABHR be promoted national wide and to have a specific focus on the availability of ABHR as a simple and feasible intervention to reduce HCAI.

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Pregnancy Induced Hypertension and Uric Acid Levels among Pregnant Women Attending Ruhengeri Referral Hospital, in Rwanda

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ABSTRACT

Background: Pregnancy Induced Hypertension (PIH) is a common burden during pregnancy usually associated with adverse maternal and paternal outcomes. The uric acid serum level was identified as an important biochemical marker which can predict preeclampsia, a type of PIH. This study was conducted to evaluate the effects of serum uric acid levels in association with blood pressure among pregnant women attending Ruhengeri Referral Hospital.

Methodology: A cross-sectional study was designed and 80 pregnant women in different gestation trimesters participated in the study. Data was collected from September to October 2018. Digital sphygmomanometer was used to test blood pressures for participants. Blood samples were collected in red top tubes and centrifuged to obtain serum for uric acid levels. Using Humastar 80, uric acid levels were measured for each participant. Data was analysed using Statistical Package for Social Sciences (SPSS) version 23.0. Bivariate correlation was used to analyse the relationship between uric acid levels and participants' blood pressure.

Results: The median age was 27 in interquartile 23-31 ranging from 19 to 39 years. 58.75% of participants were in their 1st trimester, followed by 21.25% in the 2nd trimester and 20% in the 3rd trimester. The prevalence of hypertension was 11.3% (7.5% for stage 1 and 3.8% for stage 2). Hyperuricemia was found in 15% of the participants. The mean of uric acid level was 7.12 ± 1.86 mg/dl in the hypertensive group and 4.49 ± 1.22 mg/dl in the non-hypertensive group. The study revealed a strong positive correlation between uric acid levels and systolic /diastolic blood pressure.

Conclusion: High prevalence of hypertension among pregnant women was revealed. The association of hypertension and hyperuricemia was recorded with a strong correlation between blood pressures and serum uric acid levels. Examination of Uric acid levels among pregnant women should be routinely performed for early identification and management of hypertension.

BACKGROUND

Pregnancy-Induced Hypertension (PIH) usually leads to maternal and neonatal morbidity. Developed and countries under development continue to experience PIH.¹ Around 10% among pregnant women show PIH worldwide, while 14% was observed in Sub-Sahara African countries.² A meta-analysis by Gemechu et al.³ highlighted a significant prevalence of PIH in Sub-Saharan Africa when compared to other continents. Pregnant women in Russia (1.7%), Kurdish (3.1%) and Somali (3.8%) had lower prevalence of PIH, compared to women in Finland (5.4%).⁴ The PIH was observed to be the most common cause of maternal mortality in Ethiopia due to poor awareness.¹

Hypertension in pregnancy is expressed as a systolic blood pressure of 140 mmHg or greater and a diastolic blood pressure of 90 mmHg or greater. The various types of this disorder are defined according to the pre-set criteria. The preeclampsia or eclampsia is confirmed when hypertension appears in otherwise

normotensive female after 20 weeks of gestation and is usually accompanied with proteinuria. Chronic hypertension is considered when hypertension appears prior to pregnancy or before the 20th week of gestation.^{2,5} The pre-eclampsia superimposed on chronic hypertension is when de novo proteinuria appears after the 20th week of gestation.⁵ Hyperuricemia is a strong risk factor for several maternal and perinatal complications in patients with hypertensive disorders during pregnancy.⁶ In Uganda, maternal near miss and death as outcomes of hypertension has been observed with severe pre-eclampsia associated with a high morbidity rate of 7.0%.⁷

Hypertension disorders among pregnant women in Rwanda take the second position among the causes of morbidity with 28.6% severity, according to Rulisaet al.⁸ Another research on maternal cases puts eclampsia as the leading cause of death at 30.7%.⁹ Sengoma et al.¹⁰ revealed that 2.7% of pregnant women acquire pre-eclampsia while only 1% develop eclampsia.

Additionally, hypertension in Musanze district, at Proom-inubus clinic has been associated with hyperuricemia (5.3%) and pre-eclampsia (2.1%).¹¹ Other factors contributing to hypertension were estimated at 11.78%. The highest number of pregnant women with hypertension was observed at Gisenyi district hospital with a rate of 65%.¹²

During early pregnancy, uric acid levels fall often to 3 mg/dl or below, this is usually due to the uricosuric effects from oestrogen and from the increase in renal blood flow. Uric acid levels increase during the 3rd trimester, reaching levels of up to 4-5 mg/dl by term. It is known that subjects destined to develop preeclampsia show slightly higher uric acid levels during the 1st trimester in association with a relative reduction in urinary urate excretion.¹³ Each year, over 500,000 women die due to pregnancy outcomes with 99% residing in the developing world (low- and middle-income countries). Among those deaths, 10 to 15% are related to preeclampsia and eclampsia, these are types of hypertension among pregnant women.¹⁴ Hypertension generally account for 10% of the pregnant women with 2-8% facing complication due to the pre-eclampsia.¹⁵ Mboudoet al.¹⁶ showed that among 8.2% of hypertension case during pregnancy, 77.88% was due to pre-eclampsia, 15.38% due to gestational hypertension and 5.76% due to pre-eclampsia superimposed, only 0.96% had chronic hypertension.

Evidences from the study conducted by Essiben et al.¹⁷ demonstrated that patients with eclampsia had a statistically significant association with hyperuricemia with 36.7% of the pregnant women having severe preeclampsia. Another study showed that the rate of morbidity associated with pre-eclampsia is high at 7.0%.⁷ Few related studies were carried out and only one was conducted in Rwanda. The Rwandan study showed that hypertension with uric acid abnormality was prevalent among 5.3% of pregnant women.¹¹ Therefore, this study was conducted to evaluate the uric acid levels in association with blood pressure among pregnant women attending Ruhengeri Referral Hospital.

METHODS

Ruhengeri Referral Hospital

Ruhengeri Referral Hospital is located in Musanze District of North Province in Rwanda. It was built during colonialism in 1939 as a public clinic. It served the public as a District Hospital for several years. Nowadays, this hospital officially serves as the National Referral Hospital and receives patients' references from its neighbouring hospitals and health facilities in northwest Rwanda since 2013. In addition to 406,557 people who live in Musanze District, Ruhengeri Referral Hospital serves a population estimated to 386,078 people from surrounding districts.

The hospital is open all hours (24/7) and serves patients of all categories; Out Patients Department, Internal Medicine, Surgery, Gynaecology and Obstetrics, Accident and Emergency, Paediatrics, Anaesthesiology and Critical Care Medicine, Mental Health, Pathology Services and other Allied Services.

Study Design

The study was a cross-sectional analysis of data collected from pregnant women at Ruhengeri Referral Hospital.

The study population consisted of voluntary participants who attended the Hospital during the study period precisely from September to October 2018. Demographics namely; age, blood pressure, and uric acid levels were recorded for all participants.

Population and Sample Size Estimation

The population of this study was defined by participants' pregnancy and their attendance at Ruhengeri Referral Hospital. Simple random estimation was used to choose the sample size for this study.

Inclusion Criteria

Pregnant women who attended Ruhengeri Referral Hospital for the period of the study were requested to participate in the study. Pregnant women who voluntarily consented to participate were included in the study. For any reason in their judgments, recruited participants were free to withdraw from the study at any time.

Exclusion Criteria

Hospital clients other than being women and pregnant were excluded from the study. Pregnant women who refused the voluntary participation were not included. Not accepting measurements designed for this study; either blood pressure or serum uric acid or/and both led to exclusion from the study.

Ethical Consideration

Approvals were granted by both Ruhengeri Institute of Higher Education (INES Ruhengeri) and Ruhengeri Referral Hospital Ethics committees. Data for this study was collected anonymously. Confidentiality was maintained at all levels of the study. Participants were informed that their participation in the study was voluntary and that they were free to withdraw from the study at any time for any reason. The consenting during recruitment was made verbally.

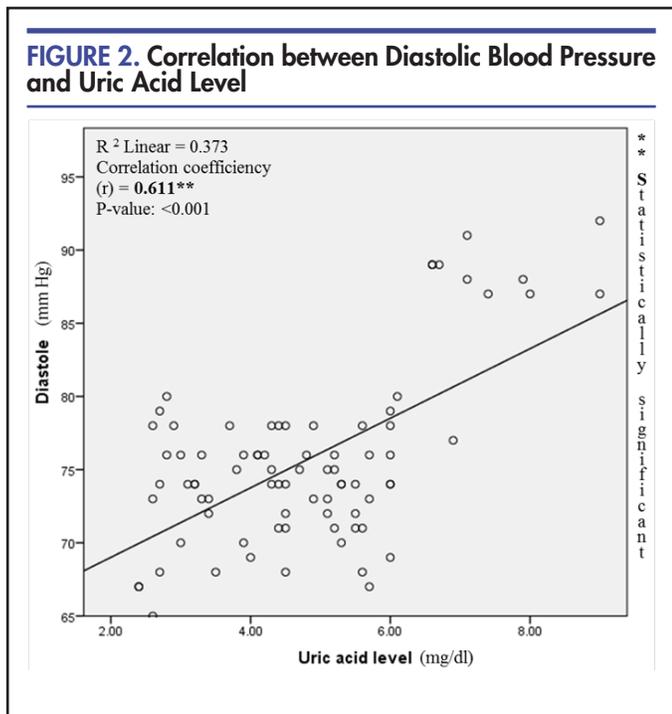
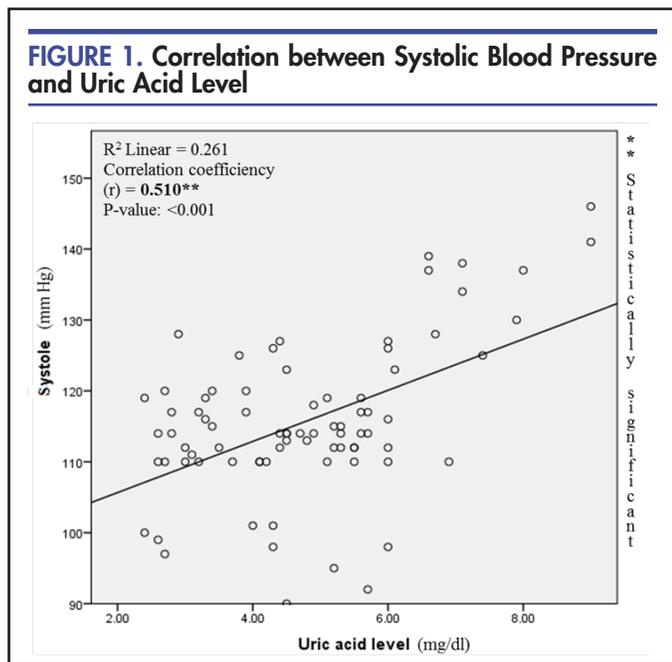
Demographics and Gestation Trimesters Data

Demographics data was collected for all recruited participants. Oral interviews were conducted to collect demographics, like age. Only females were interviewed in this study. Data for gestation trimester was collected from the participant's medical file. It was counted in weeks of gestation from week one (1) to the end of the pregnancy, usually week forty (40). It was recorded as trimester 1, 2 or 3. The first, second, and third trimester consisted of participants with pregnancy period ranging between week one (1) to week twelve (12), week thirteen (13) to week twenty-six (26), and week twenty-seven (27) to week forty (40) respectively.

Blood Pressure Testing

Blood Pressure (BP) measurements were collected from each study participant. A digital sphygmomanometer with adults cuff sizes was used in blood pressure testing. The participants were asked to seat in a chair with their feet flat on the floor and relax for 5 minutes. The arm was rested on the table at the level of the heart. The blood pressure cuff was wrapped around the top of the arm with the bottom of the cuff above the elbow. The device was switched on and automatically provided the result in approximately one minute. Results were recorded to the

data collection form in mmHg.



Uric Acid Levels Quantification

Serum uric acid levels were quantified in the present study. Venous blood samples were collected in 4ml red top tubes with clot activators for all participants by following routine venepuncture standard procedures. Collected samples were transported to the clinical chemistry laboratory unit. Bench top laboratory centrifuge was use-

d to separate blood serum from cells. Blood serum was quantified for uric acid levels by using a semi-automated chemistry analyser Humastar 80, strictly following the test operating procedure and instruments operation manual. Results for uric acid levels were read in mg/dL, and printed from the instrument-controlling computer. Results were validated and recorded to the data collection form.

Data Analysis

Collected data was cleaned and analysed using the Statistical Package for Social Sciences (SPSS) version 23.0. Figures and tables were used in presenting the analysed data. Demographic data available in this study was analysed and presented. Descriptive analysis was performed for blood pressures and uric acid levels. Results for both variables were compared with reference ranges. Hypertension and hyperuricemia was categorised for blood pressures and uric acid levels, respectively. Bivariate statistics was used to determine the relationship between hypertension and elevated levels of uric acid among participants. The association of variables was considered to be statistically significant at 95% confidence interval (CI) with the $P < .05$.

TABLE 1: Clinical Characteristics of Participants

Characteristics	Count	Percentage
Pregnancy trimester		
1	47	58.75
2	17	21.25
3	16	20.0
Mean ± SD		
Uric acid (mg/dL)	4.78 ± 1.54	
Diastole (mmHg)	76 ± 6	
Systole (mmHg)	116 ± 11	

RESULTS

Demographics and Gestation Trimesters

A total of 80 participants were recruited and included in the study (Table 1). Demographically, all participants were female with varying ages. 4 classes were made, precisely; [19-23], [23-27], [27-31], and [31-40] years, and were represented by 17.50, 26.25, 27.50, and 28.75%, respectively. The median was 27 and interquartile was 23-31. The age varied in a range of 20 years from 19 to 39 years old. From week 1 to the 12th week of gestation, this period is considered the first trimester, 47 (58.75%) participants were recorded in this trimester. Gestation week 13 to week 26 is the second trimester, 17 (21.25%) participants were recorded. The third trimester was represented by 16 (20.00%) participants with weeks of gestation 27 to 40 or above. The peak number of participants was recorded in the first trimester. The 2nd and the 3rd trimesters of gestation almost had equally distributed participants.

Blood Pressure among Study Participants

72.5% of participants in this study had normal BP results. Hypertension was found in 11.3% of participants.

TABLE 2: Comparison of Uric Acid Levels between Hypertensive and Non-Hypertensive Participants

Variable	Mean	SD	F	P-value
Hypertension				
Hypertensive group	7.12	1.86	16.157*	<.001
Non-hypertensive group	4.49	1.22		
Systolic blood pressure				
Hypertensive group	135.44	8.2	4.965*	<.001
Non-hypertensive group	113.62	9.2		
Diastolic blood pressure				
Hypertensive group	87.89	3.41	1.852*	.027
Non-hypertensive group	74.07	4.17		

* Significant (P-value less than .05)

(7.5% stage 1, 3.8% stage 2). No participant was found with low blood pressure. However, elevated blood pressure was observed in 16.2% of the study participants.

Uric Acid Levels among Study Participants

According to trimesters of gestation, uric acid levels noted were 4.84, 5.03, and 4.36 for trimester 1, 2, and 3 respectively. The prevalence of 15% was observed in participants with hyperuricemia. One third of the participants were above 30 years. In the age groups of (23-27) and (27-31) years, the prevalence of hyperuricemia was a bit low at 14.3 and 13.6%, respectively. In addition, also among the women aged below 23, the rate of hyperuricemia was a bit low.

Comparison of Serum Uric Acid Levels among Participants with or without Hypertension

In Table 2, the participating women with hypertension stage 1 and stage 2 were introduced in the hypertensive group. Normotensive and participants with only high blood pressure which had not yet developed into hypertension (specifically blood pressure of 129/80 mm Hg), were introduced in the non-hypertensive group. The mean of uric acid level reading among pregnant women with hypertension and those without hypertension was significant.

Association between Uric Acid Levels and the Severity of Hypertension among Study Participants

The study assessed the relationship between uric acid level and the severity of hypertension. Based on a bivariate correlation and on a scatter plot, the correlation between uric acid level and systolic blood pressure (Figure 1) as well as uric acid level and diastolic blood pressure (Figure 2) were determined. A strong correlation was observed between blood pressures and serum uric acid levels.

DISCUSSION

The uric acid levels among pregnant women with hypertension were evaluated in this study. Increase in uric acid level was observed in the 2nd trimester. The mean of uric acid levels noticed in general participants was equivalent to the mean observed among the non-Pregnancy Induced Hypertension (PIH) group in a study carried out in New-Delhi.¹⁸ On the other hand, like observed in this study, several studies have also showed that pregnant women who attend antenatal care arrive in the 1st and the last trimester, although in this study, the number was low in the third trimester.^{11, 19, 20}

Blood Pressure is very useful in screening and diagnosing hypertension.²¹ The total prevalence rate of hypertension was 11.3% among pregnant women in this study. Leodgard found in his study a moderate prevalence rate.¹¹ The prevalence observed for hypertension stage 1 (blood pressure ranging from 130 to 139 mm Hg and 80 to 89 mm Hg systolic and diastolic, respectively) and stage 2 (systolic blood pressure of 140 mm Hg or higher and diastolic blood pressure of 90 mm Hg or higher) in this study was low compared to the findings by Adu-Bonsaffoet al.²² whose study recorded 21.4% rate of PIH among pregnant women in Ghana and Muti et al.²³ who found a 19.4% rate of PIH in Zimbabwe. This study found a high rate of hypertension in comparison to many studies which were reviewed.^{1, 23, 24, 25, 26}

Depending on the uricosuric of oestrogen and due to the increased glomerular filtration rate, uric acid levels fall among more than 25% of pregnant women.²⁷

In this study, 15% prevalence of hyperuricemia was recorded among participants. In contrast to the findings of this study, hyperuricemia was found to be high (5.3%) in a study conducted in the same study clinic located in the same area in Rwanda¹¹ and in another study conducted by Ali et al.²⁸ in Bangladesh. The prevalence observed among Nigerian pregnant women was also more than twice the findings of the current study.²⁹ In concordance to the study by Fawzy et al.,²⁷ approximately the same prevalence among Ethiopian pregnant women was recorded. This highlight the need for assessing the demographic factors contributing to differences discussed above.

Due to its impact in predicting preeclampsia, uric acid level examination is a useful biochemical test most often performed during pregnancy.³⁰ Serum uric acid levels were compared among pregnant women with and those without hypertension. The increased mean of uric acid in the hypertensive participants is in concordance to the findings observed by Khurshid et al.³¹ who observed it to be 7.29±1.24 in the preeclamptic group compared to 4.39±0.72 mg/dl in the normal pregnancy group in a study conducted in Pakistan. The study conducted in India observed 7.63±0.59 vs 4.94±0.83 mg/dl in PIH and non-PIH women respectively.¹⁸ Additionally, the observed significant difference between the 2 groups was also observed among pregnant women in a study conducted in Nepal.¹⁴ Besides, in contrast to the findings of this study, although there was also an increase of uric acid among Japanese pregnant women attending Antenatal at the National Kyushu medical centre, the observed mean uric acid level among PIH group (3.5±0.9 mg/dl) -

was low. Not only uric acid in the PIH group was considered to be low, also among non-PIH group, their uric acid level was low 2.9 ± 0.8 mg/dl.¹⁹ This suggests that there could be a significant effect of demographic area towards uric acid levels.

The association between uric acid levels and the severity of hypertension among pregnant women was studied and was observed. The findings of this study agree with the correlation of uric acid and SBP as well as DBP observed in Chinese healthy groups.³² This may confirm the high prevalence of hyperuricemia related hypertension observed by Lédgard¹¹ who conducted the study in pregnant women in the Northern Province of Rwanda. This highlights the need for routine examination/ analysis of uric acid levels among pregnant women to assess the burden of hypertension which is very high.

CONCLUSION

The current study evaluated the association between hypertension and hyperuricemia among pregnant women. Stage 1 and 2 hypertensions were found to be high among participants. Hyperuricemia was also found to be high. The association of hypertension and hyperuricemia with a strong correlation was observed between blood pressures and serum uric acid levels. In addition, there was a significant difference between uric acid levels and blood pressure among the hypertensive and the non-hypertensive groups. The routine testing of uric acid levels among pregnant women, regardless their trimester of pregnancy is recommended in order to predict hypertension early. More related studies should be conducted in all hospitals in Rwanda to generate more data that can be used by policy makers and researchers.

Limitations of this study

The study used biochemistry standard method to measure serum uric acid levels and standard methods of blood pressure testing, thus results are valid.

-Participants in this study were from a single hospital in one district among 42 hospitals found in 30 districts in Rwanda, excluding national referrals; therefore the prevalence estimates and outcomes are not of nationwide applicability.

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Using the Health Belief Model to Explain the Patient's Compliance to Anti-hypertensive Treatment in Three District Hospitals - Dar Es Salaam, Tanzania: A Cross Section Study

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ABSTRACT

Background: Hypertension remains a public-health challenge globally. Its prevention, early detection, proper and adequate treatment and control should be given high consideration to prevent occurrence of cardiovascular disease and stroke. This study is guided by the Health Belief Model (HBM) to investigate the influence of treatment compliance using HBM constructs among elderly hypertensive patients in 3 regional hospitals in Dar es Salaam, Tanzania.

Methods: An analytical cross-sectional study was conducted in 3 region hospitals in Dar es Salaam from April to May 2012. The study included patients who were on antihypertensive medications. Simple Random Sampling was used to enrol the study participants. Data was collected using structured questionnaire. Data was analysed using SPSS version 20. Linear Multiple Regression analysis was performed to identify variables which are strongest predictor of treatment compliance among variables of the Health belief Model.

Results: A total of 135 participants were enrolled of whom 56% were compliant to hypertensive treatment. Multivariate analysis indicated significant model fit for the data ($F=11.19$ and $P\text{ value} < .001$). The amount of variance in treatment compliance that was explained by the predictors was 30.3% ($R^2=0.303$) with perceived barrier being the strongest predictor of treatment compliance ($\beta=-0.477$; $p < .001$). Other predictor variables were not statistically associated with treatment compliance.

Conclusion: The study showed that 56% of study participants had hypertensive treatment compliance and perceived barrier to treatment was the strongest predictor. Innovative strategy on improving patients' perception of barrier to treatment is recommended in order to improve treatment compliance.

BACKGROUND

Hypertension remains a public-health challenge globally. It is the main modifiable independent risk factor for development of cardiovascular disease, stroke and renal failure which increase significantly with age¹. Prevention, early detection, proper and adequate treatment and control should be given high consideration to prevent occurrence of cardiovascular disease and stroke.² Control and prevention of hypertension complications can only happen when individuals recognise the benefits of changing lifestyle behaviour and believe that they are susceptible to hypertension complications.³

Health Belief Model (HBM) has been used to explain and predict individuals health behaviours for preventing and/or controlling diseases and their complications by including perception of susceptibility, seriousness, severity, benefits and barriers to a health behaviour and cues to action.³ The global burden of hypertension projects indicate that the number of adults with hypertension will increase by 60% to a total of 1.56 billion in 2025.⁴ For Sub-Saharan Africa,

the prevalence of hypertension has been projected to be 125.5 million among adults in 2025.⁵

In Tanzania, hypertension related diseases are the second cause of hospital admission and cause of deaths.⁶

Tanzania particularly in the cities like Dar es Salaam, people are experiencing urbanisation and modernisation. This has brought about changes in their lifestyle especially their diet intake and physical activity. This has led to overweight, obesity and physical inactivity which altogether increase the risk for hypertension and cardiovascular diseases.^{7,8}

Management of hypertension requires medication and lifestyle compliance. The lifestyle modification includes; increase in exercise, lowering of body mass index, reduced-sodium diet, moderation of alcohol consumption and quitting smoking.⁹ These lifestyle modifications and taking medication properly are examples of therapeutic behaviours.⁹ The treatment guideline of hypertension in Tanzania are either non-pharmacological or pharmacological treatment. Non-pharmacological treatment calls for life style modifi-

ation which includes weight reduction, adopting dietary approaches to stop hypertension (DASH) such as eating diet rich in fibre-fruits, vegetable, unrefined carbohydrate and low-fat dairy products with reduced content of saturated and total fat. Also, reduction in dietary sodium intake, involvement in regular physical activity such as a brisk walking for at least 30 min/day 3 days a week, stop the use of all tobacco products and reducing alcohol consumption.¹⁰ Pharmacological treatment includes combination of drugs including diuretics, Angiotensin-Converting Enzyme Inhibitor (ACEI), Angiotensin Receptor Blocker-ARB, Beta-blocker and Calcium Channel Blocker.¹⁰

Uncontrolled hypertension is caused mainly by non-adherence to the antihypertensive drugs¹¹ and lifestyle.¹² Understanding drug regimens by the patients helps to improve their adherence, and thus preventing the complications related to hypertension which are debilitating and if not prevented may increase the burden of cardiovascular diseases.¹² Adhering to antihypertensive drugs remains to be an important modifiable factor towards management of hypertension. Non adherence to antihypertensive agents seriously affect the effectiveness of treatment and thus causing an increase in cardiovascular and cerebrovascular risks and consequently causing population health problems in the quality of life as well as health economics. Non-adherence to pharmaceutical therapy is a major problem all over the world. Studies on drug adherence to chronic diseases such as hypertension show that adherence is about 67.2%.¹¹

According to Rosenstock et al, the HBM constructs reported were perceived susceptibility, perceived severity, perceived barriers, perceived benefits and cues to action hypothesises that health-related action depends upon an individual’s motivation, belief of being vulnerable to a disease and one’s belief to certain health recommendations that is important in befitting health and reduce disease complications.¹⁵ (Figure 1).

Little is documented on the influence of health belief model variable on compliance to hypertensive treatments. Therefore, this study aimed at assessing the influence of Health Belief Model variable on hypertensive treatment compliance among hypertension patients in 3 region Hospitals in Dar es Salaam, Tanzania.

METHODS

Study Design and Setting

We conducted an analytical cross-sectional study design from April to May 2012 using quantitative approach. The study included data from 3 regional hospitals in Dar es Salaam; Amana, Mwananyamala and Temeke hospitals which are located in Ilala, Kinondoni and Temeke Municipalities respectively. The estimated population in these municipalities is 1,220,611, 1,775,049 and 1,368,881 people for Ilala, Kinondoni and Temeke Municipalities respectively.¹⁶ The study sites were selected because majority of hypertensive patients who are diagnosed from primary health facilities are referred to those hospitals for expert management.

Study Population

The study population included patients with hypertension who were using antihypertensive treatment and were attending hypertension clinics from the selected hospitals. Each Hospital has 2 days per week of clinic for non-communicable diseases including hypertension. All 3 hospitals have inpatient and outpatient services.

Sample Size and Sampling Procedure
Sample Size

Sample size of 135 participants was calculated using kish and Leslie formula (1965).

$$n = \frac{Z^2 p(1-p)}{e^2}$$

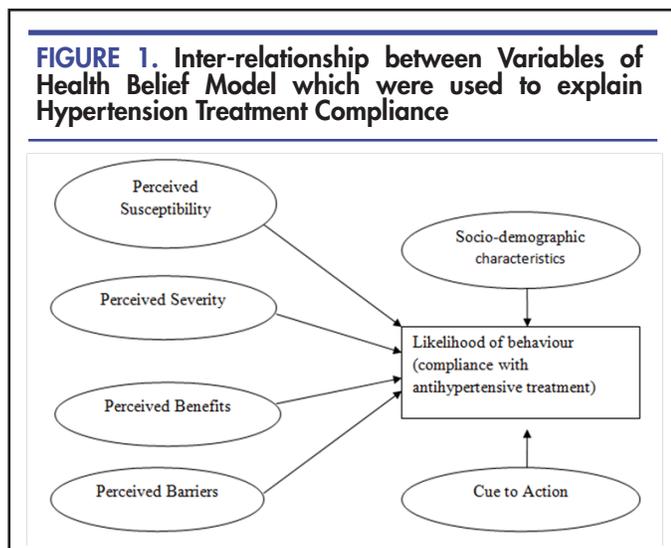
The prevalence used was 34% compliance in Temeke-Dar es Salaam.¹⁷

- Where: n = the required minimum sample size
- ε = margin of error (5%)
- p = estimated proportion of compliance 34%
- z = standard normal deviate corresponding to 95% confidence level=1.96

Considering a margin error of 5% and a 95% confidence level, the minimum required sample size obtained was 135.

Sampling Procedure

The 3 regional hospitals were selected purposively because most of the patient who have hypertension and hypertensive complications are referred to these hospitals from the Primary Health Facilities. We reviewed the records of hypertensive patients attending in each of the 3



HBM is an approach that is used to describe social behaviour as well as individual’s cognition. It was introduced in the 1950s by Social psychologists so as to facilitate in reasoning individual’s participation in health programs such as health check-ups and immunisation.¹⁴ The HBM was also widely used to explain a range of health behaviour. The model also base on studying compliances with lifestyle modification and antihypertensive medication, including understanding that high blood pressure involves both drug treatment and lifestyle changes.

hospitals for the period of 1 month. We found that 366, 583 and 340 patients attended Amana hospital, Mwanayamala hospital, and Temeka hospital respectively. The 135-sample size calculated was proportionally allocated to 3 hospitals based on the above records. Thus, 39 participants were selected from Amana, 60 from Mwanayamala and 36 from Temeka hospital. Simple random sampling was used to select the study participants. The researcher established a sampling list from patients attending hypertensive clinics to the respective study hospitals to obtain eligible participants that meet the inclusion criteria. There were pieces of paper that were written on; YES or NO. The word "YES" was used to represent the targeted study population, and "NO" was used to represent the population that was not going to participate in the study. The procedure of drawing papers from the box by each study participant was used. Once a piece of paper was picked, it was not included in the sample again and each participant was allowed to pick only once.

The Inclusion Criteria and Exclusion Criteria

All patients aged 18 years and above with a diagnosis of hypertension for at least one month with or without other co-existing medical conditions and consented to participate in the study. Participants who had been taking antihypertensive treatment for at least one month before the beginning of the study were included. All patients who had not started antihypertensive treatment and could not respond because of reasons such as being too sick to be interviewed were excluded from the study.

Measures of Outcome

The outcome variable was treatment compliance which comprised of medication regimen compliance and lifestyle modification. Medication regimen compliance was composed of 8 items, asking "how often you forget to take your medicine". The responses were measured on a 4-point Likert scale: "1" Every day, "2" frequently, "3" rarely or "4" never. For life style, compliance was having 5 items, participants were asked to respond to the single question based on a 4-point Likert scale: "How often do desirable or undesirable behaviours related to control of hypertension". The responses were: "1" Every day, "2" frequently, "3" rarely or "4" never. Some questions were set such that the highest score did not reflect the worst scenario of non-compliance. To resolve these, scores were reversed. For example, how often do you engage in physical exercise "4", every day, "3" frequently, "2" rarely or "1" never. The 13 items measuring treatment compliance and life style compliance were added up to get sum index with a distribution ranging from 33 to 52 with mean 44.2963 (SD =3.32578), the median split was used (44.4), which was dichotomised into two groups i.e. 0 = those who are non-treatment compliant and 1 = treatment compliant which was 34-43 and 44-51.

The HBM constructs included perceived severity of having hypertension, perceived susceptibility of being at risk of hypertension complications and perceived benefit were each was measured by 6 items. The reminders (cues to action) were measured by 7 items. Participants were then asked to respond: "1" strongly agree, "2" agree, "3" disagree or "4" strongly disagree.

6 items measuring perceived severity were added up to get

sum index with a distribution ranging from 7 to 24 with mean 20.10 (SD =2.85). The median split 50.4 was used as a cut-off point. Dichotomisation was done into 2 frequency groups; those who had low perceived severity and those who had high perceived severity. 6 items measuring perceived susceptibility were added up to get sum index ranging from 6 to 19 with mean of 10.79 (SD =2.83). The median split was 49.6. The sum index for perceived susceptibility was dichotomised into 1= those with low perceived susceptibility and 2= those with high perceived susceptibility.

6 items measuring perceived benefit were added up to get sum index with a distribution ranging from 12 to 24 with mean (SD) 20.24(2.87) and median split 51.1. Then dichotomised into; those with low perceived benefit and those with high perceived benefit. 7 items measuring cues to action were added up to get sum index with a distribution ranging from 15 to 28 with mean (SD) 24.27(2.65) median split 42.2, then dichotomised into 2 frequency groups; those with low perceived cues to action and those with high cues to action.

5 items measuring perceived barriers were added up to get sum index with a distribution ranging from 5 to 15 with mean (SD) 8.36 (2.48), median split 54.8, then dichotomised into; those with low perceived barrier and those with high perceived barrier. The aspects that might hinder respondents to comply with their treatment included not having enough time to do exercise. Responses were "1" strongly not a problem, "2" not a problem, "3" problem and "4" strongly a problem.

Bivariate analysis using Chi-square and Pearson correlation between HBM variables were performed. Multiple linear regression analysis was performed with treatment compliance as the outcome variable (behaviour) and the rest of HBM variables as predictors of the behaviour.

Data Analysis

Data was analysed using SPSS software programme 17.0 version. The chi-square test was used to compare proportions. Multivariate analysis was performed using Linear Multiple Regression to obtain strongest predictor variable between variables of HBM. A p-value less than 0.05 was considered statistically significant.

Ethical Approval

Muhimbili University of Health and Allied Sciences (MUHAS) approved the study (Ref. NO. MU/PGS/SAEC/Vol. VI). All participants gave their written consent to participate and were informed that they could terminate their participation at any time without incurring any cost.

RESULTS

A total of 135 participants were included in the study. The mean age of participants was 56.3, ±13.1 years. Most of the participants 76 (56.3%) were females aged between 33 to 84 years. Majority of participants 82 (60.7%) were married. With respect to education level, most of the participants 74 (54.8%) had primary education. Regarding occupation, most of the participants 75 (55.6%) were unemployed (Table 1).

Factors Associated with Treatment Compliance

The association between socio-demographic factors and -

treatment compliance was explored. Treatment compliance was significantly associated with sex. Female participants had higher proportion of treatment compliance (63%) than males (46%) ($P=.044$). Participants with less than 64 years of age 50 (56.8%) had higher proportion of treatment compliance than participants with 65 and above years (53.2%) $p=.686$. Participants with secondary education had 10 (62.5) compliance compared to those with informal education 25 (55.6%). However, the difference was not statistically significant (Table 2).

Association of Health Belief Model Variables with Treatment Compliance

Participants with high perceived severity were more compliant 39(57.4%) to hypertension treatment compared to those with low perceived severity who had only 36(53.7%) complaint to hypertensive treatment. However, the difference was not significant ($p=.672$). Those with high perceived susceptibility to hypertension complications were more compliant 45(66.2%) to hypertensive treatment compared to those with low perceived susceptibility, who had complaint of 30(57.4%) only and the difference was significant ($p=.012$). Participants with high perceived benefit of using antihypertensive treatment were more complaint 44(66.7%) to hypertensive treatment compared to those with low perceived benefit 31(44.9%) and the difference was significant ($p=.011$). Regarding perceived barrier, those with low perceived barrier were more complaint 57(77%) to treatment compared to those with high perceived barrier to hypertensive treatment (18(29.5), the difference was significant ($p=.000$). Regarding cues to action, those who had high reminders were more complaint 52(66.7%) to treatment compared to those with low reminders of using hypertensive treatment 23(40.4%) and difference was significant ($p=.002$) (Table 3).

Health Belief Model Factors Predicting Treatment Compliance

Treatment compliance showed significant positive association with perceived benefit ($r=0.27$; $P=.001$) which means the higher the perceived benefit of using medicine the higher the treatment compliance. Treatment compliance showed significant negative association with perceived barrier to treatment ($r=-0.53$; $P=.000$), indicating that the higher the perceived barrier the lower the compliance. Treatment compliance showed positive association with cues to action ($r=0.19$; $P=.022$) which means that when people receive more reminders of the importance of adhering with treatment, they become more compliant.

Perceived severity of hypertension showed significant positive association with perceived susceptibility of getting hypertension complications ($r=0.29$; $p=.001$) indicating that the higher the perceived severity of hypertension disease the higher the perception of being vulnerable to hypertension complications. Perceived severity showed positive significant association with cues to action ($r=0.2$; $p=.019$) indicating that the higher the perception of severity of hypertension the higher the following of the cues to action (reminders). Perceived benefit of using medication showed significant negative association with perceived barrier ($r=-0.45$; $p=.000$), this meant that the higher the perception of benefit the lower the perception of barriers.

Also perceived benefit of using medication showed positive association with cues to action ($r=0.32$; $p=.000$), meaning that the higher the perception of benefit the higher the perception of following reminders (Table 4).

Health Belief Model Factors Associated with Treatment Compliance

Multivariate analysis indicated significant model fit for the data ($F=11.19$ and $P\text{ value}=.000$). The amount of variance in treatment compliance that was explained by the predictors was 30.3% ($R^2=0.303$) with perceived barrier being the strongest predictor of treatment compliance ($\beta=-0.477$; $P=.000$). A negative Beta Coefficient indicates a negative association between perceived barriers and treatment compliance. Other predictor variables were not statistically associated with treatment compliance (Table 5).

DISCUSSION

This study explored factors affecting treatment compliance among hypertensive patients who were attending hypertension clinics in Dar es Salaam. This study was guided by Health Belief Model. The key findings in this study include positive association between age, sex, level of education, marital status and treatment compliance. We also found that the significant predictors of using HBM constructs were perceived susceptibility of being at risk of getting hypertension complications, perceived benefit of using medicine, perceived barrier to treatment and cues to action. After control of all factor variables among the construct of the HMB, the strongest predictor was perceived barrier.

The study revealed the percentage of treatment compliance to be 55.6% among study participants. Similarly, Imad et al reported that 55.9% of hypertension patients had good adherence to antihypertensive medication.¹⁸ The compliance rate of 55.6% in the present study was low compared to the findings in the study conducted by Okello et al in Uganda and Adidja et al in Cameroon in which the compliance rate was 85% and 67.7%, respectively.^{19,20}

Our findings showed that compliance to antihypertensive was higher than that of the study conducted by Pallangyo et al in tertiary hospitals in Tanzania which reported that 25.3% were compliant to their hypertensive treatment.²¹ Study conducted by Bovet et al in Tembeke Dar es Salaam, reported low (34%) adherence of patients to antihypertensive treatment.¹⁷ Similar to a study by Goweda and Shatla.²² The possible reason for the discrepancy observed in treatment compliance could be explained by the nature and type of hospitals included in our study. Our study considered hypertensive patients with no other complications while the study conducted by Pallangyo et al involved admitted patients with heart failure as a complication of uncontrolled hypertension.²¹

The current study shows that; participants who were 64 and below years of age had higher level of treatment compliance compared to those with 65 and above. The results are comparable to those reported in the study conducted by Demoner et al in the city of Maringá and Choi et al in Korea which reported that young age group showed association with treatment compliance and older

TABLE 1: Socio-Demographic Characteristics of Respondents N=135

Characteristics	Frequency (n)	Percentage (%)
Age (years)		
≤ 64	88	65.2
≥ 65	47	34.8
Sex		
Male	59	43.7
Female	79	56.3
Marital status		
Married	82	60.7
Separate	25	18.5
Widower	28	20.7
Level of education		
informal education	45	33.3
Primary education	74	54.8
Secondary education	16	11.9
Occupation		
Employed	60	44.4
Unemployed	75	55.6

TABLE 2: Relationship between Social Demographic Characteristics and Treatment Compliance

Characteristics	Treatment Compliance		<i>P-value</i>
	Non-compliance No (%)	Compliance n=60 n=75 No (%)	
Age			
≤ 64	38 (43.2)	50 (56.8)	.686
≥ 65	22 (46.8)	25 (53.2)	
Sex			
Male	32 (54.2)	27 (45.8)	.044
Female	28 (36.8)	48 (63.2)	
Marital status			
Married	32 (39.0)	50 (61.0)	.287
Separate	13 (52.0)	12 (48.0)	
Widower	15 (53.6)	13 (46.4)	
Education level			
Informal education	20 (44.4)	25 (55.6)	.277
Primary education	30 (40.5)	44 (59.5)	
Secondary education	6 (37.5)	10 (62.5)	
Occupation			
Employed	27 (44.0)	33 (56.0)	.908
Unemployed	33 (45.0)	42 (55.0)	

patients showed poor adherence to antihypertensive treatment.^{23,24} The possible explanation of these results may be that young people have higher income since they are able to work and thus can afford to buy medications when compared to older people. Another possible reason is that older people are more likely to have more than one disease due to aging which may have exposed them to using multiple drugs and in turn they become

frustrated and, hence, stop taking drugs.²⁵ Also cognitive and functional impairment in elderly patients increase their risk of poor drug compliance, thus they may require to have someone to remind, support and assist them in taking their drugs.²⁶

Our study results revealed that female patients were more compliant to antihypertensive medication (63.2%)

TABLE 3: Association of Health Belief Model Constructs with Treatment Compliance

HBM variables	Treatment compliance		P- value
	Non-compliant n= 60 n (%)	Compliant n =75 n (%)	
Perceived Severity			
Low	29 (42.6)	39 (57.4)	.672
High	31 (46.3)	36 (53.7)	
Perceived Susceptibility			
Low	37 (55.2)	30 (44.8)	.012
High	23 (33.8)	45 (66.2)	
Perceived Benefit			
Low	38 (55.1)	31 (44.9)	.011
High	22 (33.3)	44 (66.7)	
Perceived Barrier			
Low	17 (23.0)	57 (77.0)	.000
High	43 (70.5)	18 (29.5)	
Cues to action			
Low	34 (59.6)	23 (40.4)	.002
High	26 (23.3)	52 (66.7)	

TABLE 4: Correlation of Health Belief Model Variables with Treatment Compliance

Variables	1	2	3	4	5	6
1. Treatment compliance	-	0.104	0.141	0.274**	-0.528**	0.197*
2. Perceived severity		-	0.285**	0.090	-0.090	0.202*
3. Perceived susceptibility			-	-0.062	-0.061	-0.180*
4. Perceived benefit				-	-0.449**	0.323**
5. Perceived barrier					-	0.323**
6. Cues to action						-

*p < 0.05, **- p < 0.001

TABLE 5: Health Belief Model Factors Predicting Treatment Compliance

HBM variables	Beta	P- value
Perceived severity	0.092	.238
Perceived susceptibility	0.147	.062
Perceived Benefit	0.050	.557
Perceived barriers	0.477	.000
Cues to action	0.035	.671

R² = 0.303; F = 11.19 (P = .000)
Behaviour = Compliance to treatment.

compared to male patients ($P=0.044$). Female patients have been reported to be better at adhering to antihypertensive treatment as compared to male patients.^{27,28}

Impotence is the likelihood side effect which affects

men's compliance with antihypertensive medications. This could be the reason why males showed low level of treatment compliance compared to females.^{28,29} The findings from the current study revealed that patients wi-

th secondary level of education had a higher level of treatment compliance to antihypertensive medications as compared to those with informal education (62.5 vs 37.5%). However, the difference was not significant. The probable reason could be that patients with high education level are likely to be more complaint to antihypertensive medications, due to the fact that having high education level make an individual to think critically about hypertension complications and also to have informed decision making about use of antihypertensive medications.³⁰ This is similar to the study done by Saruna et al who reported that the level of education was significantly associated with treatment compliance.³⁰ The same was reported by Yan et al in the study conducted in China.²⁸ Also, Goweda and Shatla reported that patients with high level of education might be adherent to antihypertensive medication and life style modification since they understand the adverse effect of not being complaint to medication.²²

The association between marital status and treatment compliance was revealed, in the current study, married participants were more compliant to medications (61%) when compared to single participants. Abbas et al also found that divorce was associated with poor adherence to antihypertensive medication (OR=2.14, 95% CI=1.31–5.48).³¹ Marriage might have a positive effect on compliance to medications. Partners might help each other in reminding each other the time for taking medications and also give moral support on the importance of treatment.

Perceived barrier was an important predictor in non-compliance to antihypertensive drugs and physical exercises.

This finding agreed with the study conducted by Yang et al in rural area of China which reported that adherence to antihypertensive medications is higher with less perceived barriers³² a scale based on the HBM, and the four-item Morisky Medication Adherence Scale. Results 745 hypertensive patients participated in the study (345 men, 400 women). The perceived barrier to antihypertensive medication was also reported by Obirikorang et al in the study conducted in Ghana.³³ This is true according to the Health Belief Model: when a person perceives there is an obstacle of taking medication, he will not comply to his medication and exercise as supposed to and this will lead to complications and/or death.

Barriers of not complying with antihypertensive medication were determined. The reasons were; stopping medication due to cost of the medications^{20,34}, fear of the side effect^{35,36}, feeling well (asymptomatic)³⁷, avoiding addiction to drugs^{38,39} and use of traditional medicine.²⁸

CONCLUSION

This study reported compliance to antihypertensive treatment of (55.6%) among study participants. Perceived barrier to treatment of hypertension was the strongest predictor among the constructs of HBM. Patients need advice, support and information from health professionals in order to understand the importance of using drugs as prescribed.

It is recommended that health care providers should be aware that hypertensive patients need to be educated on

how to manage the disease and also be reminded continuously for better control of hypertension and improving the quality of their lives. This education and reminders should focus on the importance of complying to antihypertensive medications, physical exercises, diet and salt intake restriction. However, the HBM variables do not provide for advising patients the importance of treatment adherence, thus there is a need to use more than one theoretical model to provide adherence to antihypertensive advice to patients. Further studies should be conducted to assess why people have perceived barriers to treatment compliance.

Limitation of the study

This study was conducted in Tanzania government regional hospitals in 3 Municipals of the Dar es Salaam region only. A cross sectional study design was used. Therefore, results cannot be generalised to all hypertension patients in Dar es Salaam because of the nature of the study design. Self-reporting of treatment compliance could introduce recall bias by either over reporting or under reporting depending on the patient's behaviour in the recent past. Based on the reason that this was a cross-sectional study, there is a possibility of recall bias in our study. In the current study HBM, remain descriptive and does not suggest the action for patients to change their behaviour. HBM should be used with other models so that patients can be advised to change their behaviours.

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Predictors of Bacterial Vaginosis among Pregnant Women Attending Antenatal Clinic at Tertiary Care Hospital in Tanzania: A Cross Sectional Study

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ABSTRACT

Background: Bacterial vaginosis (BV) is one of the most common genital tract infections in pregnancy associated with an increased risk of pregnancy losses, maternal and perinatal morbidity and mortality. Different social behavioural and obstetric factors can contribute to the development of BV. Determining the predictors of BV could be the best way of identifying women at high risk of developing the disease.

Methods: This was a cross-sectional study conducted between December 2017 and February 2018 to determine the prevalence and predictors of BV among pregnant women attending antenatal Clinic (ANC) at Muhimbili National Hospital (MNH), Tanzania. Participants were recruited using systematic random sampling. For each consented participant, a pretested questionnaire was filled, a pelvic examination was done and a sample was collected. BV was diagnosed using Nugent's score. Data was analysed using Statistical Package for Social Scientists (SPSS) version 23.0. Bivariate and multivariate logistic regression analysis was done to determine factors that were independently associated with BV.

Results: 178 (26.7%) pregnant women out of 667 were diagnosed positive for BV. In the bivariate analysis (Table 3), age (COR 1.71; 95% CI, 1.16-2.52), level of education (COR 4.08, 95% CI, 2.84-5.84), gravidity (COR, 1.52, 95% CI; 1.04-2.23), parity (COR 1.69, 95% CI; 1.18-2.42), vaginal douching (COR 2.89, 95% CI; 1.96-4.27), HIV status (COR 9.37, 95%CI; 4.12-21.28), history of STI (COR 2.49 95% CI; 1.46-4.25), LTSP (COR 2.76, 95% CI; 1.68-4.54) and age of first coitus (COR 3.19, 95% CI; 2.24-4.56) were significantly associated with BV. After adjusting for confounders in multivariate analysis, the following risk factors remained significantly associated with BV; age of 21- 29 years (AOR, 2.22, 95%CI; 1.45-3.49), primary education level (AOR 3.97, 95% CI; 2.63-5.98), vaginal douching (AOR 3.68, 95% CI; 2.35-5.76), HIV status (AOR 6.44, 95% CI; 2.62-15.88), STI infection (AOR 2.34, 95% CI; 1.25-4.37), more than one LTSP (AOR 2.69, 95% CI; 1.53-4.74) and age of less than 18 years of first coitus (AOR 2.16, 95% CI; 1.42-3.30).

Conclusion: The prevalence of BV in pregnant women was found to be high. Age of less than 30 years, primary education level and below, vaginal douching, HIV infection, STI, more than one lifetime sexual partners and early age of sexual debut were found to be significant predictors of BV. The high prevalence of BV in our population should necessitate policy makers to include screening and treatment of BV in the future policy of antenatal care package, as BV is associated with significant maternal and neonatal morbidity and mortality. Women should also be educated on harmful effects of certain behavioural practices such as vaginal douching that predispose to BV. In addition symptoms of BV such as abnormal vaginal discharge during pregnancy are inconsistent, under reported and often overlooked. Therefore, a high-risk approach can be used for screening and treatment of asymptomatic women.

BACKGROUND

Bacterial vaginosis (BV) is one of the most common genital tract infections during pregnancy, more so in the African population.¹ It is a syndrome marked by an increased vaginal PH, milky creamy discharge and amine or fishy odour. It is characterised by a shift in the vaginal flora from the dominant lactobacillus species to a mixed vaginal flora. The number of lactobacilli morphotypes is reduced and the number of anaerobic bacterial morphotypes like Gardnerel-

la vaginalis, Prevotella, Mobilincus species, and Mycoplasma hominis is increased.² with an overgrowth of several anaerobic or facultative bacteria and with a reduction or absence of lactobacillus colonisation. The prevalence of BV among pregnant women varies across the globe due to geographical, socio-economical and clinical factors of the population. In high income countries the prevalence of BV among pregnant women ranges from 9.3% to 17%.^{3,4} In Africa, prevalence of as low as 6.4% in Burkina Faso and as high as 38% in Botswana have been reported.^{5,6}

High prevalence has been noted in most Sub-Saharan countries; 38%, 32.5%, 20.6% and 19.4% in Botswana, Zimbabwe, Kenya and Ethiopia respectively.⁶⁻⁹

Several studies showing prevalence in different sub groups have been carried out in Tanzania. A study done in Mwanza 22 years back showed the prevalence of BV to be 24% among pregnant women attending Antenatal Clinic (ANC).¹⁰ Another study of a similar nature done 14 years later at BMC showed an escalating prevalence of 28.5%, however this study only considered women in labour, hence the study cannot be applied to all pregnant women.¹¹ A study done by Aboud et al showed prevalence of BV to be 60.6 % in HIV positive pregnant women.¹²

The magnitude and determinants of BV have been observed to be varying from one place to another due to the differences in geographical, socio-economical and clinical characteristics of the study populations. Several factors have been associated with the causation of BV, these include; age, race, socioeconomic status, smoking, vaginal douching, sexual activity, multiple sexual partners, history of current or past Sexually Transmitted Disease (STI) and Human Immunodeficiency Virus infection (HIV).^{7,9,11-13} About 50% of the women with BV are asymptomatic. If symptomatic, commonly present with a malodorous discharge and usually there are no clinical signs of infection in the vaginal mucosa.²

Several clinical and microscopic scoring systems for the diagnosis of BV have been validated. The most commonly used are the Amsel's criteria and the gold standard laboratory based Nugent Gram staining evaluation.^{14,15} Slides of vaginal smears are Gram stained and the bacterial morphotypes are quantified and scored as follows: Large Gram-positive rods (*Lactobacillus* scored as 0 to 4), small Gram-variable rods (*Gardnerella vaginalis* scored as 0 to 4) and curved Gram-variable rods (*Mobiluncus species* scored as 0 to 2). Bacterial vaginosis is put on a 10-point scale where: 0-3 is regarded as normal (predominantly *Lactobacillus*), 4-6 as intermediate (mixed flora) and 7-10 positive for BV (no *Lactobacillus*).¹⁵

Bacterial vaginosis is associated with adverse maternal and perinatal outcomes such intrauterine infections, chorioamnionitis, postpartum endometritis, spontaneous abortion, Pre-Term labour (PTL), Premature Rupture of Membranes (PROM), low birth weight babies, neonatal sepsis and death.¹⁶⁻¹⁸ Intrauterine infections may occur early in pregnancy or even before pregnancy and remain asymptomatic and undetected for months until PTL or PROM occurs. Preterm labour and delivery are among the most challenging obstetric complications encountered.

Although several studies have been conducted in Tanzania showing prevalence of BV in different sub groups, no recent study has been conducted among pregnant women attending ANC to determine the prevalence and predictors of BV.¹⁰⁻¹² Given the association of BV and poor pregnancy outcome, it called for need of studying and understanding the situation in the local settings.¹⁶⁻¹⁸ Determining the predictors of BV could be the best way of identifying women at high risk of developing the disease, screening them early and managing them appropriately. This could have a substantial impact in preventing adver-

se pregnancy and neonatal outcomes associated with BV which in turn decreases the cost factors, morbidity and mortality rates for both mother and neonate. This study was therefore designed to establish the prevalence of BV and its predictors among pregnant women attending antenatal clinic at Muhimbili National Hospital (MNH).

MATERIALS AND METHODS

Study Setting

The study was conducted at ANC at MNH, Dar es Salaam. MNH is the largest tertiary care hospital in the country and is the teaching hospital for Muhimbili University of Health and Allied Sciences (MUHAS). Maternity block has 4 neonatal wards, the labour ward, maternal high dependency unit and 4 maternity wards which can accommodate 40 antenatal and postnatal women each. MNH offers specialised obstetrics services for Dar es Salaam city and suburban population (4 million people) (National population and housing census, 2012). Maternity unit receives women directly from home as well as those referred from almost all regional and district hospitals in Dar es Salaam. The Antenatal clinic is conducted in the maternity block where services are provided daily from Monday to Friday, thus a total of 5 antenatal clinics are conducted in a week. Each of the 4 firms in the department has a specific day of the week to run the ANC. There are 7 consultation rooms and one examination room. About 100 women (20 public and 80 private) attend the clinic on daily basis. About 75% women attend in view of their current pregnancy while 25% are post-natal follow-ups. Most of these women come for a follow-up visit more than once per month, majority of whom are high risk cases, while a few are new attendees. On average at each clinic, about 20 pregnant women are attending for their first time and these are referred from other public hospital, from home or those who attend as private. Among the usual services provided at the ANC are health education given by nurses and record weight and blood pressure readings at each visit. This is done before the patient enters the doctor's room. Routine screening for syphilis, blood groups, Rhesus factor, and haemoglobin level determination are also provided. Counselling and screening for HIV, as well as drugs for the prevention of maternal to child transmission of HIV are provided.

Study Design

This was an analytical cross-sectional study conducted between December 2017 and February 2018

Study Duration

The study duration was between December 2017 and February 2018.

Study Population

All pregnant women attending ANC at MNH during the study period

Inclusion Criteria

All pregnant women attending ANC clinic at MNH during the study period and women who consented to participate in the study

Exclusion Criteria

Pregnant women with a history of use of antibiotic in the

past 2 weeks, history of ante partum haemorrhage, and PROM.

Sample Size Estimation

The estimated sample size N was calculated using Fleiss formula.¹⁹

$$n = \frac{[Z_{\alpha} \sqrt{(1 + 1/m) \bar{p}(1 - \bar{p})} + Z_{\beta} \sqrt{p_0(1 - p_0)/m + p_1(1 - p_1)}]^2}{(p_0 - p_1)^2}$$

$$\bar{p} = \frac{p_1 + m p_0}{m + 1}$$

$$n_c = \frac{n}{4} \left(1 + \sqrt{1 + \frac{2(m + 1)}{n m |p_0 - p_1|}} \right)^2$$

Where α = alpha, β = 1 - power, n_c is the continuity corrected sample size and Z_p is the standard normal deviate for probability p . n is rounded up to the closest integer. P_0 (55/99 or 55.6%) is the proportion of BV in women who douched 2 or more times, P_1 (82/193 or 42.5%) is the proportion of BV in women who did not douche. Sample size, N was calculated using the study titled “Maternal Stress is Associated with Bacterial Vaginosis in Human Pregnancy” Maternal and Child Health Journal, odds ratio for overall BV was 2.4, 87% power, level of significance 0.05, ratio of sample size was 193/99 or 1.9.²⁰ Therefore, N using Open Epi and Fleiss formula was 603, which becomes 663 after taking care of 10% of non-respondents.

Sampling Technique

Recruitment of participants was conducted exclusively during clinic days. Systematic random sampling technique was used to sample the participants meeting the inclusion criteria. Simple random sampling was used to identify the first study participants in any randomly selected module out of the first 9 participants who arrived at the clinic on any given day. Every ninth pregnant woman who reported to the clinic was approached and requested to take part in the study. If the ninth woman was not eligible to participate in the study, the next one was approached until an eligible participant was recruited. Every ninth interval was arrived at by considering that an average of 100 pregnant women are seen on a daily basis and the study duration was 3 months, therefore a total of 6000 women attend the clinic over 3 months. This was then divided by the calculated study sample, N=667, arriving at the ninth interval. Participants were selected from the antenatal register after they had been registered. On an average 12 participants were recruited daily. At any point during the study procedure, the participant had the right to withdraw from the study or to refuse to answer any question. This had been accounted for by a 10% attrition rate in the sample size. A total of 7259 women attended ANC at MNH from December 2017 to February 2018. Eight hundred and seven (807) women were approached to participate in the study, among them, 137 women were not included in the study for the following reasons; 93 women were second contacts, 15 were on antibiotics and 29 women did not give consent. Therefore, of 807 pregnant women, 670 were enrolled in the study. Out of these, vaginal samples from 3 women were inadequate and were therefore excluded. The analysis was thus based

on 667 participants.

Data Collection

The purpose and procedure of the study were explained to the participants and those who gave consent and agreed to participate were enrolled in the study. Each woman was interviewed individually and questionnaires were filled in a confidential location within the ANC. A speculum examination was performed and samples taken in the examination room. This was done after they had been seen by the doctors so as to not interfere with the flow of mothers receiving antenatal care. However, where the patients required a pelvic examination by the doctor, it was done simultaneously as samples were being taken. The antenatal cards of the participants were coded using a marker to avoid re-recruitment and their hospital registration numbers documented until the desired sample size was reached. Data was collected by the Principal Investigator and research assistants using a pretested questionnaire. Three (3) research assistants (Nurse Midwife and two intern Doctors) were trained for a day on recruitment, filling and examination procedures before the commencement of the study. The questionnaire was translated to Kiswahili and pretested before commencement of the study by administering it to 10 pregnant women attending ANC at MNH, we assessed whether the women were able to understand the questions and who they would be comfortable with asking the questions (health care provider/social worker/member of the committee/research staff not working at the facility) and whether they would answer the questions truthfully to that person. We tried to ensure that this group of 10 women was representing the population of women who received care at the clinic by selecting women of different age groups, from different parts of Dar e Salaam (rural/urban), with different levels of education and at various gestational age. The questionnaire was supplemented by important obstetric data relevant for the study from the antenatal card. Collected information was; age, occupation, gravidity, parity, marital status, education levels, information on the presence and type of discharge, history of PROM, history of Pre-Term Delivery (PTD), history of miscarriage, information regarding multiple sexual partners, Life Time Sexual Partners (LTSP), age of sexual debut, vaginal douching, history of STI, HIV infection, smoking and maternal stress. HIV status of women attending ANC at MNH is routinely checked after counselling using the rapid test by a nurse counsellor. Vaginal examination was done and samples were mainly collected and delivered to the laboratory by the Principal Investigator, on days when Principal Investigator was not available, it was done by research assistants. Maternal stress was assessed using the Cohen perceived stress scale (see appendix). This is a widely used 14 item self-report scale which measures the degree to which a respondent appraises her life as being stressful. Questions were asked about feelings and thoughts during the past one month using the Likert scale and questionnaire filled by the principal and research assistants. Each item is rated on a 5-point scale ranging from never (0) to almost always (4). Positively worded items are reverse scored, and the ratings are summated to obtain the stress score.²¹ The levels of stress were grouped as low (<19), low/moderate (20-24), moderate/high (25-29) and high (>29) as per t-

he study done by Culhane et al.²⁰

Collection of Specimen

All participants underwent a standard sterile speculum examination. This was a sterile procedure done mainly by the principal investigator in the examination room with a good light source. The participants were positioned in a lithotomy position, and after wearing sterile gloves, sterile disposable Cusco's specula were used to expose the vaginal walls with no lubricant added. Macroscopic evaluation of the vaginal walls for colour, amount and consistency of the discharge was noted. Thin grey homogenous discharge is characteristic for BV. A vaginal swab was collected using a sterile cotton swab from the posterior fornix of the vagina and then placed in a sterile Stuart's transport medium to maintain moisture and labelled with the patients code number for transport to the laboratory. An evaluation sheet noting the patient's medical record number, patient's code number, and date of examination was filled. The evaluation sheet together with the labelled container were transported to the microbiology laboratory in a cooler box for Gram staining and evaluation each day. The Principal Investigator with the research assistants ensured that the specimens were delivered to the laboratory at the end of the day for processing.

Reading and Reporting the Smears

In the laboratory, the frosted edge of a glass slide was labelled with the patient's code number and date. The obtained vaginal samples were used to make a thin smear on the labelled glass slide and allowed to air dry. After the smear had dried, it was heat-fixed by passing the slide over a bunsen flame 3 times, cooled off and then Gram stained as follows: The slides were placed on a staining rack, flooded with crystal violet stain and left to stand for 1 min and then gently rinsed under tap water. They were then covered with Gram's iodine solution and left to stand for another 1 min and again washed gently under tap water. After, the slides were tilted slightly and decolourised with acetone until the runoff became clear (1-5 sec), the decolourisation time was adjusted to the thickness of the smear. The excess decolouriser was removed with gentle flow of tap water. The slides were then counter stained by flooding with safranin and allowed to stand for 1 min and then washed off gently under tap water. Finally, the slides were air dried in an upright position. The prepared slides were read and reported. This was done by 2 trained and experienced lab technologists at MUHAS Microbiology Laboratory and in case of a discrepancy, a third opinion was sought and the opinion of the third lab technologist was final. Furthermore, 10% of randomly selected slides were scored by a Microbiologist against a collection of already scored smears. In all, there was a 90% concordance, indicating that scoring was comparable and consistent. Bacterial vaginosis was diagnosed using the Nugent's method. This method is the gold standard and considered optimal because it minimises clinical subjectivity.¹⁵ Three (3) types of bacteria were evaluated by Gram stain and the results graded using Nugent's criteria. This is a standardised 0-10 point scoring system for evaluation of Gram stained vaginal smears based on 3 morphotypes: large Gram positive rods (*Lactobacilli*), small Gram negative/variable rods (*G. vaginalis* and

anaerobic rods) and curved Gram variable rod (*Mobiluncus* species). A score of 0-3 is considered normal, 4-6 intermediate, and 7-10 positive for BV.¹⁵ Normal and intermediate are considered as no BV whereas a score of 7 and above is considered to be positive. The results were recorded in the evaluation sheet containing the patient's code number, registration number, and date of examination.

Quality Assurance

Laboratory diagnosis of BV is mainly achieved by microscopy. Quality assurance ensured good practice in preparing and reading gram stains, competency of the laboratory technologists, and regular preventive maintenance and set up of the microscopes used. MUHAS standard operating procedures were used for gram staining and interpretation of slides. Reagents were made and provided by MUHAS Microbiology Laboratory and checking the appearance of reagents was done daily. Good laboratory practice requires that the report on the Gram smear should mention the presence or absence of yeast cells which was done in the reporting.

Data Analysis

Data entry was done after developing the template on SPSS version 23. Before data analysis, quick frequency tables were run to check for consistency and missed data. After data cleaning, frequencies, means and proportions of variables were computed and tests of significant difference or association between independent variables and dependent variable was done using Chi square test, results were recorded as odds ratio with 95% CI and a p value of < 0.05 was considered significant. Independent variables were social demographic factors such as age, level of education and marriage status, obstetric factors such as gravidity, parity, PTD and miscarriage and behavioural factors such as douching, LTSP, smoking, maternal stress, age of sexual debut, STI and HIV, and the dependent variable or outcome was BV. Univariate analysis was used to calculate frequencies and proportions, bivariate analysis to see the association of selected exposure variables with the outcome variable and multivariable analysis to check the association of possible factors with the BV by adjusting for potential confounders.

Ethics Approval and Consent to Participate

This study received ethical approval from Muhimbili University of Health and Allied Sciences (MUHAS) Senate Research and Publication committee as well as permission from the Executive Director of MNH. Written informed consent was obtained from the participants prior to their enrolment in the study. Confidentiality was maintained. All participants were informed of their results and participants who were found to be positive for BV, or if found to have vaginal candidiasis were treated as per MNH protocols after communicating with the doctor taking care of the patient.

RESULTS

Figure 2 shows Gram stain results using the Nugent's criteria. 178 (26.7%) participants were diagnosed to be positive for BV while 489 (73.3%) were found to be negative for BV, (which included both negative and intermediate scores).

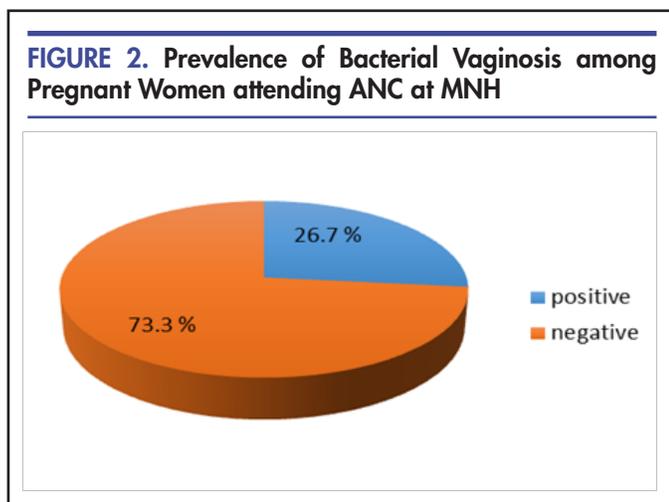
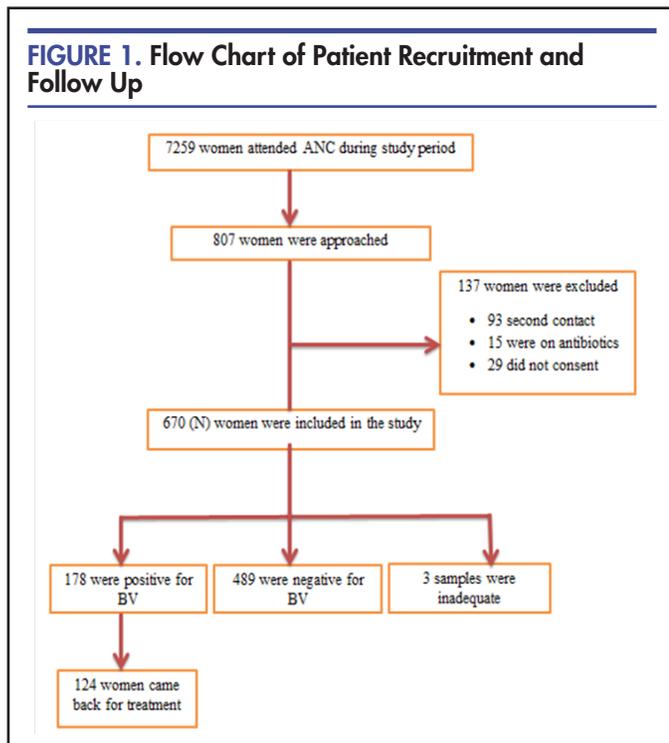


Table 1 shows the association of BV with socio-demographic and obstetric factors. Age, education levels, gravidity and parity were significantly associated with BV ($P < 0.05$)

Table 2 shows that there was a statistically significant association ($P < 0.05$), between BV and vaginal douching, HIV status, history of STI, LTSP and age at first coitus. In the bivariate analysis (Table 3), age (COR 1.71; 95% CI, 1.16-2.52), level of education (COR 4.08, 95% CI, 2.84-5.84), gravidity (COR, 1.52, 95% CI; 1.04-2.23), parity (COR 1.69, 95% CI; 1.18-2.42), vaginal douching (COR 2.89, 95% CI; 1.96-4.27), HIV status (COR 9.37, 95% CI; 4.12-21.28), history of STI (COR 2.49 95% CI; 1.46-4.25), LTSP (COR 2.76, 95% CI; 1.68-4.54) and age

of first coitus (COR 3.19, 95% CI; 2.24-4.56) were significantly associated with BV. After adjusting for confounders in multivariate analysis, factors that were found to be significantly associated with BV were; age of between 21 to 29 years (AOR, 2.22, 95% CI; 1.45-3.49), education level (AOR 3.97, 95% CI; 2.63-5.98), vaginal douching (AOR 3.68, 95% CI; 2.35-5.76), HIV status (AOR 6.44, 95% CI; 2.62-15.88), STI infection (AOR 2.34, 95% CI; 1.25-4.37), more than one LTSP (AOR 2.69, 95% CI; 1.53-4.74) and age of less than 18 years of first coitus (AOR 2.16, 95% CI; 1.42-3.30). Gravidity and parity was not significantly associated with the outcome.

DISCUSSION

The prevalence of BV in this study was noted to be high (26.7%) which can be explained by the fact that certain behavioural factors such as douching are practiced by majority of the women in Dar es Salaam.²² Higher prevalence has also been reported in several sub Saharan countries including Nigeria, Botswana, Kenya, and Zimbabwe.^{6,7,23,24} In contrast, lower prevalence was reported in Portugal (3.9%), Burkina Faso (6.2%), and India (8.6%).^{5,25,26} This vast difference in prevalence across the globe is presumably due to environmental, behavioural, socioeconomic status and stressor differences in the geographical variation.

The highest prevalence of BV occurred among women in their 20s. Similar findings were reported in studies conducted in Nigeria whereby women aged 21-30 were predominantly diagnosed to have BV as compared to other age groups.^{23,27} In comparison, a French population based study reported maternal age of less than 20 years to be significantly associated with BV as compared to older women.²⁸ Others have reported highest prevalence of BV among women aged more than 30 years.²⁹ The common finding in all these studies is that the age groups with the highest prevalence of BV are the most sexually active age group with the highest risk of pregnancies and STIs.²⁹ More than 50% of the participants in this study were in their 20s hence this could account for the high prevalence noted among this age group. Considering the urban setting of the study, women below 20 years are less likely to get pregnant due to more awareness, accessibility and availability of contraceptives.³⁰

It was noted that women who had attended primary level education and less were more likely to get BV as compared to women who had attended secondary level education and above. In a randomised controlled trial done in France, it was seen that women with primary level education were two fold more likely to get BV.²⁸ A study done in Nigeria also noted similar findings whereby lack of western education was associated with increased risk of BV.³¹ This could possibly be explained by the fact that women with low education levels may not be knowledgeable about certain harmful practices such as vaginal douching and may also delay in seeking appropriate treatment for conditions such as STI.

Women who douched during pregnancy were significantly more likely to get BV as compared to women who did not douche. This finding is due to the fact that the majority of participants in this study douched during pregnancy. More than 50% of the participants deemed douching as a good hygiene practice, which to a larger e-

TABLE 1: Socio-Demographic and Obstetric Factors Associated with Bacterial Vaginosis among Pregnant Women Attending ANC at MNH, (N=667)

Predictors	Total	Bacterial Vaginosis		P value
		Positive n (%)	Negative n (%)	
Age group (years)				
< 20	56	17(30.4)	39(69.6)	.018
21-29	369	112(30.4)	257(69.6)	
≥30	242	49(20.2)	193(79.8)	
Marital status				
Married	481	128(26.6)	353 (73.4)	.944
Unmarried	186	50 (26.9)	136 (73.1)	
Type of marriage*				
Polygamous	26	3(11.5)	23(88.5)	.074
Monogamous	455	125(27.5)	330(72.5)	
Education level				
Primary and less	249	110(44.2)	139(55.8)	<.001
Secondary and above	418	68(16.3)	350(83.7)	
Occupation				
Unemployed	241	69 (28.6)	172 (71.4)	.682
Employed (public or private)	157	41 (26.1)	116 (73.9)	
Self employed	269	68 (25.3)	201 (74.7)	
Gravidity				
Primigravida	220	47(21.4)	173(78.6)	.029
Multigravida	447	131(29.3)	316(70.7)	
Parity				
Nulliparous	278	58(20.9)	220(79.1)	.004
Parous	389	120(30.8)	269(69.2)	
History of miscarriage#				
No	292	81 (27.7)	211 (72.3)	.318
Yes	155	50 (32.3)	105 (67.7)	
History of PTD[§]				
No	333	98 (29.4)	235(70.6)	.140
Yes	56	22(39.3)	34(60.7)	

PTD – Preterm Delivery, *N=481, as only 481 participants were married, #N = 447, is equal to the number of women who were multigravida and §N = 389 is equal to the number of women who were parous i.e. women who had at least one delivery above the age of viability (28+weeks).

extent disturbed the normal flora of the vagina predisposing them to BV. Douching has been known to cause disturbance of vaginal chemical balance and microbial normal flora hence leading to overgrowth of BV causing microorganisms.²² This finding is consistent with results from several other previous studies.^{13,20}

The current study noted a high prevalence of BV among HIV infected women. However the prevalence of HIV among the participants was less than 5% in the current study. Therefore, the results may not be representative of all the population. Studies done elsewhere in the world have also highlighted a significant association of BV with HIV infection.^{32,33} This is probably due to immunosuppression caused by HIV infection which predisposes the women to infections such as BV. On the other hand, it has been noted that BV increases susceptibility to HIV

infection. Therefore, interventions to reduce the occurrence of BV may have an impact on the spread of HIV at a population level.

Women with a history of STI were noted to have a two-fold increased risk of getting BV as compared to women who had no STI. This finding is consistent with a study done among pregnant Danish women where by women with a history of STI such as Neisseria gonorrhoea and Chlamydia trachomatis had an increased risk of getting BV as compared to women who did not have any STI.³⁴ This was also noted in another study conducted in England, where women with bacterial STI had a higher risk of getting BV.³⁵ The association between STI and BV could presumably be due to high-risk sexual behaviours such as multiple sexual partners among these women. Though, having previously experienced the symptoms of

TABLE 2: Behavioural and Clinical Factors Associated with Bacterial Vaginosis among Pregnant Women Attending ANC at MNH, (N= 667)

Predictors	Total	Bacterial Vaginosis		P value
		Positiven (%)	Negative n (%)	
History of smoking before current pregnancy				
No	646	174(26.9)	472(73.1)	.421
Yes	21	4(19.0)	17(81.0)	
Vaginal douching				
No	273	42(15.4)	231(84.6)	<.001
Yes	394	136(34.5)	258(65.5)	
HIV status				
Negative	635	154(24.3)	481(75.7)	<.001
Positive	32	24(75.0)	8(25.0)	
History of STI				
No	605	150(24.8)	455(75.2)	.001
Yes	62	28(45.2)	34(54.8)	
Maternal stress				
Low stress	294	72(24.5)	222(75.5)	.391
Low moderate	274	74(27.0)	200(73.0)	
Moderate high	86	29(33.7)	57(66.3)	
High stress	13	3(23.1)	10(76.3)	
LTSP				
1	153	21(13.7)	132(86.3)	<.001
2+	514	157(30.5)	357(69.5)	
Age at first coitus				
< 18 years	227	96(42.3)	131(57.7)	<.001
≥ 18 years	440	82(18.6)	358(81.4)	

LTSP – lifetime sexual partners, STI – sexually transmitted infections.

STI may make them more aware of vaginal abnormalities and thus seek treatment earlier.

The current study found that having more than one LTSP significantly increased the risk of getting BV. This finding is consistent with other previous studies.^{9,36} In the current study, a significant relationship between more than one LTSP and BV was established as more than 3 quarters of the participants had more than one LTSP. In comparison, most of the studies conducted to establish the association of LTSP and BV, the study population was of women who are not pregnant. This is one of the few studies to do so on women during pregnancy. It has been suggested that increased number of LTSP predisposes to BV by causing the vaginal flora to become unstable.³⁷ Changes in the vaginal environment induced by sexual intercourse with a new partner may increase susceptibility to abnormal colonisation in certain women due to disruption of the woman’s already established vaginal flora. Coitus alters the physiochemical vaginal environment thereby affecting the vaginal microflora. In particular, it has been shown that the alkaline prostatic content of the ejaculate raises the vaginal pH and this favours the growth of the anaerobes.³⁸

Early age of sexual debut before 18 years was found to

be significantly associated with BV. This finding is consistent with a study conducted in Zimbabwe, where by sexual debut before the age of 20 years was found to be the strongest predictor of vaginal infections.⁷ The reason for this is not quite clear. However, it could be presumed that women who have an early sexual debut are likely to be more sexually active or have more sexual partners. In addition, immaturity of the genital tract making it to be more susceptible to vaginal infection.

The major strength of the current study was that it was conducted in the largest tertiary care hospital in Dar es Salaam and therefore included participants from most parts of Dar es Salaam.

This strength is also based on the large sample size. The limitation of this study was that self-reported risk behaviours and history of STI might have been under reported due to social acceptability. Despite this limitation, the data is reliable and can be used as proxy to predictors of BV among pregnant women.

CONCLUSION

Age below 30 years, primary education level and below, vaginal douching, HIV infection, STI, more than one lifetime sexual partners and early age of sexual debut were-

TABLE 3: Bivariate & Multivariate Analysis of Factors Associated with Bacterial Vaginosis among Pregnant Women Attending ANC At MNH, (N=667)

Predictors	Bacterial vaginosis n (%)	Bivariate analysis; COR (95% CI)	Multivariate analysis; AOR (95% CI)
Age group (years)			
< 20	17 (30.4)	1.717 (0.896 , 3.289)	1.544 (0.717, 3.325)
21-29	112 (30.4)	*1.717 (1.169, 2.520)	*2.224(1.415, 3.494)
≥30	49 (20.2)	1	1
Education level			
Primary and less	110 (44.2)	*4.087 (2.840, 5.842)	*3.975 (2.639, 5.986)
Secondary and above	86 (16.3)	1	1
Gravidity			
Primigravida	47 (21.4)	1	1
Multigravida	131 (29.3)	*1.526 (1.042, 2.234)	0.732 (0.321, 1.671)
Parity			
Nulliparous	58 (20.9)	1	1
Parous	120 (30.8)	*1.692 (1.180, 2.427)	1.290(0.820, 2.027)
Vaginal douching			
No	42 (15.4)	1	1
Yes	136 (34.5)	*2.899 (1.965, 4.277)	*3.685 (2.356, 5.765)
HIV status			
Negative	154 (24.3)	1	1
Positive	24 (75.0)	*9.370 (4.125, 21.285)	*6.442 (2.612, 15.887)
History of STI			
No	150 (24.8)	1	1
Yes	28 (45.2)	*2.498 (1.466, 4.257)	*2.343 (1.254, 4.377)
LTSP			
1	21 (13.7)	1	1
2+	157 (30.5)	*2.764 (1.681, 4.545)	*2.698 (1.536, 4.740)
Age at first coitus			
< 18 years	96 (42.3)	*3.199 (2.241, 4.569)	*2.169 (1.423, 3.306)
≥ 18 years	82 (18.6)	1	1

COR – crude odd ratio, AOR – adjusted odd ratio, LTSP – life time sexual partners, , STI – sexually transmitted infections, PTD – preterm delivery, *statistically significant.

found to be significant predictors of BV. The high prevalence of BV in our population should necessitate policy makers to include screening and treatment of BV in antenatal care package in the future, as BV is associated with significant maternal and neonatal morbidity and mortality. Women should also be educated on harmful effects of certain behavioural practices such as vaginal douching which lead to alteration of the vaginal flora thus predisposing to BV. In addition, symptoms of BV such as abnormal vaginal discharge during pregnancy are inconsistent, under reported and often overlooked. Therefore, a high-risk approach can be used for screening and treatment of asymptomatic women.

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Prevalence and risk factors for diabetes mellitus among tuberculosis patients in Moshi Municipal Council, Kilimanjaro Tanzania

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ABSTRACT

Background: Diabetes Mellitus (DM) is a worldwide public health problem and its prevalence has been rising rapidly in low and middle income countries (LMICs) including Tanzania. According to WHO report 2015, DM is ranked number six as a leading cause of death worldwide. Strong evidence suggests that DM may be associated with Tuberculosis (TB) and could affect TB treatment outcomes. Tanzania is among the 22 countries that have a high burden of TB and currently facing increased epidemic of DM. The increasing diabetes prevalence may be a threat to TB control and counteract strategies to end TB by 2030 as proposed by WHO.

Objective: To determine proportion of TB patients who are co-infected with DM in Moshi municipal council, Kilimanjaro Tanzania.

Methodology: This study was a hospital based cross-sectional study conducted in April to July 2018 at 4 health facilities; Mawenzi Regional Referral hospital, St. Joseph District Designated hospital, Pasua Health center and Majengo Health centre in Moshi municipal. The study included adults aged 18 years and above attending either of the 4 health facilities for TB care. The study included newly diagnosed and those who were on TB treatment. Interviews were conducted followed by blood glucose testing. Data was entered and analysed using SPSS

Results: A total of 153 TB patients were enrolled, their mean age was 42.5 (± 14.75) years and 46 (30.1%) were females. The prevalence of DM among TB patients in this study was 9.2%. Factors associated with TB-DM comorbidity were: age (OR 4.43, 95% CI: 1.18-16.55), HIV status (OR 3.88, 95% CI: 1.06-14.11), and family history of DM (OR 6.50, 95% CI 0.67-25.56).

Conclusion: One in ten patients with TB had confirmed DM. There is a need for future studies to assess if DM influences TB treatment and outcomes in this setting.

BACKGROUND

Tuberculosis (TB) is an infectious disease caused by bacteria (*Mycobacterium tuberculosis*) that often affects the lungs. Tuberculosis is spread from person to person through the air. When people with pulmonary TB cough, sneeze or spit, they propel the TB germs into the air.¹ Tuberculosis and Diabetes Mellitus are major causative of mortality across the world.² TB is one of the top 10 causes of death globally. It is estimated that 9.0–11.1 million people developed TB in 2017 and approximately 1.3 million died.³ Tuberculosis and Diabetes Mellitus (TB-DM) comorbidity is higher as compared to TB-HIV co-infection around the world. It is estimated that in 9.6 million new cases of active TB annually, 1 million have both TB and DM.⁴ With more than 70,000 cases each year, Tan-

zania is among the 22 high burdened TB countries where by the dual burden of TB and DM has become a major health threat⁵⁻⁷

Diabetes Mellitus increase the risk of TB by three-fold⁸⁻¹⁰; it impairs innate and adaptive responses that are necessary to counter the progression from infectious to clinical disease. DM is an independent risk factor which cause poor TB treatment response as well as death.^{11,12} The relationship between DM and TB is assisted by the fact that patients with DM have impaired cell mediated immunity, renal failure, micronutrient deficiency, and pulmonary microangiopathy, all of which increases the susceptibility of *Mycobacterium tuberculosis*.¹³

The dual burden of TB and DM in both low and middle-income countries has become a global health prob-

problem. Several studies have suggested that there is an association between DM and TB and the possible inter-link represent an important and growing challenge of TB global control.¹⁴ Conversely, Active TB patients experience Inflammation caused by cytokines such as IL6 and TNF α in response to TB infection which may cause an increase in insulin resistance and decreased insulin production, thereby leading to hyperglycemia.¹⁵ Additionally, isoniazid and rifampin have hyperglycaemic effects. Also pyrazinamide may result in difficult control of DM. Rifampin induces metabolism and decreases blood level of sulfonyleureas, leading to hyperglycemia.¹⁵

In recognition of the burden of DM and TB, the World Health Organization (WHO) and the International Union against Tuberculosis and Lung Disease (The Union), launched the Collaborative Framework for Care and Control of Tuberculosis and Diabetes to guide policy makers and programme managers in combating the TB-DM epidemic.¹⁶ However, recent studies have shown that DM prevalence among TB cases is variable and it ranges from 29.3% in Southern Mexico to 11.4% in Georgia USA^{17,18} Studies conducted in Africa reported low prevalence of DM among TB patients; 8.5% in Uganda, 8.3% in Ethiopia, 2.8% in Guinea-Bissau and 1.9% in Benin.^{13,19-21} Some studies have shown high prevalence of DM among TB patients; 29.5% in Taiwan, and 25.3% in India^{22,23}

In Tanzania, the comorbidity of DM and TB has not been of great concern as a growing health threat at the national level. Although, National Tuberculosis and Leprosy Programme identified 2 major risks of TB; one being HIV for which patients have an annual risk of 5-10% of developing TB, DM which has an annual of 1.5 times higher risk of developing TB.²⁴ Therefore, DM is increasing among TB patients making it one of the risk burdens of TB in Tanzania. Considering that two thirds of DM patients in Africa are not aware that they have the disease, screening for DM among TB patient may contribute to early diagnosis.¹⁶ However, there is no recommendation from the ministry of health and social welfare to all health facilities about DM screening to new TB patients as compared to the screening for HIV. In Tanzania, there is limited information on DM among TB patients, therefore this study wants to determine Prevalence and factors associated with DM among TB patients in Moshi Municipal council. Information from this study may contribute to the Community, Ministry of Health and social welfare, and National Tuberculosis and leprosy Programme, the need for routine screening of DM among TB patients and appropriate strategies for interventions.

METHODOLOGY

Study Design

A cross-sectional study was conducted among TB patients attending health facilities that offer TB treatment in Moshi Municipality, Tanzania from April to June 2017.

Study Population

All TB patient aged 18 years and above attending selected TB health facilities at Moshi Municipality in Kilimanjaro Region. Patients who were not permanent residents of Moshi Municipality were excluded from the study.

Study Area

Kilimanjaro region is located in North-eastern part of Tanzania mainland. It has 7 districts including Moshi municipal council.

This study was conducted in 4 Health facilities offering TB services in Moshi Municipal council namely; Mawenzi regional referral hospital, St Joseph hospital, Majengo hospital, and Pasua health Centre.

Sample Size Estimation

Sample size (N) was determined by using a precision formula $N = \frac{Z^2 p(1-p)}{e^2}$,

whereby **Z** is Standard Normal Deviation of 1.96 corresponding to 95% Confidence Interval, **P** is Population prevalence of 16.7% from a Descriptive Cross Sectional study titled **Diabetes is a risk factor for pulmonary tuberculosis, a case control study from Mwanza Tanzania**, and **e** is Precision set at 5% (0.05).

The required minimum sample size of 213 was obtained from the above estimation and the final sample size was determined to be 234 TB patients after additional of 10% for non-response rate.

Sampling Technique

All TB patients aged 18 years and above who visited the selected health centres for clinic during the study period were enrolled.

Study procedures

We collected Information concerning the socio-demographic and the associated factors using a pre-tested standard questionnaire. After patient agreement, he/she filled the questionnaire for collection of socio-demographic factors and risk factors of DM among TB patients on their visit for commencement of TB treatment. DM was investigated as follows: Random blood glucose (RBG) test was performed, if the level is less than 11mmol/L, no further action was taken. If RBG is more than 11mmol/L, then the patient was asked to return for Fasting Blood Glucose (FBG) the next morning. A glucometer ACCU-CHEK Active Glucose Monitoring System (Roche Diabetes care Inc. Indian) was used for screening DM. WHO diagnostic criteria were used for making a diagnosis of DM, i.e. Fasting Blood Glucose (FBG) value of ≥ 8 mmol/L. Patients found to be diabetic were referred to the diabetes clinic of their respective facility for further evaluation and management. Moreover, known DM patients were educated on the need to continue follow-up care for DM.

Data Collection Tools

Questionnaires in Swahili language were used for data collection. The questionnaire had 2 sections; section one included socio-demographic information such as age, education status and marital status. Section two included information on risk factors for DM such as HIV status, alcohol consumption, cigarette smoking and participants' family history of DM. Smoking was categorised as ever smoke or never smoke in life time, alcohol was categorised as ever drink or never drink in a life time and family history of DM involved asking if there is a first degree relative with DM, information about HIV status of the newly diagnosed and under medication participants were retrospectively obtained from the TB registry book in every clinic, DM was measured using a glucometer ACCU-CH-

EK Active Glucose Monitoring System (Roche Diabetes care Inc. Indian) A blood sample was collected through a finger prick and dropped on a glucometer to give a reading. Information concerning socio demographic and associated factors was collected by using a pre-tested standard questionnaire administered by trained research assistants.

Data Collection Methods and Tool

Data was collected by conducting interviews guided by Questionnaires. The questionnaires contain information on social demographics, information about risk factors associated with DM among TB patients, microangiopathy etc Biological samples collection tools were used for collection of samples for DM screening among TB patients.

Laboratory Procedures and Machine

A glucometer machine (ACCU-CHEK Active Glucose Monitoring System (Roche Diabetes care Inc. Indian) uses strips. The strips contain chemicals that react with glucose in the drop of approximately 0.3 to 1µl of blood. It takes about 3 to 60 seconds to read the test strip; the glucose value in mg/dl is displayed on a digital display. Laboratory procedures were practiced as follows; Patients’ fingertips were cleaned using 70% alcohol swabs. A new glucometer strip was inserted for each test for every individual patient. A spot on a cleaned patient’s finger was chosen and patient’s fingertip was lanced to get a drop of blood. The test strip was held close to the lanced fingertip to collect the blood drops until enough blood is absorbed to begin the test. It takes about 3 to 60 seconds to read the test strip. The glucose value in mg/dl is display on a digital display. Used test strips and lancets were discarded properly, the results were recorded on the patients’ request forms.

Patients were given their results and those with diabetes were referred to the diabetic clinics in their respective health centres.

Data Quality

During data collection, a daily basis check-up of the questionnaires and patient request forms was done to ensure the correctness and completeness of the information collected.

Data Analysis

Statistical Package for Social Sciences (SPSS) version 20 (SPSS, Chicago, IL) was used for data analysis. Descriptive analysis was done for data summarisation, whereby mean and its corresponding measures of dispersion were used for numeric variables, frequency and percentages for categorical variables. Odds Ratio (OR) and the corresponding 95% Confidence Interval (CI) was used to determine factors associated with DM using logistic regression models. All variables which were statistically significant at the univariate analysis were carried for multivariable analysis. A p-value of <0.05 was considered statistically significant.

Ethical Consideration

Ethical approval to conduct the study was obtained from the Kilimanjaro Christian Medical University College Ethical Committee (Ethical approval number 2039). Permission to carry out the study was obtained from the District Medical Officer (DMO) of Moshi Municipality and in

-charge of selected health facilities. Written, informed consent was obtained from each participant. Confidentiality with regards to the information of the participants was highly maintained as no names appeared on the questionnaires. Participants who did not want to participate were not denied access to services at the health facilities. Participants with raise FBG of 7 mmol/L were referred to the diabetes clinic of their respective facility for further evaluation and management.

RESULTS

Socio-Demographic Characteristics of the Study Participants

A total of 153 participants were analysed in this study. The overall mean age of the participants was 42.5years (standard deviation (SD) (±14.75). Majority 107(69.9%) of the participants were male and about 77(51.6%) aged between 18-39 years. For other socio-demographic characteristics of the study participants, See Table 1.

TABLE 1: Socio-Demographic Characteristics of the Participants (N=153)

Variables	N	%
Sex		
Male	107	69.9
Female	46	30.1
Age		
18-39	79	51.6
≥ 40	74	48.4
Educational level		
Formal education	144	94.1
Informal education	9	5.9
Marital status		
Single	45	29.4
Married	108	70.6
Occupation		
Employed	27	17.6
Unemployed	39	25.5
Self employed	87	56.9

Prevalence of Diabetes Mellitus among TB patients

The prevalence of DM in this study was 14(9.2%). The prevalence was 11(14.9%) higher among older age group compared to the younger group, also higher 4(23.5%) among HIV positive patients and patients with family history of DM.

Factors Associated with Diabetes Mellitus among TB Patients

Table 2 shows univariable and multivariable analysis on the factors associated with DM among TB patients. The significant factors found to be associated with DM were age, family history of DM and HIV status. Participants aged 40 years and above had 4.42 times higher odds of developing DM as compared to younger age group (18-39) (OR 4.4295% CI 1.18-16.55) and the association was statistically significant. Also, participants with family history of DM had 6.5-time higher odds of developing DM as compared to patients with no family history of DM (OR 6.5001, 95% CI 0.67-25.56), likewise participants who were HIV sero-positive had 3.8 times higher odds of-

TABLE 2: Factors Associated with Diabetes Mellitus among TB Patients (N=153)

Variables	N	Diabetes Mellitus Diabetic n (%)	OR (95%CI)	AOR(95%CI)
Sex				
Male	107	12 (11.2)	2.77 (0.59-12.95)	2.91 (0.52-16.17)
Female	46	02 (4.3)	1	1
Age				
18-39	79	03(3.8)	1	1
≥ 40	74	11(14.9)	4.42 (1.18-16.55)	7.68 (1.38-42.72)
History of smoking				
Yes	67	09(13.4)	2.51 (0.80-7.89)	
No	86	05(5.8)	1	-
Alcohol consumption				
Yes	116	11(9.5)	1.18 (0.31-4.51)	
No	37	03(8.1)	1	-
Family history of DM				
Yes	12	04(33.3)	6.50 (1.68-25.56)	17.5 (2.64-116.07)
No	141	10(7.1)	1	1
Physical exercise				
Yes	46	05(10.9)	1.32 (0.42-4.21)	-
No	107	09(8.4)	1	
HIV status				
Positive	17	04(23.5)	3.87 (1.07-14.12)	2.5 (0.59-10.64)
Negative	136	10(7.4)	1	1
Marital status				
Single	45	01(2.2)	6.02 (0.76-47.88)	
Married	108	13(12.0)	1	-
Education status				
Formal education	144	13(9.0)	0.79 (0.09-6.85)	
Informal education	09	01(11.1)	1	-

developing DM as compared to those who were HIV-negative (OR 3.88, 95% 1.06-14.11).

DISCUSSION

The prevalence of DM among TB patients in Moshi municipality was 9.2%. The factors significantly associated with TB-DM comorbidity were age (≥ 40), HIV status and family history of DM.

The prevalence of DM among TB patients in this study is comparable with that reported in Dar es salaam Tanzania, (9.7%), Nigeria (9.4%), and a pooled prevalence of a meta-analysis study of SSA (9.0%).^{11,16,25} However, the prevalence is lower compared to that reported in Pakistan (14.8%), India (13.9%) and Bangladesh (12.8)²⁶⁻²⁸ Other studies have reported lower prevalence as compared to our study; Uganda (8.5%), Tanzania (4.5) Lusaka Zambia (2.3%), Mozambique (1%).^{19,29,30,31} The possible explanations for the difference could be difference in study setting and screening method used in DM diagnosis, for example, in the study conducted in Pakistan²⁶, both FBG and HBA1C were used for DM screening which is more effective as compared to the method used in the current study. Also, the present study was conducted on a relatively small sample size compared to the sample sizes considered in other studies.

The odds of DM was higher among participants aged 40 years and above and having family history of DM. This may be explained by the fact that type two diabetes is common in old age people compare to young age people and the possibility of inheriting DM traits. Our findings are similar to the study conducted in Dar es salaam Tanzania, Kenya and Ethiopia^{11,32,33}, but contrary to that of Nigeria³⁴ where no difference in the odds of DM was found.

HIV infection was a significant risk factor for TB and this is similar to the study done in Ethiopia.³³ This can be explained by the fact that HIV infection weakens the immune system and increase the risk of TB, however, this contrary to the study done in Kenya.³²

This study shows no association between sex, education level, marital status and occupation of the study participants and this is similar to a community based cohort study conducted in China and a cross sectional study conducted in Pakistan.^{26,35} However, this is contrary to a systematic review by Workneh *et al.* 2017 and a study conducted in Bangladesh.^{28,36} The possible explanation for this difference could be due to the difference in the study sample size. This study's sample size was small compared to other studies.

Study Strength and Limitations

We conducted a DM screening programme among all TB patients across 4 health facilities in Moshi municipality. The study has the following limitations; utilisation of FBG for diagnosis. FBG has low sensitivity and may fail to detect DM in some patients which may have caused under estimation of the prevalence of DM. FBG is recommended as initial DM screening test in resource-limited settings; Using of A glucometer machine (ACCU-CHEK Active Glucose Monitoring System). The glucometer is less sensitive for diagnosis when compared to other diagnosis methods such as HBA1C; The Small sample size used in this study resulted into having a wide Confidence Interval, thus, precaution should be taken while interpreting the outcomes of this study.

CONCLUSION

In this study, we found that at least one in ten patients with TB had confirmed DM. Therefore, we strongly recommend to routine screening for DM among all TB patient and special emphasis should be given for early screening of DM among TB patients so as to contribute to improved detection and early treatment.

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Uptake of Modern Contraceptive Methods among Burundian Women and Associated Factors: Analysis of Demographic and Health Survey Data, Burundi 2016–2017

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ABSTRACT

Background: Globally in 2017, Burundi was the 9th country with the highest population growth rate of 3.2% and a fertility rate of 5.5 children per woman. This probably suggested low uptake of Modern Contraceptive methods (MCM) in the country. Our analysis investigated factors associated with low uptake of MCM among women of reproductive age in Burundi.

Methods: Cross sectional data of non-pregnant women aged 15-49 years was extracted from the Burundi Demographic and Health Survey (2016-2017). We analysed the data at univariate, bivariate and multivariate levels to assess factors influencing MCM uptake among these women using Epi-Info 7.2.2.6.

Results: Of the 9,945 women, 2,372 (23.8%) were using MCM. Ngozi province had the highest prevalence of MCM users [284/691(37.7%)]. The most used MCM among respondents was injectable contraceptive (48.3%). As respondent's age increases, the odds of using MCM decreases; 20-24 years (aOR=0.9, 95% CI [0.6-1.2]), 30-34 years (aOR=0.8, 95% CI [0.5-1.0]), 35-39 years (aOR=0.7, 95% CI [0.5-0.9]), 40-44 years (aOR=0.5, 95% CI [0.5-0.9]) and 45-49 years (aOR=0.4, 95% CI [0.2-0.5]) compared with those in the age group 15-19 years. Muslims (aOR=1.5, 95% CI [1.2-1.9]) and Jehovah witnesses (aOR=3.1, 95% CI [1.7-6.5]) were more likely to use MCM than Catholics.

Conclusion: The prevalence of MCM remains low among women of reproductive age in Burundi, with injectables being the most used method. Factors such as respondent's age and religion were significantly associated with MCM use. Enhanced access to family planning information and services targeting women who are 30 years or more and engaging religious leaders for their active participation is recommended.

BACKGROUND

In 1900, the world population was estimated to be about 1.7 billion.¹ By 2018, the population had risen to 7.6 billion.² Sixty percent (60.0%) of the world's population live in Asia (4.5 billion), 17.0% in Africa (1.3 billion), 10.0% in Europe (742 million), 9.0% in Latin America and the Caribbean (646 million), the remaining 6.0% in Northern America (361 million) and Oceania (41 million).² China (1.4 billion) and India (1.3 billion) remain the 2 most populous countries of the world, comprising 19.0% and 18.0% of the global total, respectively.² Currently, 80.0% of the world's population resides in less developed countries and this figure is expected to reach 90.0% by 2050.¹

The world's population continue to grow albeit more slowly than in the recent past. Ten (10) years ago, the global population was growing by 1.2% per year. Today, it is growing by 1.1% per year, yielding an additional 83 million people annually.² The European

Union (EU) population is now growing slowly and is even expected to decline further in long term. So, the EU represents an ever-shrinking proportion of the world's population, at just 6.9% today down from 13.5% in 1960, and is projected to decline further by the end of this century to just 4.1%.³ Rapid population growth in Africa is anticipated even though there assumptions that there will be a substantial reduction of fertility levels in the near future. The medium-variant projection assumes fertility in Africa will fall from around 4.7 births per woman in 2010-2015 to 3.1 in 2045-2050, reaching a level slightly above 2.1 in 2095-2100.²

Burundi is among the 10 countries with highest fertility rates globally by 2017 (occupying the 9th position), with 5.5 children per woman.⁴ Historical data shows that uptake of modern contraceptive method grew from 16.9% to 18.8% in 2012 and 2016 respectively.⁵ In terms of maternal health, maternal death rate has decreased from 1,220 (1990) to 712-

(2015) per 100,000 live births.⁶ However, it is still among countries classified by the World Health Organisation (WHO) as having made no progress towards reducing Maternal Mortality Ratio (MMR) between 1990 and 2015.⁷ Studies have shown that unintended pregnancies among young women greatly contribute to high maternal and neonatal mortality through increased risk of unsafe abortion, birth injuries and postpartum depression.^{8,9}

Therefore, delaying or avoiding pregnancies among young women and reducing the number of pregnancies among older women are key interventions in preventing and reducing maternal deaths more especially in countries with high maternal mortality like Burundi.

Universal access to effective contraceptive methods ensures that all adults and adolescents can avoid the adverse health and socio-economic consequences of unintended pregnancy while living a satisfying sexual life. Key global initiatives; the Sustainable Development Goals and the Global Strategy for Women's, Children's and Adolescent's Health call for universal access to family planning services as a right for women and girls, this is crucial to a healthy life.¹⁰ Women, men, or couples can choose from the many available contraceptive methods to help them plan their family and prevent unplanned pregnancy. They also need to know that, during the next 12 months, if they are having sex regularly and do not use any contraceptive method, about 8 out of every 10 women will become pregnant.¹¹

Despite efforts taken by the Government of Burundi in favour of family planning which helped to increase the prevalence rate of modern contraceptives from 2.7% in 2000 to 34.0% in 2014¹²; the country, in 2017, remains in the ninth position globally in terms of high growth (3.2%) and fertility rate (5.5 children per woman).⁵ The Burundi general population was projected to be 11,890,784 in 2021, making a density of 463 inhabitants / km².¹³ The determinants of modern contraceptive uptake have been explored around the world among women of child bearing age (15-49 years).^{8,14-19} For instance, in northwest Ethiopia, in 2015, Modern contraceptive methods utilisation was found to be 31.7%.²⁰ In the same period, its prevalence in Dibindi, Democratic Republic of Congo (DRC) was 18.4%.¹⁶ Factors like age, education status, marital status, Spousal announcement about family planning issues, residence and income among others were factors associated with modern contraceptive methods utilisation.^{15,20-22} However, published data on these factors among Burundian women is limited. Understanding the key factors influencing modern contraceptive uptake among women of reproductive age who are at a higher risk of maternal morbidity and mortality will help inform appropriate interventions that could improve uptake of modern contraceptives. Therefore, the aim of this analysis is to investigate the factors associated with low uptake of MCM among women of reproductive age in Burundi.

METHODS

Study Design and Data Source

A secondary analysis of cross-sectional household data for women of reproductive age collected during the 2016-2017 Burundi Demographic and Health Survey was conducted. The survey was aimed at producing representati-

ve results at country level, urban and rural area level, Bujumbura city and other provincial levels. In achieving this, the national territory was divided into 18 fields of study corresponding to the 18 provinces and in each field of study (except Bujumbura Mairie which has no rural part), 2 strata were created: the urban and the rural stratum, from where samples were drawn.

2 stage sampling technique was used in this study; In the first stage, 554 Primary Sampling Units (PSU) or clusters were drawn from a list of Enumeration Areas (EAs) established during the 2008 General Population and Housing Census (RGPH), using systematic sampling technique with allocation proportionate to size. The size of the PSU is the total number of households in that particular unit. A list of households in each of the PSU/clusters provided the sampling frame in which 30 households per cluster were drawn using systematic sampling technique, also in the second stage from both urban and rural areas. A total of 16,637 households (3,191 in urban areas from 106 clusters and 13,446 in rural areas from 448 clusters) were selected. All women aged 15-49 years, usually living in the selected households, or present the night before were eligible for the survey. 4 questionnaires were used to collect data. Total number of eligible women interviewed was 17,269; among them, women who were not pregnant were asked if they ever used any method to avoid getting pregnant. In our analysis, only participants who provided responses to all the variables (dependent – contraceptive uptake and independent – religion, education, age, and others) were included. Hence, the sample size that was finally used for the analysis was 9,945.

Study Variables and Measurements

Dependent Variable

The outcome variable in this study was modern contraceptive methods uptake. Women who reported current use of modern contraceptive methods were considered as current users of modern contraceptives and those who responded that they use traditional methods or with a 'no' answer were regarded as non-users.

Independent Variable

The independent variables included socio-demographic information such as age (15-19, 20-24, 25-29, 30-34, 35-39, 40-44 and 45-49 years), religion (Catholic, Protestant, Muslim, Jehovah witness, Adventist and no religion), socio-economic information which included the type of residence (urban and rural), education (none, primary school, secondary school or above), ownership of radio or television, and work/employment (working or not working). Other independent variable included was breastfeeding status.

Data Management and Analysis

We downloaded data from the Burundi Demographic and Health Survey (DHS) program which was transferred into Microsoft Excel 2016 for cleaning. The data was then transferred into Epi-Info 7.2.2.6 for re-coding and analysis of the variables to suit the study objectives. Descriptive statistics was used to summarise the data and results were presented as frequency and proportions in tables and charts. Bivariate analysis (Pearson Chi square [χ^2]) was conducted to determine the association between modern contraceptive uptake and each of the predictor variables.

Variables that had an association with modern contraceptive uptake at ≤ 0.2 at bivariate level were further analysed using unconditional multiple logistic regression to identify independent predictors of modern contraceptive uptake. Crude and Adjusted Odds Ratios and their 95% Confidence Intervals (95% CI) were estimated. All statistical analyses were performed at statistical significance level of *P-value* equals or less than .05. Quantum Geographic Information System Version 3.0.2 (QGIS 3.0.2) was used to draw the map of the study location.

RESULTS

Socio-Demographic Characteristics

A total of 9,945 women were eligible for the analysis based on the set inclusion criteria. The respondents' mean age was 33.1 ± 8.2 years. Majority, 5709 (57.4%) of the respondents were within 25 to 39 years' age group. Most of them, 8,069 (81.1%) were residing in rural areas. Overall, Catholics were the majority 5,681 (57.1%) followed by protestants [3,361 (33.8%)], while Muslims were 435 (4.4%) and Jehovah witness were 33 (0.3%) among the respondents. About half [4,695 (47.2%)] of the respondents had no formal education, those with primary education were 3,849 (38.7%) while those who had secondary or more were 1,401 (14.1%). More than half [5,638 (56.7%)] were breastfeeding. In terms of employment status, 8,666 (87.1%) were working, less than half of the respondents [4,048 (40.7%)] owned either a radio or television among which only 1,735 (17.5%) were listening to radio or watching television at least once a week.

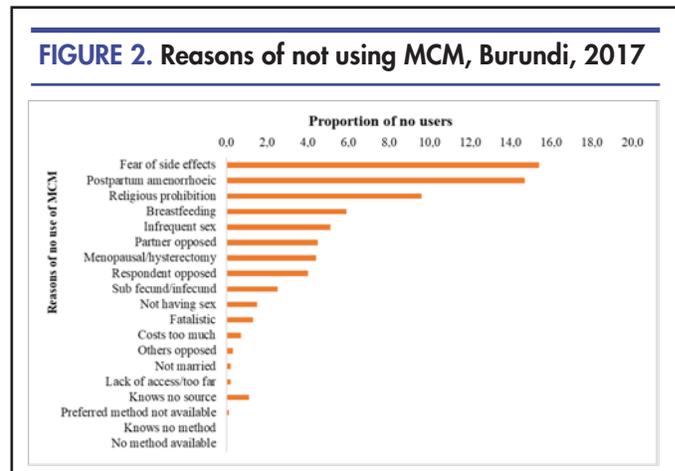
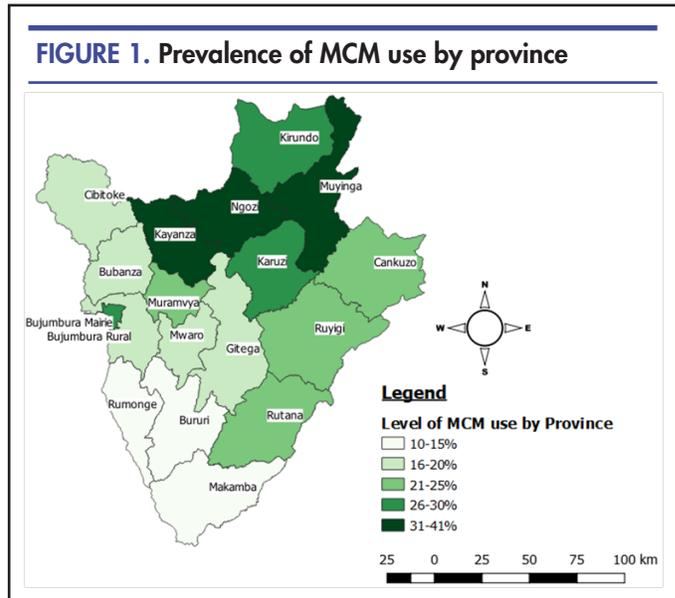


TABLE 1: Distribution of modern contraceptive users and type of contraceptives used, Burundi, 2016-2017

Characteristics	Frequency	Percent
Modern contraceptive method use		
Users	2372	23.85
No users	7573	76.15
Type of methods used (n= 2372)		
Injections	1146	48.31
Implants/Norplant	627	26.43
Pill	180	7.59
Male condom	174	7.34
IUD	96	4.05
Female sterilisation	60	2.53
Standard days method (SDM)	47	1.98
Lactationalamenorrhoea (LAM)	19	0.80
Male sterilisation	12	0.51
Emergency contraception	9	0.38
Female condom	2	0.08

Utilisation of Modern Contraceptive Methods

Out of the 9,945 respondents, 2,378 (23.9%) were using modern contraceptive methods at the time of interview. Among those who were using modern contraceptive methods, 1,146 (48.2%) were using injectables, follow-

ed by implants accounting for 627 (26.43%) of the respondents. Pills and male condom were used by 180 (7.6%) and 174 (7.3%) respondents respectively. The least used methods were Emergency contraception [9(0.4%)] and female condom [2(0.1%)] respectively (Table 1).

Figure 1 shows that the prevalence of MCM uptake varies from one province to another. It was highest in the Northern part of the country; Ngozi province (41.1%) followed by Kayanza (34.9%) and Muyinga (31.6%) province. The provinces in the South had the lowest prevalence of 14.9%, 13.9% and 12.5% for Rumonge, Bururi and Makamba province respectively.

Among those who were not using MCM at the time of interview, One-fifth (20.9%) of them mentioned postpartum amenorrhoea as the reason for not using MCM. Other reasons given were; fear of side effects (12.9%), religious prohibition (7.7%) and having infrequent sex (4.9%). The reason with least responses was the non-availability of the method/ service (Figure 2).

TABLE 2: Association between respondents’ background characteristics and modern contraceptive use Burundi, 2017

Characteristics	Modern contraceptive methods use				X ²	P-value
	Yes Freq	%	No Freq	%		
Age						
15-19	67	31.0	149	68.9	211.4	<.001*
20-24	455	31.2	1004	68.8		
25-29	566	27.4	1499	72.6		
30-34	513	25.9	1466	74.1		
35-39	398	23.9	1267	76.1		
40-44	254	18.1	1149	81.9		
45-49	119	10.3	1039	89.7		
Residence						
Rural	1784	22.1	6285	77.9	70.9	<.001*
Urban	588	31.3	1288	68.7		
Religion						
Catholic	1393	24.5	4288	75.5	110.2	<.001*
Protestant	694	20.6	2667	79.3		
Muslim	178	40.9	257	59.1		
Adventist	70	23.3	230	76.7		
Jehovahwitness	17	51.5	16	48.5		
No religion	20	14.8	115	85.2		
Highest educational level						
No education	900	19.2	3795	80.8	118.8	<.001*
Primary	1033	26.8	2816	73.2		
Secondary/higher	439	31.3	962	68.7		
Visited HF in the last 2 months						
Yes	2137	24.8	6471	75.2	33.1	<.001*
No	235	17.6	1102	82.4		
Currently working						
Yes	1376	17.1	6659	82.9	17.5	<.001*
No	996	52.2	914	47.8		
Having Radio/TV						
Yes	1151	28.4	2897	71.6	78.5	<.001*
No	1221	20.7	4676	79.3		
Listening Radio/TV						
Not at all	1072	20.7	4096	79.3	69.3	<.001*
Less than once a week	423	24.4	1312	75.6		
At least once a week	877	28.8	2165	71.2		
Currently breast feeding						
Yes	1376	24.4	4262	75.6	2.1	.144
No	996	23.1	3311	76.9		

* Statistically significant

Factors Associated with Modern Contraceptive Uptake

Table 2 shows that background characteristics of women are associated with the uptake of MCM. After controlling the possible confounders, the results from unconditional logistic regression in table 3 shows that women aged 30-34 years (aOR = 0.7; 95% CI = 0.5-0.9), 35-39 years (aOR=0.7; 95% CI=0.5-0.9), 40-44 years (aOR=0.6; 95% CI=0.4-0.8) and 45-49 years (aOR=0.4; 95% CI=0.2-0.5) were less likely to use modern contraceptive methods compared with young adolescent women aged 15-19 years. Being an urban resident was also significantly

associated with modern contraceptive methods uptake (aOR=1.3; 95% CI=1.2-1.5). Compared with Catholics, Protestants (aOR=0.8; 95% CI=0.7-0.8) and those without religion (aOR=0.6; 95% CI=0.4-0.9) were less likely to use modern contraceptive methods. However, Muslims (aOR=1.5, 95% CI=1.2-1.9) and Jehovah witness (aOR=3.1; 95% CI=1.6-5.9) were more likely to be users of modern contraceptive methods. Having primary education (aOR=1.2; 95% CI=1.1-1.3) or secondary/higher education (aOR=1.2; 95% CI=1.1-1.6) was not significantly associated with modern contraceptive methods uptake compared with those without any formal educa-

TABLE 3: Logistic Regression for Independent Predictors of Modern Contraceptive Use

Characteristics	cOR	95% CI	P - value	aOR	95% CI	P - value
Age						
15-19	Ref			Ref		
20-24	0.9	0.7-1.3	.692	0.9	0.6-1.2	.439
25-29	0.8	0.6-1.1	.133	0.8	0.5-1.0	.085
30-34	0.7	0.5-2.0	.049*	0.7	0.5-0.9	.023*
35-39	0.7	0.5-0.9	.025*	0.7	0.5-0.9	.019*
40-44	0.5	0.4-0.7	<.001*	0.6	0.4-0.8	.002*
45-49	0.3	0.2-0.4	<.001*	0.4	0.2-0.5	<.001*
Residence						
Rural	Ref			Ref		
Urban	1.6	1.5-1.8	<.001*	1.3	1.2-1.5	<.001*
Religion						
Catholic	Ref			Ref		
Protestant	0.8	0.7-0.9	<.001*	0.8	0.7-0.8	<.001*
Muslim	2.1	1.7-2.5	<.001*	1.5	1.2-1.9	.002*
Adventist	0.9	0.7-1.2	.646	0.8	0.6-1.1	.170
Jehovah witness	3.0	1.5-5.8	.001*	3.1	1.6-5.9	.001*
No religion	0.5	0.3-0.9	.015*	0.6	0.4-0.9	.041*
Highest educational level						
No education	Ref			Ref		
Primary	1.5	1.34-1.7	<.001*	1.2	1.1-1.3	.055
Secondary/higher	1.9	1.7-2.2	<.001*	1.2	1.1-1.6	.082
Visited HF in last 2 months						
No	Ref					
Yes	1.4	1.2-1.6	<.001*	1.1	1.0-1.3	.104
Currently working						
No	Ref					
Yes	0.8	0.7-0.9	<.001*	0.9	0.8-1.0	.069
Having radio/TV						
No	Ref					
Yes	1.5	1.4-1.6	<.001*	1.2	1.1-1.4	.002*
Listening Radio/TV						
Not at all	Ref			Ref		
Less than once a week	1.2	1.1-1.4	.009*	1.1	1.0-1.3	.068
At least once a week	1.5	1.4-1.7	<.001*	1.2	1.1-1.4	.066
Currently breast feeding						
No	Ref					
Yes	1.4	1.3-1.5	<.001*	1.1	1.0-1.2	.034*

* Statically significant

tion (Table 3).

DISCUSSION

The results of the analysis indicated that the prevalence of MCM is low among women of reproductive age in Burundi. Despite the effort of the Burundi government and the ministry of health in mobilising people on modern contraceptive uptake, utilisation has dropped from 30.8% in 2013¹² to 23.8% in 2017. This can be explained by the non-availability of law that limits the number of children a woman should have. The prevalence in Ngozi province was the highest in the country and above the national average level. It is also the second province with highest

population density²³. This could probably explain their high uptake of MCM since they do understand the consequences of having many children and therefore agree to embrace family planning/child spacing services. The prevalence of MCM from this analysis is similar to that reported in the Burundi Demographic and Health Survey in 2016-2017 where 23.0% of non-pregnant women were using MCM as against 6.0% who were using traditional methods.²⁴ Our findings were also consistent with that of Aviahsah et al in Ghana (2014) and those from various studies in Africa, where the prevalence was 21.5%¹⁸ and between 20.0% and 30.0%.^{15,16,18,20-22} However, the uptake of MCM in Burundi is lower than uptake in Mala-

where the prevalence was 30.9% in 2016.⁸ In a study conducted in northwest Ethiopia, uptake was also found to be higher than that of Burundi where 44.6% of women always used one of the MCM²⁰. The most used methods among women were injections/injectables and implants/norplant. This finding was consistent with that obtained by Alemayehu et al in Ethiopia where injections and implants were the most used contraceptive methods.^{21,22} However, our results differ from the study conducted in Kenya where the commonly used contraceptives were condoms (35%) and pills (33%).¹⁹

Most of the respondents' socio – demographic characteristics were significant predictors of MCM uptake. We observed that young women (aged 15–24 years) were more likely to use MCM compared to older women. This however, differs from the results of Ntambue et al in Mbuji-Mayi, DRC in 2015 where the age was not significantly associated with the uptake of MCM.¹⁶ Our analysis in the final adjusted model revealed that educational level of a woman did not influence her likelihood to use modern contraceptives. This differs from what Aviisah et al found in Ghana (2014), where women who had primary education as their highest level of educational attainment were 27.0% more likely to use modern contraceptives than women who had no formal education. While those who attained higher educational levels were 48.0% more likely to use modern contraceptives than women without formal education.¹⁸ A study conducted in Bangladesh on prevalence and determinants of contraceptive use among employed and unemployed women revealed that employed women with higher educational levels had a marked increased probability of contraceptive use compared to illiterates.²⁵ Place of residence to a large extent, by default, influence different living habit. It was found that uptake of modern contraceptives was 33.0% higher among women in urban areas than those in rural areas. This is consistent with what was found in Ghana (2014).¹⁸ Religion play a major role in family planning methods utilisation. Religious beliefs about modern family planning varies from one region or faith to the another. Our analysis found that Protestants were 25.0% less likely to use MCM than Catholics. Muslims were 51.0% more likely to use MCM than other faith. Jehovah witness was also 3 times more likely to use MCM when compared with Catholics. Okech et al also found that religion negatively affects the uptake of MCM in Kenya's City Slums.¹⁹ However, a study in Ghana (2014)¹⁸ found no statistically significant association between religion and MCM use. Having radio or television was also found to be among the predictors of MCM use in our study, which is consistent with the study conducted in South Ethiopia by Tadesse et al in 2013.²¹

CONCLUSION AND RECOMMENDATIONS

The prevalence of MCM in 2017 among women of reproductive age in Burundi was low and has a declining trend compared with what was obtained in 2013. Place of residence, religion and having a radio/television are significant predictors of MCM use among women in Burundi. In order to improve utilisation of modern contraceptive methods among women of reproductive age in Burundi, we recommend the following:

- Family planning program officers should strengthen family planning education especially among the rural res-

idents.

- Health professionals should engage religious leaders in the promotion of family planning services to their respective congregations in order to do away with religious beliefs that act as barriers to MCM use.

Limitations of the Study

This study relied on reported rather than actual MCM uptake. Future studies should consider prospectively or transversally collecting data within a specified period. However, this was beyond the scope of this study.

Ethical approval and consent to participate

Permission to use the data was obtained from the DHS program. The original study obtained ethical clearance from the Burundi National Ethics Committee (NEC). All participants provided oral informed consent.

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Prevalence and Predictor of Exclusive Breastfeeding among Mothers of 0 to 6 months Infants from Pastoralists and Hunters' Community in Tanzania; A Community Based Cross-Sectional Study

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ABSTRACT

Background: Initiating breastfeeding during the first hour after birth and continuing breastfeeding exclusively for 6 months prevents childhood infections such as diarrhoea. Exclusive breastfeeding (EBF) for the first 6 months of life of the baby is recognised globally as the best and the most effective intervention to ensure the survival of babies. The aim of this study was to determine the prevalence of EBF and its predictors among mothers of 0 to 6 months infants from pastoralists and hunters' community in Manyara region-Tanzania.

Methods: This was a community-based analytical cross-sectional study that involved 342 mothers of 0 to 6 months infants who were randomly selected through 4 stage multistage sampling technique. Data was collected using an interviewer-administered questionnaire. Collected data was analysed using Statistical Package for Social Sciences (SPSS) version 20. Binary Logistic Regression analysis was used to establish factors associated with EBF practices.

Results: The prevalence of EBF among postnatal women from hunters and pastoralists societies was 47.1% at 95% CI=41.7%-52.5%. After adjusted for confounders, the predictors of EBF practice were age of infants (0-1 months, AOR=2.838 at 95% CI= 1.326-6.075, $p=.007$), age of mothers (26-35 years, AOR=1.851 at 95% CI= 1.059-3.234, $p=.031$), level of education of infants' mothers (primary education, AOR= 2.374 at 95% CI= 1.321-4.265, $p=.004$) and knowledge on exclusive breast feeding, AOR=2.51 at 95% CI= 1.435-4.393, $p=.001$.

Conclusion: Majority of mothers from pastoralists' and hunters' societies were not practising EBF. Predictors of EBF practice were; the age of infants, maternal age, level of education of the mother and knowledge on exclusive breastfeeding. Poor EBF practice was mainly contributed to low level of knowledge about the EBF. The low level of knowledge could have been contributed by poor access to maternal services. Nature of living (lack of permanent settlement) of the study population could have contributed to low access to maternal services. An innovative interventional study is highly recommended to come up with strategies that will improve knowledge on EBF and practice of EBF

BACKGROUND

Child mortality remains a public health challenge globally. It is estimated that 70% of deaths that occurred between the ages of 0-25 years in 2019 were mostly comprised of children below 5 years, amounting to 5.2 Million deaths. The first month of life was the riskiest period for child survival as 47% of below 5 deaths occurred in this period. 28% of below 5 death occurred among children aged 1-11 Months.¹

Exclusive Breast Feeding (EBF) for the first 6 months of the life of the baby is recognised globally as the best and most effective intervention to ensure the survival of babies.² Globally, about 35% of babies are breastfed exclusively, whereas in sub-Saharan Africa, babies who are breastfed exclusively range between 22% and 33%.³

How infant feeding is done in the first 6 months is diverse and is based on geographical, economical and cultural settings whereby the main concern is the time when mothers initiate breastfeeding, complementary breastfeeding, duration of breastfeeding and the age at which mothers wean their infants.⁴ A study conducted in the United States of America (USA) reveals that practicing EBF for not less than the first 6 months can stop over 900 deaths of infants and children which occur yearly in the USA.⁵

The prevalence of EBF of babies from birth to 6 months has however increased among developing countries from 33% in the year 1995 to 39% in the year 2010 and the West and Central Africa have shown much improvement.⁶ Despite so many studies having been conducted on EBF, the practice is still not extensive in

developing countries and is still far beyond the global expectation of 90%, which leaves a gap for much betterment. Furthermore, the associated factors can be quite different between one country and another or even within the same country.⁷ In a study conducted in Baghdad, exclusive Breastfeeding is reported to have the ability to decrease the risk of lower respiratory infections. The study further states that the infants who are provided with formula feeding have a 2.7 times risk for Acute Respiratory Infection (ARI) compared to breastfed infants while those infants breastfed for less than 3 months have a 2.5 times risk for ARI.⁸

Milk from a woman's breasts boosts sensory and cognitive maturity and protects the baby from common childhood illnesses and chronic illnesses as well as shortening the time to recover from illness.⁹ Studies have also indicated that breast milk prevents metabolic diseases especially against obesity and type 2 diabetes mellitus.¹⁰ Early initiation of complementary foods and liquids decrease the amount of breast milk the infant takes and thus reducing the absorption of the necessary nutrients found in breast milk, hence increasing the chances for the infant to acquire ARI and diarrhoea.¹¹ Other studies have shown that EBF is associated with a reduced risk of HIV infection from mother to child.¹²

Milk from a woman's breasts is the only food derived from nature that a baby requires for the first 6 months of life. Breast milk is easily digestible and absorbable, provides the baby with all nutrients and contains digestive enzymes. Infants who are breastfed exclusively for 6 months tend to develop a high IQ, less risk for developing childhood obesity and are also protected against childhood diseases.¹³ EBF is protective against otitis media.¹⁴ EBF also has benefits for the mother whereby; it increases hormone production which helps in the uterine contractions preventing postpartum haemorrhage. It also acts as natural contraception as it delays the time for fertility, reduces the risk for ovarian and breast cancer while promoting bond for both mother and child.¹⁵

In Tanzania, the EBF rate is still low, at about 59% compared to the global target of 90%, however initiating breastfeeding during the first hour after delivery is at 51%¹⁶. In the locality of Manyara Region, the EBF is still very low compared to the national level with prevalence of 33.3% according to Tanzania National Nutritional Survey¹⁷, whereby initiating breastfeeding during the first hour after delivery is reported to be 76%.¹⁶ In Zanzibar, although mothers have good knowledge of breastfeeding practices, many did not practice EBF and the reported rate of EBF was 20.8%.¹⁸ This can be explained with the existing challenges for meeting exclusive breastfeeding such as the belief that breast milk alone is not sufficient in meeting babies' nutritional needs, short maternity leave and socio-cultural pressure to introduce water and artificial feeds.¹⁹

Previous studies have listed several factors associated with exclusive breastfeeding such as ethnicity of the mother²⁰, maternal education^{20,21}, family income²⁰, perceived inadequate breast milk²¹, maternal age²², mode of delivery²¹ and knowledge about EBF.²³

Despite the sensitisation through media, drama on EBF -

practice, still suboptimal breastfeeding is existing in the Manyara region where the majority of the habitant population are hunters and pastoralists. Little is known on predictors of EBF practices among indigenous pastoralists and hunters' communities in the Manyara region.

METHODS

Research Design

This study was a community-based cross-sectional analytical study that involved assessing the exposure and outcomes of EBF and predictors of EBF practice.

Study Area

This study was conducted in rural areas of the Manyara region in 3 districts namely; Mbulu, Simanjiro, and Hanang. This Region is located in the Great Rift Valley and has large herds of cattle and wildlife reserves. It is home for the most distinctive indigenous tribes. The Hadzabe tribe who live in Yaeda Chini valley practice hunting and collecting of wild honey, roots and wild fruits. Other tribes found in the region are; Iraqw, Gorowa, Maasai, Barbaig/ Mang'ati.²⁴ In a report from the 2012 National Census, the region has a population of 1,425,131 people. Among these, females are 708,046.²⁵ The region has 10 hospitals, 25 health centres and 207 dispensaries. Similar to other regions, the numbers of health facilities do not match the population, also, the region has an additional barrier towards accessing maternal health services. The majority of hunters and pastoralists do not have permanent settlements as they migrate depending on the availability of pasture. The majority of rural dwellers in Tanzania depend very much on health facilities as their sole source of health education.

Study Population

The study population included all mothers from pastoralists and hunters' community together with their infants of 0 to 6 months of age in the 3 selected districts within the Manyara region.

Inclusion Criteria

Postnatal mothers with infants aged 0 to 6 months from hunters and pastoralists societies who consented to participate in the study.

Exclusion criteria

Postnatal mothers with infants aged 0-6 months from hunters and pastoralists societies who were very sick, mentally sick and those with infants who were very sick.

Sample Size Estimation

This study used the proportion of 33.3% of women practicing EBF in the Manyara Region as reported in the Tanzania National Nutrition Survey.

The formula used was adopted from Cochran, 1975

$$n = \frac{Z^2 pq}{e^2}$$

Where;

n= minimal sample size desired

p= proportion of the target population estimated to be exclusively breastfed 33.3%

q=1-p

e=marginal error 5%

Z = standard normal deviation at, 95% confidence inter-

val 1.96

$$n = 1.96^2 \times 0.333 (1 - 0.333) / 0.05^2$$

$$n = 323.5 \approx 324$$

The computed figure 324 was adjusted by 10% for the inconsistencies and incompleteness. The sample size arrived at was 356 participants

Sampling Technique

Manyara Region was selected purposively because it showed a low prevalence of EBF (33.3%) as reported in the Tanzania National Nutrition Survey¹⁷. It is also the home for pastoralists and hunters community. The study employed the multistage sampling technique. This involved 4 stages:

First stage: Selection of Districts: 3 districts out of 5 districts in the Manyara region were randomly selected using Simple Random Sampling by Lottery Selection.

Second stage: Selection of Wards: Simple Random Sampling by Lottery method was employed to select 2 wards out of 8 wards in each district, making a total of 6 wards.

Third stage: Selection of Villages: On each of the selected ward, 3 villages out of 4 was selected using Simple Random Sampling by Lottery method, making a total of 18 villages. Each ward in Tanzania contains approximately 4 villages.²⁵

Fourth stage: Selection of Household: After obtaining a list of households with infants from the community health care workers' register, 19 households out of approximately 34 households were selected using Simple Random Sampling from each of the 18 villages.

Data Collection Method

Data was collected using interviewer-administered questionnaires and documentary reviews. 5 research assistants were recruited and trained about the tool and data collection process. The principal investigator and the research assistants were fluent in 3 languages; English, Swahili and the local language of the interviewee. The tool was developed in English and translated into Swahili. The questionnaire was then translated to specific local languages to facilitate easy capture of the data. Documentary review involved analysing Reproductive and Child Health (RCH) cards which were obtained from mothers. The instrument was piloted among unselected villagers in Manyara Region and minor modifications were done before the final document of the tool was released. Data was collected from 8th April 2019 to 6th June 2019.

Variables

Independent variables were maternal characteristics and socio-cultural factors. The dependent variable was prevalence and predictors of EBF

Variable Measurement

EBF practice was measured by using close-ended questionnaires with 7 selected items each having 1 mark for the correct answer and 0 score for incorrect answer. Before Principal Component Factor (PCA), analysis was done to extract the items, one item was excluded since it had the same response (yes). On the first phase of PCA,

the variance was 33.694 and all remaining 6 items were above 0.3. Mean was 0.86, median 0.97, minimum 2.48 and maximum was 2.85976. Since data was not normally distributed, median was used as a cut-point for categorisation. Participants who scored below-median were considered as non-EBF mothers while those scoring above the median were considered as EBF mothers.

Maternal knowledge of EBF was measured by 22 items. Each right answer had 1 mark and the wrong answer had a zero mark, making a total of 22 (100%). Principle Factor Analysis was employed to extract items. Among 22 items, 2 items carried the same value (yes) for all respondents so they were excluded during data processing.

In the first phase of Principle Factor Reduction analysis, 20 items were included and the highest variance was 25.737, then 2 items were again excluded because they had a weighted score of <0.3. During the 2nd phase of Factor Reduction, 18 items were selected, the highest variance was 31.011. All the remaining 18 items scored more than 0.3, therefore these items were used for scoring. Normality test showed that data was normally distributed. Therefore, mean was selected to be the cut point for scoring. Mean = 0.49, median = 0.27, mode = 2.72, SD 1.14, minimum -1.75, maximum = 2.72. Those who scored above the mean had adequate knowledge, and those who scored below mean had inadequate knowledge.

Data Analysis

Data was first checked for completeness and missing information and then manually cleaned before it was analysed using Statistical Package for Social Sciences (SPSS) version 20 developed by IBM USA. Demographic characteristics were analysed by Descriptive Statistics to indicate frequencies and percentages. Frequencies were recorded in charts, which showed the prevalence and magnitude of the selected variables. A normality test was used to test the distribution by histogram. To assess the level of knowledge of EBF and practices of breastfeeding among respondents, Principal factor analysis was employed to determine the scores.

A chi-square test was used to test the relationship between maternal variables and EBF practices. Maternal variables with a p-value less than 0.2 in the Chi-square test were entered into a regression model to establish the association. Binary Logistic regression was used to determine the strength of association between the selected variables controlling for confounder variables whereby both Odds Ratio (OR) and Adjusted Odds Ratio (AOR) were reported. Significance level was set to 0.05 ($P < .05$) equivalent to 95% Confidence Interval.

Ethics Approval and Consent to Participate

The proposal was approved by the Ethical Review Committee of the University of Dodoma in Dodoma, Tanzania Ref: UDOM/DRP/134/VOL VII/36. Furthermore, a letter of permission was obtained from the Manyara Region Administration. Both written and verbal consents were sought from study participants after explaining to them the study objectives, procedures and their right to refuse to participate in the study at any time they wish. For study participants who were younger than 18 years, verbal consent to participate was sought from their parents or guardians.

RESULTS

Socio-Demographic Characteristics of the Infants Aged 0-6 Months and their Mothers

Of the 356 sampled mothers, the response rate was 96% which is equivalent to 342 mothers.

The majority, 155 (45.3%) of infant mothers were in the age group of 16- 25 years with mean 27.59 ± 6.498 . Nearly half, 164 (48%) of the study respondents had no formal education. The majority of infants were aged between 4-5 months 130 (38.0%). The mean age of the infants was 2.76 ± 1.023 . Most of the infants, 227 (66.4%) were male and most of them 222 (64.9%) had good progress in immunisation according to schedule (Table 1).

Prevalence of Exclusive Breastfeeding Practice

The results of this study show that more than half of the respondents 181 (52.9%) were not practicing EBF while only 161 (47.1%) were practicing EBF. The prevalence of EBF practice was 47.1% and 95% CI= 41.7%-52.5%

Maternal Knowledge of EBF

In general, among all the study respondents, only 147 (43.0%) had adequate knowledge of exclusive breastfeeding

The Relationship between Socio-Demographic Characteristics and EBF

Socio-demographic characteristics which showed a significant relationship with EBF were the age of the infant ($p < .001$), age group of infants' mothers ($p = .026$), Mother's level of education ($p < .001$), mother's occupation ($p = .022$), Religion ($p = .005$), mothers' knowledge about EBF ($p < .001$) and the number of antenatal visits ($p < .001$) (Table 2)

When adjusting for confounders, knowledge on EBF was found to be a strong predictor of EBF. Those with adequate knowledge on EBF were nearly 3 times more likely to have good breastfeeding practices compared to those with inadequate knowledge, AOR=2.51 at 95% CI= 1.435-4.393, $p = .001$, age of infants (6 months, AOR= 2.838 at 95% CI = 1.326-6.075, $p = .007$), age of mothers (26-35 years, AOR=1.851 at 95% CI= 1.059-3.234, $p = .031$) and level of education of infants' mothers (primary education, AOR= 2.374 at 95% CI= 1.321-4.265, $p = .004$) (Table 3).

DISCUSSION

In the current study, the prevalence of EBF among mothers of infants aged 0-6 months from pastoralists and hunters' communities in the Manyara Region was low (42.4%) if compared to the national average of EBF of 59%.²² A higher prevalence of EBF has been reported by a similar study done in Kigoma Tanzania.²⁷ The reason for the difference could be due to differences in study settings. The current study was done among rural communities while the study in Kigoma was among urban dwellers. The low prevalence could be due to cultural factors and the nature of lifestyle of this community. A previous study done in Kenya has reported that socio-cultural beliefs (considering colostrum as 'dirty, a curse, bad omen, associated with breastfeeding while engaging in extramarital affairs, a fear of the 'evil eye' when breastfeeding in public) play suboptimal roles in EBF practice.²⁸

The hunters and pastoralists do lack permanent settlements, they move according to the availability of pasture and food. For such a lifestyle, it becomes hard for them to access maternal health services where they could access health education on EBF.

The findings from the current study showed that the EBF prevalence (42.4%) was higher compared to the previous study by Tanzania National Nutrition Survey which reported the EBF in Manyara region to be 33.3%¹⁷. This increase could be because of the time that has passed since the survey was conducted and women may have acquired some knowledge since several media sensitise people about of importance EBF. These results were compared to findings from previous studies in Ghana, where it was reported that the EBF practice was 66.0%, Manhean et al.²⁹, this is higher than the current study. The difference could be due to differences in sample characteristics and knowledge the mothers had on EBF and methods used for data collection. Meanwhile, a study in Bangladesh reported that EBF practices were at 35.90%.³⁰ However, the findings from another study in Ethiopia³¹ reported EBF practice of 44.2% which was in contrast to the current study. Furthermore, a study which was conducted in rural Coast region Tanzania reported EBF practice to be at about 30%.³² However, a study conducted in Muheza reported EBF practice to be 24.1%.³ This difference in results could be due to the difference in sample size which was used and geographical location.

The study found that maternal knowledge about EBF significantly influenced their practice on EBF. Postnatal mothers who had adequate knowledge of EBF were almost 3 times more likely to practice Exclusive Breastfeeding when compared with those with inadequate knowledge. This means, knowledge of EBF plays an optimal role in EBF practice. Similar previous studies conducted elsewhere have also reported significant association between knowledge on EBF and EBF practice.^{33,34}

In the current study, only 45.9% of postnatal mothers had adequate knowledge of EBF. The reason for inadequate knowledge of EBF could be that women in this community have low level of education. Secondly, because they move from place to place grazing livestock, they have little time to attend ANC from where they could get knowledge of EBF. Another reason could be due to the language used to provide health education during maternal services visits at health centres, the majority of women of this community could only understand messages spoken in their local languages while the medium of communication in health facilities is Swahili.

In contrast, a similar study in Nigeria reported low knowledge of EBF where only 30.0% of women were adequately informed.³⁴ However, in a study conducted in Ghana among rural lactating mothers, 74% had general knowledge of EBF which they got from health care providers during antenatal and postnatal visits.³⁵

In Malawi, the rate of EBF among babies below 6 months of age increased from 3% in 1992 to 71% in 2010. This was attributed to the government's implementation of the Infant and Young Child Feeding (IYCF) program as well as enrolment of a mass education program to increase support and EBF knowledge.¹¹

TABLE 1: Socio-Demographic Characteristics of the Infant and Mother (N=342)

Variable	Frequency (n)	Percentage (%)
The age group of infant mothers		
16- 25 years	155	45.3
26-35 years	137	40.1
36-45 years	50	14.6
Education of infant mothers		
None	164	48.0
Primary	154	45.0
Secondary/higher	24	7.0
Marital status of infant mothers		
Married/cohabiting	317	92.7
Unmarried	25	7.3
Occupation of the infant-mother		
Livestock keeper	151	44.2
Hunter	54	15.8
Peasants	103	30.1
Employed /Self-employed	34	9.9
Tribe of the infant-mother		
Maasai	102	29.8
Barbairq/Mang'ati	86	25.1
Iraqw	79	23.1
Hadzabe	52	15.2
Other tribes	19	5.6
Ndorobo/Akea	4	1.2
The religion of infant-mother		
Traditional	168	49.1
Christians	163	47.7
Muslims	11	3.2
District of residence		
Mbulu	119	34.8
Hanang	113	33.0
Simanjiro	110	32.2
Toilet available		
Yes	326	95.3
No	16	4.7
Safe water available		
Safe	98	28.7
Unsafe	244	71.3
Hygiene		
Good	304	88.9
Poor	38	11.1
Parental smoking		
Yes	127	37.1
No	215	62.9
The age group of infants (month)		
0-1	55	16.1
2-3	65	19.0
4-5	130	38.0
6	92	26.9
Sex		
Boys	227	66.4
Girls	115	33.6

TABLE 2: The Relationship between Socio-Demographic and EBF

Variable	EBF(n=145) n(%)	Mixed feeding (n=197) n(%)	X ²	P-value
Age group of infants				
0 to 1 month	22 (40)	33 (60)	20.423	<.001
2 to 3 months	36 (55.4)	29 (44.6)		
4 to 5 months	45 (34.6)	85 (65.4)		
6 months	58 (63)	34 (37)		
Sex of a child				
male	104 (45.8)	123 (54.2)	.431	.512
female	57 (49.6)	58 (50.4)		
The age group of mothers				
16-25 years	71 (45.8)	84 (54.2)	7.309	.026
26-35 years	74 (54)	63 (46)		
36-45 years	16 (32)	34 (68)		
Level of Education of mother				
no formal education	54 (32.9)	110 (67.1)	25.798	<.001
primary education	91 (59.1)	63 (40.9)		
secondary /higher education	16 (66.7)	8 (33.3)		
Occupation of a mother				
peasant	49 (47.6)	54 (52.4)	9.620	.022
employed/self-employed	22 (64.7)	12 (35.3)		
livestock keeping	73 (48.3)	78 (51.7)		
hunting	17 (31.5)	37 (68.5)		
Marital status				
Married/cohabiting	153 (48.3)	164 (51.7)	2.461	.117
Not married	8 (32)	17 (68)		
Tribe				
Iraqw	39 (49.4)	40 (50.6)	11.002	.051
Barbaig	43 (50)	43 (50)		
Hadzabe	17 (32.7)	35 (67.3)		
Maasai	47 (46.1)	55 (53.9)		
Ndorobo	1 (25)	3 (75)		
Others	14 (73.7)	5 (26.3)		
Religion				
Christian	88 (54)	75(46)	10.772	.005
Muslim	8 (72.7)	3(27.3)		
Traditional/pagan	65 (38.7)	103(61.3)		
Parity				
Primipara	62(43.7)	80 (56.3)	1.136	.287
Multipara	99 (49.5)	101 (50.5)		
Number of ANC Visits				
None	29 (27.1)	78 (72.9)	27.976	<.001
One-three	79 (52)	73 (48)		
Four or more	53 (63.9)	30 (36.1)		
Place of Childbirth				
Health Facility	82(41.2)	117(58.8)	26.230	<.001
Traditional Birth attendants	99(69.2)	44(30.8)		
Knowledge about EBF				
Adequate	103(65.6)	54 (34.4)	39.995	<.001
Inadequate	58(31.4)	127 (68.6)		

The study also found that the age of the infant influenced EBF practice. Postnatal mothers with neonates were almost 3 times more likely to practice EBF compared to postnatal mothers with infants aged 6 months and above.

The reason for this could be due to the belief that breast milk alone cannot meet the nutritional requirements of older infants. Also, this could be due to maternal engagement in household activities which may sometimes

TABLE 3: Predictors of Exclusive Breastfeeding (EBF) (N=342)

Variable	OR	95% CI Lower	Upper	P-value	AOR	95% CI Lower	upper	p-value
The age group of infants								
6 months	1				1			
4 to 5 months	1.86	0.899	3.857	.094	2.097	0.937	4.696	.072
2 to 3 months	0.79	0.415	1.52	.487	1.041	0.506	2.142	.914
0 to 1 months	2.56	1.289	5.08	.007	2.838	1.326	6.075	.007
The age group of mothers								
16-25 years	1				1			
26-35 years	1.39	0.876	2.204	1.39	1.851	1.059	3.234	.031
36-45 years	0.56	0.284	1.091	.557	1.985	0.84	4.689	.118
Level of Education of mother								
no formal education	1				1			
primary education	2.94	1.862	4.649	.000	2.374	1.32	4.265	.004
secondary /higher educ.	4.07	1.642	10.111	.002	1.864	0.535	6.491	.328
Occupation of a mother								
peasant	1				1			
employed/self-employed	2.02	0.905	4.508	.086	0.987	0.351	2.771	.98
livestock keeping	1.03	0.625	1.703	.904	1.14	0.636	2.041	.66
hunting	0.51	0.253	1.012	.054	1.019	0.439	2.366	.964
Knowledge about EBF								
Inadequate	1				1			
Adequate	4.18	2.656	6.568	.000	2.51	1.435	4.393	.001
Number of ANC Visits								
None	1				1			
One-three	2.91	1.71	4.955	.000	1.554	0.766	3.152	.222
Four or more	4.75	2.561	8.818	.000	1.954	0.843	4.53	.119
Place of Childbirth								
Traditional Birth attendants	1				1			
Health Facility	3.21	2.04	5.053	.000	1.445	0.767	2.72	.255

necessitate separation with the infant for hours. Similar previous studies on predictors of EBF have reported similar findings.^{19,33}

The study also found that maternal level of education predicted significantly EBF practice. Postnatal mothers who had primary education were twice more likely to practice EBF compared to postnatal mothers with no formal education. A previous study conducted in Northern Tanzania on predictors of EBF practice reported a different finding that women’s level of education does not predict the practice of EBF.³ Different findings could be due to differences in the study communities. In the current study, language barrier could have played a great role in hindering acquisition of knowledge on EBF. Postnatal mothers who attended primary level of education have the advantage of learning the Swahili Language, the language used in the delivery of maternal health services, including health education in health centres. This factor could have favoured them to acquire adequate knowledge on EBF which in turn facilitated the practice of EBF. The current study also found that maternal age predicted the practice of EBF. Postnatal mothers with advanced age were twice more likely to practice EBF than young postnatal mothers. The finding is in line with a similar previous study conducted in Northern Tanzania.³ Another study conducted in Zimbabwe has reported maternal age of below 25 years as a barrier towards EBF practice.

Study Limitations

The key information gathered from the study participants was self-reported which is subject to under-or over-reporting. Despite the systematic data collection approach, there may have been some intrinsic bias in the questionnaire or manner in which questions were asked that might have affected the responses. Although the reported predictors were controlled through regression analysis, the causal-effect relationship study is recommended.

CONCLUSIONS

The EBF practice is poor in the Manyara region. Postnatal mothers who were more likely to practice EBF were those of advanced age, with infants aged 0-1 months, had a primary level of education and had an adequate level of knowledge on EBF. The study recommends an innovative interventional study to come up with cost-effective strategies to improve EBF practice among hunters and pastoralists communities, specifically, to address their knowledge on EBF as the vast majority of them had inadequate knowledge on EBF.

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Use of Haematological Changes as a Predictor of Dengue Infection among Suspected Cases at Kairuki Hospital in Dar Es Salaam, Tanzania: A Retrospective Cross Sectional Study

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ABSTRACT

Background: Dengue is a viral disease transmitted by female *Aedes* mosquitoes which are commonly found in tropical and subtropical areas. There is a dramatic increase in annual incidence rate of dengue attributed to urbanisation, poor environmental management as well as increased people mobility. Outbreak of dengue have been reported in Tanzania in recent years with Dar es salaam being the most affected region. Dengue is associated with haematological derangements and it indicates the severity of the disease. These changes have not been well elucidated in Tanzanian patients. The aim of this study was to determine these derangements among dengue patients admitted at Kairuki hospital in Dar es salaam, and compare these changes with non-dengue febrile patients.

Methods: A retrospective cross sectional study was conducted among patients who were suspected to have dengue; tested for dengue IgM and their Complete Blood Count were tested during the index illness. This information was obtained from Kairuki hospital laboratory database. Haematological parameters were compared between dengue and non-dengue patients using SPSS Version 20.0. Binary logistic regression analysis was used to determine haematological predictors of dengue positive results.

Results: A total of 255 patients were enrolled, whereby 188(73.7%) were dengue positive and 67 (26.3%) were negative. Dengue patients had relatively low mean total white blood cell counts compared to non-dengue patients (Student's test = -2.7; p value = .007). Furthermore, Mean lymphocyte count was significantly low in dengue patients compared to non-dengue patients (Student's (t) test = -5.1; p < .001). Other haematological parameters were not significantly different. Lymphopenia was a significant predictor for dengue positive results (Adjusted Odd Ratio = 5.26 (95% CI = 2.28-12.2; P value < .001).

Conclusion: Patients with dengue had significantly low total white blood cell and lymphocyte count compared to non-dengue febrile patients. Lymphopenia is a significant haematological predictor for dengue positive results. Case defining signs and symptoms combined with these haematological changes may be used by clinicians as a guide to order confirmatory test for suspected dengue cases.

BACKGROUND

Dengue is a viral disease caused by the dengue virus that belongs into the *flaviviridae* family. There are 4 distinct dengue serotypes (DEN-1, DEN-2, DEN-3, and DEN-4). Despite their serotypical differences, they lead to the same clinical presentation. The infection by one serotype confers lifelong immunity to that particular serotype, but subsequent infection by other serotypes is associated with a more severe disease.¹ Dengue is transmitted mainly by female *Aedes aegypti* and *Aedes albopictus* mosquitoes, which are mainly distributed in tropical and subtropical regions.² There is a prevailing spread and increased cases of dengue fever. In 2017, it was estimated that 105 million people got infected with dengue, with 41,000 deaths, and an estimated incidence rate of 1,371 per 100,000 population.³ Variations in temperature, travel, rainfall, and degree of urbanisation are major

influencers of transmission.⁴ Severe dengue is among the leading infectious cause of morbidity in Latin America and some Asian countries.⁵

Clinical presentation of dengue is not specific, thus, cannot be differentiated from other febrile illnesses on clinical grounds. In 2009, World Health Organization (WHO) developed clinical classification of dengue according to clinical signs and symptoms: dengue without warning signs, dengue with warning signs (abdominal pain, persistent vomiting, body fluid accumulation, mucosal bleeding, lethargy, hepatomegaly, elevated haematocrit, and rapid decrease in platelets count), and severe dengue.⁶ Severe dengue comprises of severe plasma leakage, severe bleeding and severe organ involvement.⁶ Most dengue infections are asymptomatic or mild disease. Only 10% develop severe disease. Case fatality rate of untreated or poorly treated severe cases is as high as 20%. How-

ever, with appropriate management and treatment, the mortality can be reduced up to 2%-5%.⁸ Tanzania has been experiencing sporadic dengue outbreaks. The most recent outbreaks occurred in 2010 followed by other outbreaks in 2012, 2013, 2014, 2018, and 2019. These occurred during the heavy rainy seasons that start from March through June. In the 2019 outbreak, the regions that were most affected included; Dar es salaam, Tanga, Pwani, Morogoro, Singida, and Kilimanjaro. In this episode, more than 3,500 cases and 3 deaths were reported⁹. Seroprevalence is also remarkable in other regions within Tanzania which signifies the wider spread of dengue in the country.^{10,11,12,13}

Dengue is associated with several haematological changes such as leucopenia, lymphopenia or lymphocytosis, thrombocytopenia and elevated haematocrit.^{14,15,16,17,18,19} These changes are immune mediated and may vary from one region or ethnic group to another due to heterogeneity and previous disease exposure.^{20,21,22} There is paucity of data describing these derangements in Tanzanian patients.

The aim of this study was to determine the haematological changes among patients with confirmed dengue infection compared to non-dengue patients with similar signs and symptoms attending Kairuki hospital in Dar es Salaam-Tanzania. If detected early, these changes may guide clinicians to perform specific confirmatory tests and provide appropriate management and counselling.

MATERIALS AND METHODS

Study Design and Study Site

We conducted a retrospective case-control study at Kairuki hospital which is a National referral level facility located in Kinondoni Municipal in Dar es salaam. It is also a teaching hospital for Hubert Kairuki Memorial University, providing both inpatient and outpatient care with capacity of up to 200 beds and an average of 600 outpatients per day.

Study Population and Participants Selection

The study involved patients who visited Kairuki hospital in the period between April to June 2019, were suspected to be having dengue and subjected to dengue serology test. Criteria for inclusion in the study were; availability of basic demographic information (age, sex, and residence), availability of dengue test results and Complete Blood Count (CBC). Those with indeterminate dengue test results and missing or invisible values in CBC were excluded from the study. We used the hospital database and laboratory logbooks to get basic demographic information, dengue test results as well as haematological findings from the Complete Blood Count (Beckman-Coulter, Model Act 10, Brea, CA, USA.). Dengue test was regarded as positive if patients tested positive either for non-structural protein-1 antigen (NS1-antigen), or immunoglobulin M (IgM) for dengue by SD Bioline Duo Rapid Test (Standard Diagnostic, Inc., Gyeonggi-do, Korea) or both.

Sample Size Estimation

The minimum sample size was calculated using the formula for comparing 2 means from independent samples.²³ The power of the study was set at 80% with type I(α) and II(β) error of 0.05 and 0.2 respectively. We used t

he total white blood cells as a reference value and assumed the Normal Standard Deviation of total white blood cells to be the same in both groups (dengue and non-dengue participants) at $1.5 \times 10^9/l$. We calculated the sample size that would enable us to detect the difference (variance) in mean total white blood cell count between the groups (dengue and non-dengue participants) from $1 \times 10^9/l$ and above. The minimum sample size estimated in each group was calculated using the following formula:

$$n = (Z_{\alpha} + Z_{\beta})^2 * 2 * \sigma^2 / d^2,$$

where:

n= minimum sample size in each group

Z_{α} = Critical value at $\alpha = 0.05$ which is 1.96

Z_{β} = Critical value at $\beta = 0.2$ which is 0.84

σ = standard deviation of the mean in both groups

d is the variance of the mean between the groups

Therefore,

$$n = (1.96 + 0.84)^2 * 2 * (1.5 * 10^9)^2 / (1 * 10^9)^2 = 35.$$

Thus, the minimum sample size in each group was estimated to be 35 participants.

Data Analysis

Data was analysed using Statistical Package for Social Sciences (SPSS) version 20.0 (IBM Corp., Armonk, NY, USA). Proportions and categorical variables were compared using Chi square, Spearman's or Kendall's Tau Test whenever appropriate with their respective odd ratios and 95% confidence intervals. Continuous variables (absolute counts) between groups (dengue and non-dengue patients) were compared using Student's (t) test. Binary logistic regression analysis was used to determine demographic and haematological predictors of dengue positive results. Probability (p- value) of less or equal to 0.05 was considered statistically significant.

Ethical Considerations

Ethical clearance was obtained from the Ethical Review Committee of the Hubert Kairuki Memorial University teaching hospital, with approval number KH/RE/HKM/10/19. Strict confidentiality was maintained throughout data collection and analysis process. No personal identifiers were included in data mining and data analysis was performed anonymously.

RESULTS

A total of 255 participants were enrolled out of 662 patients who were subjected to dengue test. Participants who did not meet the selection criteria were excluded. Those were patients who had inadequate information, or patients who did not have complete blood count results (figure 1). Among the enrolled, 188(73.7%) tested positive for dengue while 67 (26.3%) tested negative. 215(84.3%) were between 41 and 60 year of age, while 8(3.5%) were below 20 years of age (Table 1)

Most of the participants(42.7%)were residing in Kinondoni Municipal. Sexes were equally distributed among dengue positive and negative patients. Those with positive dengue results had relatively low mean total white blood cell counts compared do dengue negative participants [Student's test= -2.7; p value=.007 (figure 2)].

FIGURE 1. Screening and Enrolment Algorithm of Study Participants

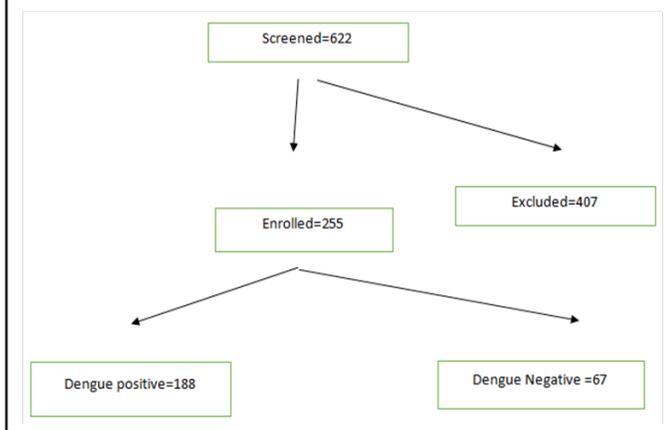
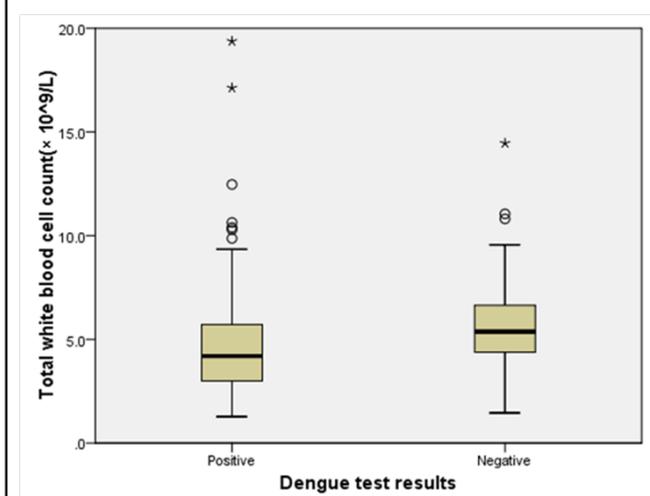


FIGURE 2. Difference in Mean Total White Blood Cell Count between Dengue and Non-Dengue Febrile Patients at Kairuki Hospital, 2019



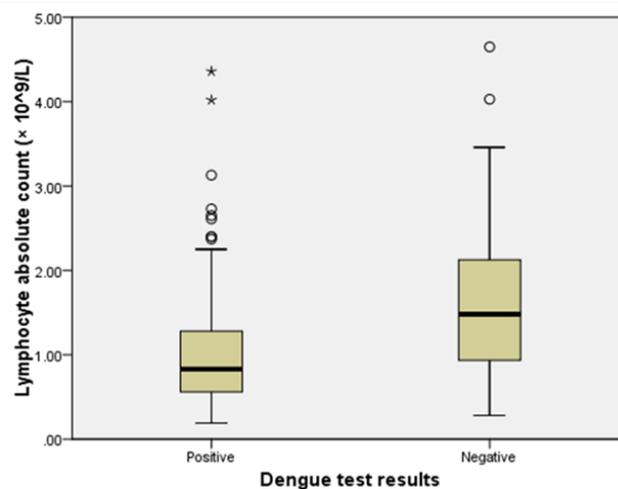
Mean total white blood cell count for dengue positive= $4.7 \times 10^9/L$. Mean Total white blood cell count for dengue negative= $5.6 \times 10^9/L$ (Students (t) test= -2.7 ; $p=.007$)

In addition, mean lymphocyte count was significantly low in dengue patients compared to non-dengue patients [Students (t) test= -5.1 ; $p<.001$ (figure 3)].

Patients with dengue had low mean platelet count compared to non-dengue patients, but the difference was not statistically significant [Student's test (t)=- 0.86 ; $p=.39$ (figure 4)].

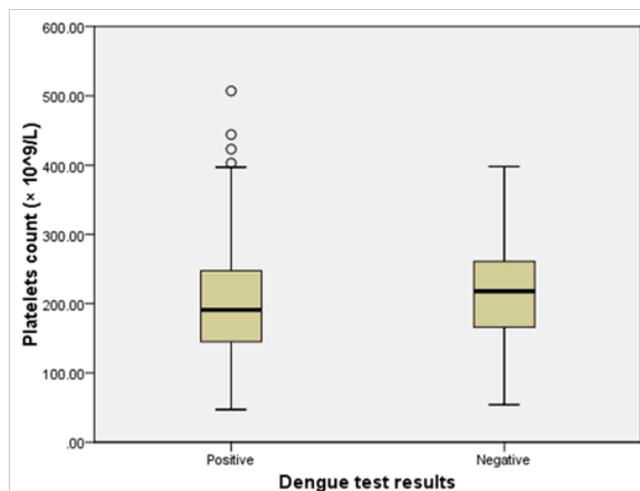
After controlling the confounding variables by stratification of total white blood count, lymphocyte count, and platelets, lymphocyte count was found to be highly associ-

FIGURE 3. Difference in Mean Lymphocyte Count between Dengue and Non-Dengue Febrile Patients at Kairuki Hospital, 2019



Mean lymphocyte for dengue positive= $1.01 \times 10^9/L$. Mean lymphocyte count for dengue negative= $1.61 \times 10^9/L$ Students (t) test= -5.1 ; $p<.001$

FIGURE 4. Difference in Mean Platelet Count between Dengue and Non-Dengue Febrile Patients At Kairuki Hospital, 2019



Mean platelets count for dengue positive patients= $202.7 \times 10^9/L$. Mean platelets count for dengue negative patients= $212.9 \times 10^9/L$ (Student's test (t)=- 0.86 ; $p=0.39$; $p=.39$)

ated with dengue positive results (Adjusted Odd Ratio = 5.26 (95% CI= $2.28-12.2$; P value $<.001$) (table 2).

TABLE 1: Baseline Characteristics of Study Participants (N=255)

Variable	Dengue Test Results Positive N(%)	Dengue Test Results Negative N(%)	Total N(%)	Chi-Square (X2)	p-Value
Age of participants					
Below 20 years	8 (4.3)	1 (1.5)	9 (3.5)	1.46	.7
Between 21-40 years	11 (5.9)	3 (4.5)	14 (5.5)		
Between 41-60 years	156 (83.0)	59 (88.1)	215 (83.3)		
Above 60 years	13 (6.9)	4 (6)	17 (6.7)		
Total	118 (100)	67 (100)	255		
Sex					
Male	100 (53.2)	30 (44.8)	130 (51)	1.4	.24
Female	88 (46.8)	37 (55.2)	125 (49)		
Total	188 (100)	67 (100)	255 (100)		
Attendance (Month)					
April	70 (37.2)	38 (56.7)	108 (42.4)	7.7	.006***
May	118 (62.8)	29 (43.3)	147 (57.6)		
Total	188 (100)	67 (100)	255 (100)		
Residence (Municipal)					
Kinondoni	84 (44.7)	25 (37.3)	109 (42.7)	4.6	.31
Ubungo	34 (18.1)	12 (17.9)	46 (18)		
Ilala	24 (12.8)	12 (17.9)	36 (14.1)		
Temeke	18 (9.6)	3 (3)	21 (8.2)		
Kigamboni	28 (14.9)	15 (22.4)	43 (16.9)		
Total	188 (100)	67 (100)	255 (100)		

DISCUSSION

The findings from this study suggest that patients with dengue have leucopenia compared to non-dengue febrile patients. We have also demonstrated that lymphopenia is highly predictive of dengue positive results. This is similar to other studies conducted in other parts of the world.^{15,24,25,26} Elevated lymphocytes with atypical morphological features have been observed in some studies.^{27,14} However, we could not demonstrate the same in our study as we did not perform peripheral smears.

Elevated lymphocytes with atypical features have been associated with secondary dengue infection, which indicates the role of immunological response, and differences in cytokines produced during the first and subsequent disease exposure.^{28,29} This could be the result of augmented immune response due to secondary viral antigen exposure leading to a more severe form of the disease, a phenomenon also known as “the original antigenic sin”.³⁰

Previous researches have demonstrated that cross reactive non neutralising antibodies from a previous dengue serotype bind to the new serotype and facilitate entry into the cells through Fc-receptors leading to activation of T-lymphocytes with subsequent lymphocytosis.^{31,32}

Contrary to other studies, thrombocytopenia and elevated haematocrit were not significant in dengue positive patients compared to dengue negative patients. This could be due to the fact that these features are more common in patients with severe symptoms such and vascular leak-

age, haemorrhage and shock.^{18,33} This indicates that most of the patients in our study had a mild disease (classical dengue) with low likelihood of mortality.^{33,28}

These findings (normal platelets, haematocrit and leucopenia) with lymphopenia being predominant suggests that the current dengue infection could be the first exposure in most of the patients. Effective preventive measures are very important as further outbreaks with repeated infections will result into a more severe form of infection and possible increase in morbidity and case fatality.

CONCLUSION

Leukopenia and lymphopenia are the most common findings in dengue patients in non-endemic areas like Dar es salaam. Lymphopenia is the most reliable predictor for dengue positive results among febrile patients with similar signs and symptoms. Case defining signs and symptoms combined with these haematological changes may be used by clinicians as a guide to order confirmatory test for patients who are suspected to have dengue infection.

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TABLE 2: Social Demographic and Haematological Predictors of Dengue Positive Results among Febrile Patients At Kairuki Hospital, 2019

Variables	Dengue serology test		TOTAL	COR		95% CI		P value	AOD		95% CI		P value
	Positive N (%)	Negative N (%)		Lower	Upper	Lower	Upper		Lower	Upper			
Residence/(Municipal)													
Kinondoni	84(37.3)	25(44.7)	109(42.7) Ref	1.800	0.834	3.887		0.135					
Ubungo	34(18.1)	12(17.9)	46(18.0)	1.518	0.612	3.76		0.368					
Ilala	24(12.8)	12(17.9)	36(14.1)	1.071	0.421	2.728		0.885					
Temeke	18(9.6)	3(4.5)	21(8.2)	3.214	0.814	12.6		0.096	2.991	0.640	13.97		0.164
Others	28(14.9)	15(22.4)	43(16.9)										
TOTAL	188(100)	67(100)	225(100)										
Age of participants													
Below 20 years	8(4.3)	1(1.5)	9(3.5) Ref	2.462	0.232	26.1		0.455	3.727	0.267	51.93		0.328
Between 21-40 years	11(4.9)	3(4.5)	14(5.5)	1.128	0.206	6.16		0.889					
Between 41-60 years	59(88.1)	156(83)	215(84.5)	0.814	0.255	2.59		0.727					
Above 60 years	13(6.9)	4(6.0)	17(6.7)										
TOTAL	188(100)	67(100)	255(100)										
Sex													
Male	100(53.2)	30(44.8)	130(52)	1.402	0.800	2.45		0.238	1.334	.665	2.675		0.418
Female	88(46.8)	37(55.2)	125(49) Ref										
TOTAL	188(100)	67(100)	255(100)										
Platelet count(x109/L)													
0.Normal (100-300)	144(76.6)	52(77.6)	196(76.9) Ref	0.376	2.08	0.782		0.782					
Low (<100)	19(10.1)	7(10.4)	26(10.2) 0.886	0.268	2.81	0.814							
Elevated>300	25(13.3)	8(11.9)	33(12.9) 0.869										
TOTAL	188(100)	67(100)	225(100)										
Hematocrit (%)													
Low (<35)	52(27.7)	17(25.4)	69(27.1) Ref	3.059	0.400	23.4		0.282	7.256	.287	183.7		0.229
Normal (35-55)	134(71.3)	48(71.6)	182(71.4)	2.792	0.383	20.3		0.311	1.785	.099	32.26		0.695
Elevated (>55)	2(1.1)	2(3)	4(1.6)										
TOTAL	188(100)	67(100)	255(100)										
Haemoglobin(g/ dl)													
Low (<12)	45(23.9) 2	0(29.9)	65(25.50) Ref	1.500	0.232	9.6		0.670					
Normal (12-16)	140(74.5)	45(67.2)	185(72.5)	2.074	0.336	12.8		0.432					
Elevated (>16)	3(1.6)	2(3)	5(2)										
TOTAL	188(100)	67(100)	255(100)										
Red blood cell count (x1012/L)													
Low (<3.5)	6(3.2)	2(3)	8(3.1) Ref	1.750	.275	11.1		0.554					
Normal (3.5-5.5)	170(90.4)	58(86.6)	228(89.4)	1.710	.643	4.5		0.283					
Elevated (>5.5)	12(6.4)	7(10.4)	19(7.5)										
TOTAL	188(100)	67(100)	255(100)										
Wesophil absolute count (x109/L)													
Low (<0.02)	5(2.7)	1(1.5)	6(2.4) Ref	15.	0.663	339.5		0.089	9.508	.233	388.4		0.234
Normal (0.02-0.5)	182(96.8)	63(94)	245(96.1)	8.667	0.885	84.8		0.064	6.659	.510	86.8		0.148
Elevated (>0.5)	1(0.5)	3(4.5)	4(1.6)										
TOTAL	188(100)	67(100)	255(100)										

Continued

TABLE 2: Continued

Variables	Dengue serology test		TOTAL	COR	95% CI		AOD	95% CI		P value
	Positive N (%)	Negative N (%)			Lower	Upper		Lower	Upper	
Total white Blood cells count (x10⁹/L)										
Normal (4-10)	102(54.3)	52(77.6)	154(60.4)	Ref						
Low (<4)	81(43.1)	13(19.4)	94(36.9)	0.785	0.147	4.1	0.450	0.035	5.842	.541
Elevated (>10)	5(2.7)	2(3)	7(2.7)	2.492	0.437	14.2	1.862	0.115	30.22	.662
TOTAL	188(100)	67(100)	255(100)							
Neutrophil absolute count (x10⁹/L)										
Low (<2)	66(35.1)	15(22.4)	81(31.8)	Ref						
Normal (2-7)	111(59)	48(71.6)	159(62.4)	1.6	0.447	5.7	.470			
Elevated (>7)	11(5.9)	4(6)	15(5.9)	.841	0.255	2.7	.776			
TOTAL	188(100)	67(100)	255(100)							
Lymphocyte absolute count (x10⁹/L)										
Low (<20)	87(45.3)	11(16.4)	98(38.4)	Ref						
Normal (20-40)	101(53.7)	56(83.6)	157(61.6)	Ref						
TOTAL	188(100)	67(100)	225(100)							
Basophil absolute count (x10⁹/L)										
Low (<0.01)	15(8)	8(11.9)	23(9)	Ref						
Normal(0.01-0.1)	173(92)	59(88.1)	232(91)	0.639	0.258	1.5	0.617	.208	1.825	.383
TOTAL	188(100)	67(100)	255(100)							
Monocyte Absolute count (x10⁹/L)										
Low (<0.12)	21(11.2)	4(6)	25(9.8)	Ref						
Normal (0.12-1.2)	167(88.8)	63(94)	230(90.2)	1.981	.654	5.9	1.129	.283	4.511	.864
TOTAL	188(100)	67(100)	255(100)							

COR=Crude Odd Ratio, OR=Adjusted Odd Ratio, CI=Confidence Interval

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Environmental factors influencing Prevention and Control of Schistosomiasis Infection in Mwea, Kirinyaga County Kenya: A cross sectional study

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ABSTRACT

Background: Schistosomiasis remains a major public health problem in Kenya. Environmental factors are critical in creating a medium for growth and spread of schistosomiasis vectors. The study investigated the environmental factors influencing prevention and control of schistosomiasis infection in Mwea West Sub County, Kirinyaga County-Kenya.

Methods: A multi stage sampling was used to identify four hundred and sixty-five (465) household. Analytical descriptive cross-sectional design that utilised quantitative data collection method was used. Data was collected using a pretested structured questionnaire and analysed using Chi square tests or Fisher's exact tests where applicable.

Results: Study results indicated a significant association $p < .001$ between household level of education, members being affected by floods during the rainy season and schistosomiasis infection. The result further indicates level of significance ($p < 0.047$) in the association between sources of water in a household and schistosomiasis infection. No level of significance was posted between having a temporary water body in the area $p (= .072)$ and schistosomiasis infection. In addition, there was no significant association between proximity to the nearest water source, $p = .074$ and proximity to the nearest health facility $p = 0.356$ with schistosomiasis infection.

Conclusions: The study recommends carefully designing safe water sources in order to match the goal of effectively controlling and reversing the trends of schistosomiasis infections. The community should be made aware of the risk factors of schistosomiasis including water utilised in the household's alongside raising health seeking behaviours for diagnosis and treatment of schistosomiasis as a way of reducing the spread of infection.

BACKGROUND

Schistosomiasis is among the Neglected Tropical Diseases (NTDs) targeted for control by the World Health Organization.¹ According to WHO, 218 million individuals suffer from schistosomiasis globally while 700 million are at risk in 76 endemic regions. According to the report, Kenya was ranked among the 10 highest burden countries in the African region with almost 12 million people said to be in need of Preventive Chemotherapy (PC) while treatment coverage approximated to be zero.²

The burden of schistosomiasis cannot be wished away with literature suggesting that the disease accounts for an estimated 1.9 million Disability Adjusted Life Years (DALYs) annually with 90% of the burden currently concentrated in Africa. Though school age children have been the focus for both treatment and epidemiologic evaluation because of their high risk of infection, schistosomiasis infection and morbidity risk extends to preschool-aged children, women of reproductive age, and other high-risk groups (e.g., car washers, fishermen, and rice farmers). This suggest that treatment of additional at-risk groups is required in order to achieve comprehensive morbidity control.³

The two (2) main species of schistosomiasis in Kenya are *S. mansoni* and *S. haematobium* with approximately 2.5 million people feared to be at risk of infection.⁴

Transmission of schistosomes is said to be through human contact patterns to infested water, the presence of competent intermediate snail hosts, availability of suitable snail hosts habitats, and freshwater environment contamination with stool/urine containing eggs. The distribution of the disease mainly depends on the presence of *Bulinus* spp. and *Biomphalaria* spp. as intermediate host snails for *S. haematobium* and *S. mansoni*, respectively.⁵

In Kenya, schistosomiasis occurs mostly in western, coast, and selected foci in central part of the country.⁶ Preventive anthelmintic chemotherapy usually through Mass Drug Administration (MDA) programs is the preferred and prioritised first line strategy recommended by the World Health Organization (WHO) to overcome the burden and morbidity inflicted by these infections. Additionally, interventions targeting improvement of access to Water, Sanitation and Hyg-

iene (WASH) are encouraged as long-term and sustainable control measure.⁷

Schistosomiasis has been known to contribute significantly to lower social economic conditions in areas where it is endemic and causes a great deal of disability thus reducing the work performance among the infected individuals.⁸

Previous studies including the one conducted by Ministry of Public Health and Sanitation and Ministry of Education in conjunction with Japan International Cooperation Agency (JICA), initiated a schistosomiasis control program based on mass treatment in Mwea West Sub County. A total of 43,928 school age children from 86 schools were de-wormed by trained school teachers. The prevalence of the parasitic infections in the 5 cohort schools was 38 % for *S. mansoni* before treatment. There was an overall parasitic re-infection rate of 16 % for *S. mansoni*, 6 months after treatment. The trend of re-infection continued after treatment to 22 % in the second year, 31 % in the third year and 17 % in the fourth year.⁶

A proper understanding of disease prevalence and the effects of the environment will not only provide a useful tool for proper planning of effective control programmes but also form a basis of exploring other potential adverse health related effects instigated by schistosomiasis. This study aimed at investigating environmental factors influencing the prevention and control of schistosomiasis in Mwea West Sub- County Kirinyaga County Kenya.

METHODS

Study Area

The study was conducted in Kangai and Thiba locations in Mwea West Sub County. Mwea Sub County is one of the 5 sub counties of Kirinyaga county. Kirinyaga County covers an area of 1,478.1 Square Kilometres. The County lies between 1158 M and 5380 M above sea level in the South and at the Peak of Mount Kenya respectively. The 2019 Kenya Population and Housing Census (KPHC) put the population of the County at 610,411 and Mwea sub County at 125,962⁹. The mean annual rainfall is approximated to be 1200 and 1600 mm per year. The Sub County is home to Mwea irrigation scheme where a number of water canals crisscross the area supplying irrigation water to the farms and villages respectively. The main socio-economic activities include rice and horticultural farming.¹⁰ In a publication by Kenya National Bureau of Statistics (KNBS) and Society for International Development (SID),¹¹ only 34% of residents use improved source of water with only 35% of residents having homes with cement floors. According to the Kirinyaga County Integrated Development Plan 2018 –2022¹⁰, the county has 202 health facilities comprising of 109 public health institutions, 39 Mission/NGO facilities and 54 private clinics.

The largest Mission Health facility is the Mwea Mission hospital, in Mwea Sub County. There are 3 level four hospital facilities located in Kirinyaga Central, Gichugu and Mwea Constituencies. The County has 348 Early childhood development (ECD) centres, 326 primary schools, 143 secondary schools and 29 tertiary institutions.

Study Design

The study employed an analytical descriptive cross-section-

nal design adopting quantitative data approach to investigate environmental factors influencing the prevention and control of schistosomiasis in Mwea West sub-County Kirinyaga County.

Sample Size Determination

The minimum sample size was computed using the formula by.¹² The current prevalence is unavailable, thus an assumed prevalence of 50% was used in the computation of the minimum sample size required for the study with a 5% margin of error and a design effect of 1.2%. The following equations provides the determination of the sample size.

$$n = \frac{Z^2 p(1 - p)}{d^2} \times DEFF \tag{1}$$

Where;

n= is the minimum calculated sample size for populations greater than 10,000

Z= Standard errors from mean corresponding to the 95% confidence level is 1.96

P= the target prevalence, assumed 50%, p=0.5

d= the level of statistical significance (allowable error / precision) of 5%, d=0.05

DEFF= Design Effect

Thus,

$$n = \frac{1.96^2 \times 0.5(1 - 0.5)}{0.05^2} \times 1.2 \tag{2}$$

$$n = \frac{3.8416 \times 0.5 \times 0.5}{0.0025} \times 1.2 = \frac{1.15248}{0.0025} = 460 \tag{3}$$

Allowing for a non-response rate of 1% gave a final adjusted sample size of 465 as below

$$n = 460 \times \frac{101}{100} = 464.6 \sim 465 \tag{4}$$

Data Collection

The main instrument used for quantitative data collection was a structured questionnaire. The questionnaire was translated into Kiswahili. The investigators recruited research assistants who were conversant with Mwea Sub County and also who are proficient in the Kikuyu language.

A total of 465 household heads were enrolled in the study by use of simple random sampling technique. Having carried out probability proportional to size and identified the households that acted as the sampling frame, the former method was used in identifying the specific households visited using 10 as the nth in skipping 1 household to the other. A random walk was utilised in identifying the first household. The study largely used Last Birthday method for within household selection due to its accuracy.¹³ Prior to data collection that took a total of 7 days, 10 research assistants were recruited and trained for 2 days and a pre-test conducted on the second day. In the evening of the same day, all gaps identified on the tool were corrected accordingly before embarking on data collection. The training focused on the objective of the research, understanding of the questionnaire, modalities of data collection and how to collect data. During the training, both English, Swahili and kikuyu languages were used for better understanding of the questionnaire. The main issues -

captured in the questionnaire included socio-demographic characteristics and environmental factors. The 10 field assistants were employed to assist in administering the questionnaire under close supervision of the principal investigator and biostatistician. The questionnaire took an average of 30 to 35 minutes to administer

Data Management and Analysis

Quantitative data collected was entered into Microsoft Excel and Microsoft Access 2019 Office Application Software and statistical analysis done after data validation. Data from the questionnaires were then fed into the IBM Software, the Statistical Package for Social Scientists (SPSS) version 23.¹⁴ Descriptive statistics including mean, or median, frequencies and proportions were appropriately generated. Chi square test was used to test associations between variables.

Ethical Considerations

This study was reviewed and approved by the KEMRI Ethical Review Committee (SSC/ERC protocol No. 2061). The study used questionnaires uniquely coded with results of each questionnaire being kept in strict confidence. Participating in the study was voluntary and participants could withdraw at any point. Participants were assured of confidentiality and that no names will appear in any report. Written informed consent was obtained from participants before embarking on the study.

RESULTS

Socio-Demographic Characteristics of the Respondents

Out of 465 participants, females formed the majority 297(63.9%) with 292(63%) of the participants being married while 94(20.2%) of participants were either widowed, single or divorced. A majority of the participants 463(99.6%) were Christians with Muslims and others constituting only 2(0.4%). 66.7% of the total participants had attained primary level education while the rest had either no formal education, secondary education or post-secondary. Further analysis on occupation of the participants revealed that 368(79.1%) were farmers while less than 1% were unemployed as shown in Table 1.

Environmental Factors associated with Schistosomiasis Infection

Less than half of the participants 212(45.6%) stated that they lived in mud houses, 187(40.2%) lived in wooden houses while majority 333(71.6%) of the respondents' houses had earthed floor. In addition, almost all 447(96.1%) participants used pit latrines in their homestead and more than half 267(57.4%) of the participants used canal as their main source of water. Almost all participants stated that the proximity to the nearest water source and a health facility from their homestead was between 1 and 5 kilometres (km) away while 358(77%) had temporary water bodies in their locality as shown in Table 2.

Associations between Demographics, Environmental factors and Schistosomiasis Infection

Table 3 summarises the results for the association between *S. mansoni* infection and household demographic variables and environmental.

Generally, female participants had the highest infection than male participants, though not statistically significant ($p=.060$). Households with the highest primary education level were the most infected compared to those who had secondary level with a strong significance ($p=.001$). The results also show that the households were much likely 436(93.8%) to be infected with *S. mansoni* during rainy seasons with a strong significance ($p=.0001$). Source of water remain an important factor when it comes to infections with households fetching their water from canals 340(73.1%) and rivers 326(70.1%) likely to be infected ($p=0.047$) compared to the households getting piped water and rainwater. Though a majority 330(71%) of the households indicated that they travel between 1 and 5 km to their nearest water source and that they have temporary water bodies like swamps and rivers 340(73.1%), no statistical significance was deduced. There was no significance either between having suffered from *S. mansoni* and proximity of homestead to the nearest health facility.

DISCUSSIONS

Most of the NTDs including Schistosomiasis control interventions are largely focused on preventive chemotherapy which is implemented through school based programs.⁸

According to our findings, males were more affected compared to female. The findings are similar to a study in Migori Kenya.¹⁵ In another study done in Sudan, though not statistically significant, boys were found more affected than girls.¹⁶

According to WHO, there is need for integrated approach to overcome the global impact of NTDs through 5 interventions: innovative and intensified disease management; preventive chemotherapy; vector ecology and management; veterinary public-health services; and the provision of safe water, sanitation and hygiene.² The percentage of households accessing improved source of water for drinking is much less than the national figures that stands at 88.2% in urban and 59.1% in rural areas¹¹ indicating a significant problem in accessing this important basic need.

In our study, male were more affected than female and this concurs with a study in Northern Ghana¹⁷ and Zambia¹⁸ that found high level of infection among male than female. Female did not show statistical significant association with schistosomiasis infection in our study. There has been inconsistent association of sex with schistosomiasis infection. The association between gender and schistosomiasis infection varies in different communities where some studies have reported association with female gender.¹⁹ It is now clear that men and women have different water contact behaviour relating to activities among them swimming, fishing, farming and even doing laundry.

In our findings, the prevalence of schistosomiasis infection reduced with increase in education. The respondents with primary education level were more likely to be infected in comparison to those who had reached secondary or post-secondary level of education with a statistical significance of $p=.001$. The education level may affect the behaviour and attitude of the individuals. For instance, those with low education may spend more of their time in water hence exposing themselves. In addition, they are

TABLE 1: Socio-Demographic Characteristic of Respondents

Variable	Response	Frequency (Percentage %)
Gender	Male	168 (36.1%)
	Female	297 (63.9%)
Marital Status	Married	371 (63.0%)
	Single	45 (9.7%)
	Divorced	23 (4.9%)
	Widow	20 (4.3%)
	Widower	6 (1.3%)
Religion	Christian	463 (99.6%)
	Muslim	1 (0.2%)
	Other	1 (0.2%)
Level of Education	No Formal Education	34 (7.3%)
	Primary Education	311 (66.9%)
	Secondary Education	107 (23.0%)
	Post-Secondary	11 (2.4%)
Occupation	Public Servant	4 (0.9%)
	Farmer	368 (79.1%)
	Business	32 (6.9%)
	Informal Employment	59 (12.7%)
	Not Employed	2 (0.4%)
Age group (years)	17-26years	160 (34.4%)
	27-36years	132 (28.4%)
	37-46years	60 (12.9%)
	46-56years	49 (10.5%)
	57-66years	40 (8.6%)
	67-76years	18 (3.9%)
	77-86years	6 (1.3%)

likely not to use protective gears while at their working sites. Our study is similar to a study by¹⁹ which revealed that those educated had significantly better knowledge on the signs and symptoms, transmission (snail) and prevention of schistosomiasis when compared to their counterparts. It is also similar to a cross sectional community based field study conducted in Nigeria where the risk of infection was higher in those with primary school education.²⁰ In contrast, a previous study from Uganda found no significant association between educational level and the level of knowledge on schistosomiasis.²¹ As far as education plays an important role in people’s perceptions and practices of controlling schistosomiasis,²² previous studies from Africa and Asia showed that the odds of having lower knowledge about schistosomiasis were significantly higher in the respondents who had primary education level or below.^{23,24}

Study results indicate that there is a significant association between households being affected by floods during the rainy season and household members having schistosomiasis infections. The findings are similar to a study done in Eastern China where there was high number of human infections that occurred during flooding of the lake.²⁵ It is key to note that; (i) floods and associated sediment input create and sustain suitable snail habitat, (ii) floods are a major source of introduction and re-introduction of snails, (iii) floods lead to the admixture of dif-

ferent parasite lineages to which snail populations may not be well adapted, and (iv) Inundation following heavy rains helps sustain suitable habitat for free-swimming parasite larvae.

While it is clear that sanitation breaks the transmission cycle of many diseases, a number of factors influence the degree to which disease protection is afforded i.e seasonality; which has general impacts on the transmission of schistosomiasis diseases. The season can also have impacts on the sanitation facilities themselves with heavy rains causing pit latrines and sewerage systems to flood and become inoperable and possibly contaminate the environment. The current study finding concur with systematic review that found people with safe water and adequate sanitation having significantly lower odds of a *Schistosoma* infection.²⁶

The present results reveal significance association between sources of water in a household and schistosomiasis infection. This concurs with a cross sectional study in South Africa where learners who went to an open source of water for their domestic needs had a 64.2% infection rate. In the same study, the prevalence increased with decreasing distance to the water body.²⁷ The frequency and type of water contact also depend on water sources and its availability in the community.²⁸

There was no significant association between proximity

TABLE 2: Distribution of Responses on Environmental Factors

Questions	Response	Frequency (n=465)	Percentage
Type of house structure?	Concrete Blocks	25	5.4
	Stone Building	41	8.8
	Mud House	212	45.6
	Wooden	187	40.2
Type of flooring in the house?	Cement/tiles	67	14.4
	Wooden planks	61	13.1
	Earth/Sand	333	71.6
	NA	4	0.9
Type of toilet in the homestead?	Toilet	5	1.1
	Pit latrine	447	96.1
	None	10	2.2
	Other	3	0.6
Source of water for drinking?	Piped/tap water	13	2.8
	Rainwater	23	4.9
	Stream/river	148	31.8
	Canal	267	57.4
	Others	14	3
Distance to the water source	Less than km	1	0.2
	1km-5km	460	98.9
	6km-10km	2	0.4
	11km-15km	2	0.4
Presence of swamps/rivers in	Yes	358	77
	No	107	23
Distance to health facility	1km-5km	461	99.1
	6km-10km	3	0.6
	11km-15km	1	0.2

to the nearest water source, and schistosomiasis infection in the current study and this does not concur with previous studies which revealed that community proximity to an open water source showed a very strong association with infection. This could be attributed to the fact that majority of the respondents were living within the vicinity of the water bodies given that the area is majorly an agricultural area. In a study by²⁹ which reported that fetching of water and living close to a stream and/or a water pool were identified as significant risk factors for Schistosomiasis infections. Studies show that human contact with *cercariae* infested water cause *Schistosoma* infection hence prevention of such water contact can prevent the transmission of the parasite. However, researchers argue that though safe water supplies reduce such water contact, total prevention of the parasite may not be possible due to the difference proportion of water contact geared by the different culture, socio economic differences and environmental factors.²⁶

Limitations

The study site being largely an irrigation scheme might show a high prevalence. We did not carry out a comparative study with a different study area that could have given us a better picture on the effects of environment and schistosomiasis infection. Participants might have altered their response or might have had a recall bias on

whether they had suffered from schistosomiasis. The results should therefore be interpreted with caution.

CONCLUSIONS/SIGNIFICANCE

Results from this study suggest that flood prevention and mitigation strategies need to be put in place in flood prone areas because these populations are exposed to greater health problems like communicable diseases e.g schistosomiasis. Providing efficient health education to people residing in schistosomiasis endemic areas is imperative for an effective and sustainable control programme. Our review suggests that increasing access to safe water and adequate sanitation are important measures to reduce the odds of schistosome infection.

The study recommends designing and construction of safe water sources in order to match the goal of effectively controlling and reversing the trends of schistosomiasis infections. The community should be made aware of the risk factors of schistosomiasis alongside raising health-seeking behaviours for diagnosis and treatment of schistosomiasis as a way of reducing the spread of infection.

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TABLE 3: Distribution of Environmental Factors and Having Suffered From Schistosomiasis Infection

Description	Having suffered from <i>S. mansoni</i> infection		n (%)	Statistical Significance
	Yes n(%)	No n(%)		
Gender of the respondents				
Male	158(94.0)	7(6.0)	168(100)	p=.060
Female	268(90.2)	29(9.8)	297(100)	
Level of Education of the respondents				
Primary	112(36.01)	199(63.99)	311(100)	<.001
Secondary	48(44.86)	59(55.14)	107(100)	
Post-Secondary	5(45.45)	6(54.55)	11(100)	
Not Educated	2(5.88)	32(94.12)	34(100)	
Member of household infected by schistosomiasis during rainy season				
Yes	181(93.8)	12(6.2)	193(100)	<.001
No	68(53.1)	60(46.9)	128(100)	
Sources of Water				
Pipe/Tap Water	6(46)	7(54)	13(100)	p<.047
Rain Water	19(83)	4(17)	23(100)	
Stream/River	103(70)	45(30)	148(100)	
Canal	94(73)	73(27)	267(100)	
Other	8(62)	3(38)	13(100)	
Proximity of homestead to the nearest water source				
Less than 1km	0(0)	1(100)	1(100)	p= .074
1km-5km	326(71)	34(29)	460(100)	
6km-8km	2(100)	0(0)	2(100)	
11km-15km	2(100)	0(0)	2(100)	
Presence of temporary water bodies such as swamps and rivers in the area				
Yes	261(73)	97(27)	358(100)	p=.072
No	69(64)	38(36)	107(100)	
Proximity of homestead to the nearest health facility				
1km-5km	326(71)	135(29)	461(100)	p=.356
6km-10km	2(100)	0(0)	2(100)	
11km-15km	1(100)	0(0)	1(100)	

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Prevalence and determinants of occupational Injuries among welders in small scale metal workshops in Wakiso District, Uganda

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ABSTRACT

Background: Injuries are a public health concern accounting for 2.78 million fatalities globally. Welders are exposed to a broad range of injuries (e.g. cuts, burns, eye injuries, skin irritations, and musculoskeletal disorders) and yet, there is paucity of information on context specific determinants to inform injury prevention and control. This study determined the factors associated with occupational injuries among welders in Uganda.

Methods: A cross-sectional study was conducted among welders in Wakiso District, Uganda. Pretested and translated questionnaires were used to collect data from 327 randomly selected respondents using face to face interviews. 2 parishes were purposively selected, and 20 metal workshops were systematically selected in each parish. Descriptive statistics and adjusted odds ratios were computed

Results: A high prevalence 287 (87.8%) of self-reported occupational injuries was found among welding workers with cuts/burns 242 (84.3%) and eye injuries 180 (62.7%) reported as the most sustained injuries. Occupational injuries were associated with being a casual labourer with informal training (AOR 4.70 (2.03-10.84)) and working for longer hours (AOR 2.63 (1.26-5.51)). Those with more work experience were less likely to be involved in occupational injuries (AOR 0.30 (0.11-0.84)).

Conclusions: The prevalence of occupational injuries among small-scale welding workers was high and this was associated with learning their trade at work and working for longer hours. Mitigation measures that focus on safety at workplace, advocating for capacity training, and enforcement of workplace regulations should be instituted.

BACKGROUND

Occupational injuries are a global public health concern with more than 2.78 million fatalities and approximately 374 million non-fatal occupational injuries sustained annually at workplaces.¹ In the recent years, Low and Middle- Income Countries (LMICs) have accounted for three quarters of the global burden of fatal occupational injuries which is not the case in developed countries that have seen a steady decline.² In LMICs, standards and practices are below acceptable levels due to the laxity in the enforcement of occupational health and safety regulations.³ Across the African region, welders continue to contend with the effects of occupational injuries and yet there is inadequate literature on the injury burden. In Uganda, Micro, Small, Medium Enterprises (MSMEs) Enterprises play a vital role in creating employment and contributes 20% to the country's Gross Domestic Product (GDP).⁴ However, occupational hazards and injuries continue to be a burden especially among people working in Small Scale Metal Workshops (SSMW).⁵

People who work in SSMW indulge in high exposure

activities such as heavy lifting, cutting, polishing and joining of metal pieces through gas and/or metal-arc welding. Such activities expose the workers to both safety and health hazards such as fire, noise, electric shock, tips and falls, glare and ergonomic hazards.⁶⁻⁸ The high prevalence of occupational injuries among the welding workers is usually attributed to individual and workplace factors such as age, lack of institutional training, work experience, long working hours, failure to implement safety regulations, alcohol/tobacco use and use of sub standardised Personal Protective Equipment (PPE).

Uganda has a legal framework under the Occupational Safety and Health (OSH) Act 2006 that provides the rights, duties and responsibilities for workers to ensure work place safety.⁹ However, progress in reducing the incidence of occupational injuries remains sub optimal since the compliance to OSH requirements has been documented to be low among welders and it has been attributed work environment and negligence of welders.^{10,11} Most studies conducted in the Ugandan context have largely focused on knowledge, attitudes and practices towards utilisation of sa-

safety and health practices among welders^{12,13} with limited information on the factors. Estimating the prevalence of occupational injuries and associated factors among welders is important in generating information that will guide injury prevention and control programs among welders. The purpose of this study was to estimate the prevalence of occupational injuries and associated factors among welders in Uganda.

METHODS

Study Design

A descriptive cross-sectional study that utilised quantitative data collection methods was conducted between October 2018 and January 2019. This study was conducted among welders working in SSMW within Kajjansi town council, Wakiso district.

Study Setting

The study was conducted in Kajjansi town council, a peri-urban area found in Wakiso district, Uganda. Wakiso District is located in the central southern part of the Central Region of Uganda and has an estimated population of 1,997,418.¹⁴ Kajjansi town council is situated in Ssisa Sub County approximately 16 kilo metres South of Kampala, the capital of Uganda. Kajjansi town council is made up of 12 parishes which are both rural and urban. Majority of the population are employed in informal businesses such as hairdressing, carpentry, tailoring, welding among others. The numerous informal welding workshops found in Kajjansi town council employ a significant population within the town council.

Sample Size Estimation

The study sample size (n) was calculated using the Leslie Kish formula (1964) at 95% Confidence Interval (Z), a Prevalence (P) of occupational injuries among welders working in SSMW was assumed at 50%, Marginal Error (ε) of 5.5% and a 10% non-response rate was used.

$$n = \frac{Z^2 P(100\% - P)}{\epsilon^2}$$

Z = 1.96 (standard normal deviate at 95% confidence interval)

$$n = \frac{1.96^2 50\%(100\% - 50\%)}{5.5\%^2} = 317.5 \approx 318$$

Adjusting for non-response

$$n = 318 + 318 \times 10\% = 349$$

Therefore, the study sample size was 349 respondents. However, we collected information from 327 respondents.

Sampling and Data Collection

Sampling Procedure

Two (2) parishes in Kajjansi town council i.e. Namulanda and Kitende were purposively selected for the study. 20 metal workshops were systematically selected from each

parish. Respondents from each workshop were then randomly sampled and a number proportionate to the existing number of people was selected. A maximum number of 10 respondents per workshop were selected randomly. The inclusion criteria included: being at least aged 18 years, currently working at SSMW for at least 6 months and being present at the time of the study. Exclusion criteria included being absent at the time of the study, refusal to consent and not being in a good mental health i.e. being under the influence of alcohol or illicit drugs.

Data Collection

A questionnaire with both open-ended and closed-ended questions was used. It included sections on; socio-demographic data, job description, PPE ownership and utilisation, workplace condition and morbidity of injuries. The questionnaires were developed in English then translated to the local language, Luganda. Pretesting of the questionnaires was done to ascertain reliability, validity and quality of the study. 2 research assistants were trained on the data collection techniques and were briefed about the study objectives. Informed consent was sought from eligible respondents and the questionnaire was administered in Luganda at a place of convenience and privacy to the participant. Data was collected through face to face interviews and interviews took an average of 15 minutes per participant. Occupational injuries were self-reported as respondents were asked about injury history within the past 1 year prior to the study.

Data Management and Analysis

Data collected was checked daily for any inconsistencies and incompleteness. Data was entered using EpiData 3.02 software, later cleaned and analysed using STATA 14.0 (StataCorp, Texas, USA) analytical software. Descriptive, Bivariate and Multivariate data analyses were done. Frequencies and percentages were used to describe the variables while Crude Odds Ratios (COR) and Adjusted Odds Ratios (AOR) at 95% confidence intervals and p-values of ≤0.05 were presented in tables and later interpreted.

Ethical Approval and Consent to Participate

This study was approved by the Makerere University School of Public Health Research and Ethics committee. Permission to conduct this study was sought from Kajjansi Town council, Wakiso district and informed consent was sought from all the study respondents.

RESULTS

Socio Demographic Characteristics

The questionnaire completion rate was at 327(93.7%). All respondents were males with a mean age of 25 years (SD±8.08). Most respondents, 206(63.0%) were below 25 years and 147(45.0%) had attained primary level education. More than half of the respondents, 209 (63.9%) had worked for less than 5 years.

Workplace Characteristics

Almost all of the respondents, 316 (96.6%) indulged in cutting of metal pieces. Majority of the respondents 205 (62.7%) were casual labourers who got the skill through on the job learning and more than half, 247(75.5%) worked for 8 hours and above per day. More than three quarters of the respondents 301(92.0%) had work target-

TABLE 1: Workplace Characteristics

Variable	Frequency (n=327)	Percentage (%)
Roles at the workshop*		
Heavy lifting	145	44.3
Cutting	316	96.6
Welding	295	90.2
Painting	167	51.1
Training attained		
Institutional training	122	37.3
Causal labourer (No formal training)	205	62.7
Work hours per day		
Below 8 hours	68	20.8
8 hours and above	247	75.5
Do have work targets		
Yes	301	92.0
No	26	8.0
Work experience (years)		
Below 5 years	209	63.9
5 years	23	7.0
Above 5 years	95	29.1

*-Multiple response

TABLE 2: Occupational Injuries Sustained in the Past One Year among Metal Workshop Workers

Variables	Frequency (n=327)	Percentage (%)
Sustained any occupational injuries?		
Yes	287	87.8
No	40	12.2
Injuries sustained*		
Burns and cuts	n=287	84.3
Eye strain	180	62.73
Head and back injuries	99	34.5
Falls and trips	57	19.8
Fractures	84	29.3
PPE ownership		
Yes	317	96.9
No	10	3.1
PPE utilisation		
Yes	n=317	98.4
No	5	1.6
Type of PPE used*		
Goggles	n=317	90.5
Face masks	110	34.7
Gloves	241	76.0
Overall and boots	254	80.1

*-Multiple response

ts and more than half of the respondents 209 (63.9%) had below 5 years of work experience (Table 1).

Prevalence of Occupational Injuries

The overall prevalence of occupational injuries among w-

TABLE 3: Factors Associated with Occupational Injuries among Welders

Variable	Occupational Injuries				Crude Odds Ratio (COR) at 95% Confidence Interval (C.I)	P-value
	Yes F	%	No F	%		
Age groups (years)						
Below 25	184	64.1	22	55.0		
26-35	68	23.7	7	17.5	1.16 (0.47-2.84)	.743
Above 35	35	12.2	11	27.5	0.38 (0.16-0.85)	.019*
Education level						
Never went to school	29	10.1	4	10.0		
Primary	134	46.7	13	32.5	1.42 (0.43-4.68)	.562
Secondary/tertiary	124	43.2	23	57.5	0.74 (0.24-2.31)	.609
Marital status						
Single/ divorced	190	66.2	29	72.5		
Married	97	33.8	11	27.5	1.35 (0.64-2.81)	.429
Work experience (years)						
Less than 5 years	192	66.9	17	42.5		
5 years	19	6.6	4	10.0	0.42 (0.13-1.38)	.153
Above 5 years	76	26.5	19	47.5	0.35 (0.17-0.72)	.004*
Training attained						
Institutional training	96	33.4	26	65.0		
Causal labourer (No formal training)	191	66.6	14	35.0	3.69 (1.85-7.40)	<.001
Work hours						
Below 8 hours	69	24.0	18	45.0		
8 hours and above	218	76.0	22	55.0	2.58 (1.31-5.10)	.006*
Have work target?						
Yes	269	93.7	32	80.0		
No	18	6.3	8	20.0	0.27 (0.11-0.66)	.005*
Tobacco use						
Yes	17	2.9	1	2.5		
No	270	94.1	39	97.5	0.41 (0.05-3.15)	.389
Alcohol use						
Yes	35	12.2	11	27.5		
No	252	87.8	29	72.5	2.73 (1.25-5.95)	.011*

*-Statistically significant at $P < .05$

elders was 287 (87.8%) and majority of which 242 (84.3%) had sustained burns/ cuts. Almost all of the respondents, 317 (96.9%) owned PPE and 312 (98.4%) utilised their PPE during work. Most of the respondents, 287(90.5%) used goggles during their work (Table 2).

Factors Associated Occupational Injuries among Welders

At bivariate analysis; those aged above 35 years (COR=0.38, CI=0.16-0.85, $P=0.019$), those who had worked for more than 5 years (COR=0.35, CI=0.17-0.72, $P=.004$) and those who had no work targets (COR=0.27, CI=0.11-0.66, $P=.005$) were less likely to have sustained occupational injuries. Respondents who worked as casual labourers (COR=3.69, CI=1.85-7.40, $P<.001$), worked

for 8 hours and above (COR=2.58, CI=1.31-5.10, $P=.006$) and consume alcohol (COR=2.73, CI=1.25-5.95, $P=.011$) were more likely to have sustained occupational injuries (Table 3).

At multivariate analysis after controlling for potential confounders, work experience of more than 5 years (AOR=0.30, CI=0.11-0.84, $P=.021$) and working without targets (AOR=0.20, CI=0.07-0.57, $P-value=.002$) were protective while working as a casual labourer (AOR=4.70, CI=2.30-10.84, $P<.001$) was significantly associated with occupational injuries (Table 4).

DISCUSSION

Majority of the respondents were below 25 years of age-

TABLE 4: Factors Influencing Occupational Injuries among Small-Scale Metal Workshop Workers

Independent variable	Crude Odds Ratio (COR) at 95% Confidence Interval (C.I)	Adjusted Odds Ratios (AOR) at 95% Confidence Interval (CI)	P-value
Age	0.97 (0.93-1.01)	1.04 (0.98-1.11)	.153
Work experience (years)			
Less than 5 years			
5 years	1.16 (0.47-2.84)	0.35 (0.10-1.27)	.112
Above 5 years	0.38 (0.16-0.85)	0.30 (0.11-0.84)	.021*
Training attained			
Institutional training			
Causal labourer (No formal training)	3.69 (1.85-7.40)	4.70 (2.03-10.84)	<.001*
Work hours			
Below 8 hours			
8 hours and above	2.58 (1.31-5.10)	2.63 (1.26-5.51)	.010*
Have work target?			
Yes			
No	0.27 (0.11-0.66)	0.20 (0.07-0.57)	.002*

*-Statistically significant at P<.05

and had attained primary level education. Uganda's demographic profile indicates that majority of the population are predominantly the youth who are employed in the informal sector.¹⁵ This finding is consistent with those found in similar studies conducted in Nepal and India where welders were predominantly male under the age of 25 years.¹⁶⁻¹⁹

The overall prevalence of occupational injuries among welders working in small scale metal workshops was high at 87.8%. These findings are consistent with those found by other similar studies conducted in South India, Nigeria and Kenya.^{16,20,21} This high prevalence of occupational injuries is due to inadequate enforcement of OSH legislation, inadequate professional job training and inadequate awareness OSH issues related to welding.^{12,22}

Burns and cuts on the hands and fingers were the most prevalent occupational injuries sustained and these findings are consistent to those found in Eastern Uganda, Nigeria, Iran and coastal South India.^{12,20,23,24} A review of literature showed that most welders are highly aware of eye protective devices since eye injuries are perceived to be more severe than other injuries.^{20,25,26} Goggles were the commonest PPE used, these findings are consistent with those found in India and Ethiopia.^{16,19,27} This could be attributed to the high awareness about the instant health implications of welding flash light that arise during metal-arc/gas welding and low perception of occupational risk to other body parts.²⁸⁻³² This finding implies that most of the welding workers prioritise eye safety to other body parts.

The finding that causal labourers with no formal training were approximately four times more likely to have sustained occupational injuries as compared to their counterparts indicates that the unprofessional on-the-job

training provided is skills-based and little attention is given to safety.^{33,34} Similar findings were found in studies conducted in Nigeria, Nepal and Pakistan.^{17,34,35}

This study found out that those welding workers who did not have work targets to be less likely to have sustained occupational injuries and this could be attributed to sufficient time allocated to accomplish a task. A review of literature showed that 8 hours per 5 days per week is maximum exposure limit recommended to welding workers.³⁶ Workers with work targets tend to work beyond 8 hours or more than 5 days per week thus becoming more susceptible to making errors that make them sustain occupational injuries.^{33,37}

In this study, it was established that workers with more than 5 years of work experience were less likely to have sustained occupational injuries. These findings are similar to those found in studies conducted in Northern Nigeria and southern India^{11,38} and this has been attributed to the appropriate use of PPE as a result of previous exposure to injuries and hazard awareness amongst the experienced welding workers.^{27,39} Supportive supervision should be provided to inexperienced workers in order to ensure guidance and knowledge sharing on issues related to occupational safety.

Limitation: The study was cross sectional in design and therefore causality was not possible to assess. The results could have been affected by recall bias as the respondents were required to remember their experience. Nevertheless, the study gives an insight on the factors associated with occupational injuries among welding workers in a peri-urban setting. This information is important for designing appropriate strategies and interventions to curtail occupational injuries through implementation of workplace regulation.

CONCLUSION

The prevalence of occupational injuries among small-scale welding workers was high and this was associated to the unprofessional on-the-job learning and working for more than 8 hours. These findings call for advocacy for integrating occupational safety and health aspects in the on-the-job trainings amongst welding workers. Existing workplace regulations should be upheld by law enforcement officers and Public health department to ensure employers are not overworked at their workplaces.

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