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KNOWLEDGE AND PRACTICE OF IMAGING OF CHILDREN WITH SUSPECTED CASES OF NON-ACCIDENTAL INJURIES AMONG RADIOGRAPHERS WITHIN MAIDUGURI METROPOLIS, NORTHEASTERN NIGERIA

***[1]Luntsi Geofery, [2]Hadiza Ahmed, [2]Muhammad Musa Abubakar, [1]Nkubli Bobuin Flavious, [2]Shatane Ibrahim Namba, [2]Ahmadu Adamu**

[1]Department of Medical Radiography, College of Medical Sciences, University of Maiduguri, Borno State, Nigeria

[2]Department of Radiology, University of Maiduguri Teaching Hospital, Maiduguri, Borno State, Nigeria

**Correspondence:geostuffy@unimaid.edu.ng*

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ABSTRACT

Objectives: To assess the knowledge and practice of Non-accidental injuries (NAI) among radiographers practicing within Maiduguri Metropolis.

Methods: A cross-sectional study was conducted using a questionnaire to elicit information on knowledge and practice of imaging children with Non-accidental injuries. The information elicited from the questionnaire related to the following themes: Demographic characteristics, knowledge and practice of imaging children with NAI. Informed consent was sought from participants. Descriptive statistics (mean, frequencies) were used to analyze the data.

Results: A total of 45 questionnaires were distributed to radiographers, and 36 (100%) were completed and returned. A total of 23 (63.9%) were males and 13 (36.1%) were females. The majority 34 (94.4%) of the respondents had good knowledge of NAI. Skeletal survey was the examination commonly requested in children with NAI as reported by 23 (63.9%) respondents, and the majority of the participants 31 (86.1%) had no specialty training in pediatric imaging. A total of 23 (63.9%) participants knew that using a single film to image the whole body (baby-gram) was an obsolete examination.

Conclusion: Radiographers in this study have good knowledge of NAI in children and are involved in imaging children with suspected cases of non-accidental injury. It is evident from the results of this study that NAI among children occurs in our environment and a majority of these cases are underreported and may even go unnoticed. Having adequate knowledge of clinical and radiologic manifestations of NAI in children will enable the radiographer to deliver evidence-based practice in line with international best practices.

Keywords: Non-accidental injury (NAI), Child abuse, Radiographers.

Introduction

Non-accidental injury (NAI) in children or physical child abuse also referred to as battered child syndrome, shaken baby syndrome, or non-accidental trauma (NAT) has been recognized as a major public health burden impacting the health and welfare of children

and adolescents and remains one of the leading causes of morbidity and mortality in children worldwide (1-3). According to the United Nations Convention on Child Rights Act, 2003, a child is anyone who has not attained 18 years (4,5). Child abuse is 'any kind of physical, sexual, emotional abuse, neglect or negligent treatment, commercial or other exploitation resulting in actual or potential harm to the child's health, survival, development, or dignity in the context of a relationship of responsibility, trust or power (1,6).

Nigerian society is still plagued with incidences of child labour, child maltreatment, child trafficking and neglect. In recent times, there have been increased reports of kidnappings, forced labour and forced marriages (1). Growing evidence suggests that in addition to the immediate negative effects of maltreatment on children, there are associated host of problems that are manifested in adolescence and adulthood (6,7). Radiographers among other healthcare professionals, perform a critical role in the care, assessment and radiological management of NAI in children. They play an integral role in preserving the catalogue of evidence in proven cases of abuse (8). Radiological investigations are essential when assessing children who may have been subjected to physical abuse (9). Imaging in NAI has however remained a debated issue with little agreement on how, when and what type of imaging modalities should be used in the investigation of suspected cases of NAI (9). Investigating NAI requires thorough history taking and adequate clinical examination, which are usually supplemented with radiological investigations, including plain radiographic and cross-sectional imaging (3). It is noteworthy that most of the history provided would often be incomplete or misleading, especially from the parents, guardians and even caregivers, and physical examination alone may not reveal occult injuries, the knowledge of radiographers about NAI will play a vital role in identifying and diagnosing NAI in children even when it is concealed (10). Failure to diagnose NAI carries a great risk of morbidity and mortality, particularly in children who are non-ambulatory and non-verbal yet (3).

In the past few decades, technological advances have propelled a significant increase in the radiological arsenal, consequently, the availability of hitherto not available; conventional radiography, Ultrasonography, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) among others are now available most developing countries including Nigeria (11). Computed tomography is widely being used as first-line trauma triage, this is not unconnected to the fact that it has an edge over plain film or conventional radiography by providing 3-D imaging capabilities, and cross-sectional images thus avoiding superimposition which is a major drawback in conventional radiography. However, given the relatively high radiation dose involved in CT, it should not totally replace conventional radiography. In situations where a CT scan is performed during trauma evaluation, the full skeletal survey should still be performed (11). Ultrasonography is also widely used as an extension of the physical examination and as an adjunct to, not replacement or sole modality for conventional imaging methods of skeletal trauma in cases of suspected physical abuse (10). The radiographic skeletal survey is the principal radiological investigation of suspected child abuse, and it is commonly presented as evidence in child protection cases, criminal proceedings and other types of litigation (10). Fractures are reported to be the second most common finding in child abuse, after skin lesions such as bruises and contusions (5,12). Fractures can occur in any part of the skeletal system and they are high chances of being multiple with different spectrums of findings (10,12). Conventional radiography has historically been and, to date continues to be the mainstay in radiological imaging of suspected child abuse. It aids in identifying new cases of possible child abuse, where an incidental finding on a radiograph may be the first sign of child abuse and in the workup of suspected child abuse cases. Thus, having a good knowledge of NAI injuries and their common presentations and symptoms by radiographers will not only inform their practice but will also help in identification and possibly communicate the same to the reporting radiologist who may not have the

opportunity of interacting with the patient during imaging investigation (10,12).

Methods:

This was an explorative cross-sectional study that investigated the knowledge and practice of imaging children with Non-accidental injuries among Radiographers. Ethical approval was obtained from the institutions involved in the study and informed consent was obtained from all the participants and participation was voluntary. A 28-item semi-structured questionnaire was used to collect data. The questionnaire consisted of participants' demographic characteristics, the knowledge of imaging children with non-accidental injuries (NAI), and the practice of imaging children with NAI. The questionnaires contained questions related to knowledge and practice of imaging children with NAI. The participants indicated their level of agreement with the statements using a four-item Likert scale ranging from (4= 'strongly disagree', 3= 'disagree', 2= 'agree', 1= 'strongly agree'). The questionnaire was adopted from (13-17) and adapted to suit the study's objectives, pilot-tested and with a Cronbach alpha value of 0.82. The data collected were analyzed using descriptive statistics using the statistical package for social sciences (SPSS) version 18.0.

Results

A total of 100% (36) responses were received from the radiographers. Of these, 63.9% (23) were males and 36.1% (13) were females. The largest age group with 80.6% (29) was the group from 24 to 34 years, and a good majority 80.1% (29) had a first degree as their educational qualification, while 63.9% (23) of respondents had greater than three years of work experience. Participants were from three hospitals: labeled A, B, and C for anonymity, as shown in Table 1.

The majority of 94.4% (34) participants had good knowledge of NAI and were also involved in imaging children brought for radiologic examinations and a total of 36.1% (13) agreed that pediatric imaging is a recognized sub-specialty in their department. A total of 63.9% (23) agreed that skeletal survey was the standard protocol for imaging children in their department, and a total of 77.7% (28) of the respondents disagreed that there is no need to sub-specialize in pediatric imaging as every radiographer should be able to demonstrate requested projections. About 63.9% (23) were also against using a single film to image the whole body of a child for economic purposes and to avoid multiple exposures to radiation. Conventional radiography (plain X-rays) 63.9% (23) and ultrasound 22.2% (8) were the commonest imaging modalities used to image children presenting with NAI in this study, as seen in table 2.

A total of 61.1% (22) of the respondents claimed that skeletal survey is the examination commonly requested in children with NAI and 13.9% (3) were of the opinion that skull radiography is the most commonly requested examination in children with NAI. Also, 55.6% (20) of the respondents suggest that bone is the common organ of interest and 2.8% (1) go for other specifications. The majority of the respondents, 58.3% (21) claimed that fractures are the most common findings and 2.8% (1) suggest that lung infections are the most common. About 52.8% (19) of respondents believed lateral projections best demonstrate fractures of the spines. Also, 38.8% (14) respondents believed AP projections best demonstrates fracture of the appendicular skeleton. A good number of the respondents 52.7% (19) claimed that PA and the lateral projections best demonstrates fracture of the skull. The respondents identified the culture and traditions of the people 25% (9), unwillingness and lack of cooperation from the healthcare team 16.7% (6), lack of strong legislation against perpetrators 16.7% (6), lack of functional social care service 13.9% (5), and the lack of dedicated pediatric facility and immobilization devices, as the major challenge to imaging children with suspected cases of NAI, as shown in Table 3.

Table 1: Demographic Characteristics of the Participants

Hospital	Frequency	Percentage (%)
Number of Children attended to per week		
Center A	23	63.9
Center B	7	19.6
Center C	6	16.6
Total	36	100
Gender		
Male	23	63.9
Female	13	36.1
Total	36	100
Age		
18-24	2	5.6
25-34	29	80.6
35-44	3	8.3
45 & above	2	5.6
Total	36	100
Marital Status		
Single	18	50
Married	16	44.4
Divorced	1	2.8
Others	1	2.8
Total	36	100
Educational Qualification		
Diploma	1	2.8
Bachelor's Degree	29	80.1
Master's Degree	4	11.1
Doctor of Philosophy	2	5.6
Total	36	100
Present Post?		
Intern Radiographer	13	36
Senior Radiographer	17	47.2
Principal Radiographer	4	11.2
Chief Radiographer	2	5.6
Total	36	100
Years of working experience?		
0-2 years	13	36.1
3-5 years	14	38.9
6-8 years	2	5.6
9-11 years	3	8.3
12 years & above	4	11.1
Total	36	100

Table 2: Knowledge of Imaging Children with Non-Accidental Injury (NAI)

Items	Frequency	Percentages
Do you Know What NAI is?		
Yes	34	94.4
No	2	5.6
Total	36	100
Are you involved in pediatrics imaging in the Radiology Department?		
Yes	34	94.4
No	2	5.6
Total	36	100
Is pediatric imaging a recognized sub-specialty in your department?		
Yes	13	36.1
No	23	63.9
Total	36	100
Is there any standard protocol for examining children with NAI in your department?		
Yes	9	25.0
No	27	75.0
Total	36	100
Is Skeletal survey used as the standard protocol for imaging children with NAI?		
Yes	23	63.9
No	13	36.1
Total	36	100
There is no need for sub-specialize in pediatric imaging as every radiographer should be able to handle pediatric cases.		
Strongly agree	3	8.3
Agree	5	13.9
Strongly disagree	16	44.4
Disagree	12	33.3
Total	36	100
Do you have sub-specialty training in Pediatric imaging?		
Yes	5	13.9
No	31	86.1
Total	36	100
What level of sub-specialty training do you have?		
Postgraduate certificate	2	5.6
Conference/workshop (CPD)	3	8.4
In-house seminar	31	86.1
Total	36	100
Is it advisable and economical to use a single film to image the entire baby, to avoid multiple exposures during skeletal survey?		
Strongly agree	2	5.6

Agree	11	30.6
Strongly disagree	6	16.7
Disagree	17	47.2
Total	36	100
What is the equipment used in imaging children with suspected NAI in your department?		
Conventional Radiography	23	63.9
Digital radiography system	3	8.3
Computed tomography (CT)	2	5.6
Ultrasound	8	22.2
Total	36	100

Table 3: Practice of Imaging Children with Non-Accidental Injury (NAI)

Item	Frequency	Percentage
Type of examination commonly requested for NAI		
Lower extremities	6	16.7
Upper extremities	5	13.9
Skull	3	8.3
Skeletal survey	22	61.1
Total	36	100
Commonest finding in children presenting with NAI		
Fracture	21	58.3
Abusive head trauma	4	11.1
Bruises	4	11.1
Burns	3	8.3
Birth injuries	2	5.6
Lung infection	6	16.7
Total	36	100
What projections are used to best demonstrate fracture of the spine during follow-up?		
AP projection	6	16.7
Lateral projection	19	52.8
PA projection	3	8.3
Oblique projection	8	22.2
Total	36	100
What projections are used to demonstrate fractures in the appendicular skeleton during follow-up?		
AP projection	14	38.9
PA projection	9	25
Lateral projection	9	25
Oblique projection	4	11.1
Total	36	100
What projections are used to demonstrate fracture of the Skull during follow-up?		
AP + Lateral projection	19	52.7
PA + Lateral projection	9	25.0
PA + Lateral + Townes projection	8	22.2
Total	36	100
What are the common challenges of imaging children with suspected NAI?		
The culture and traditions of the people	9	25.0
Unwillingness and poor cooperation from the healthcare team	6	16.7
Lack of strong legislation against the perpetrators	6	16.7
Lack of functional social care/child protection services within the community	5	13.9
Lack of immobilization devices and dedicated pediatric imaging facility	10	27.6
Total	36	100

Discussion

Radiographers are among the first-line caregivers in a hospital setting; hence they play a pivotal role in identifying suspected cases of NAI in children (12). The imaging's role is not only in detecting radiological findings, but also in differentiating these findings from normal variants and other conditions, determining the age of fracture, and suggesting the mechanism of injury (3). The inability to diagnose and report NAI carries a significant risk for morbidity, particularly in non-ambulatory and nonverbal children (19, 20).

Participants in this study demonstrated good knowledge and awareness of imaging children with non-accidental injuries. The majority of participants were involved in imaging children presenting with suspected non-accidental injury. Similar findings were reported by the previous studies that found good knowledge of NAI among radiographers (12,14,21,22). Good knowledge based on evidence best practices underpins the practice of radiography which enables radiographers to competently deliver quality radiography services. The majority of the respondent

also agreed that history and clinical examination supplement radiological investigation. This agrees with the recommendations by Nguyen (3) where a detailed history and good clinical/physical examination could be vital in identifying occult fractures. Only a few of the respondents have a sub-specialization in pediatric imaging; however, most of the participants recognized it as a sub-specialty. Previous studies (21, 23-26), also reported a lack of formal education and training in pediatric imaging. However, a few respondents claimed there was no need to sub-specialize in pediatric imaging as every radiographer should be able to demonstrate requested radiographic projections. Increased education (sub-specialization) and optimized clinical and radiological protocols are empirical approaches to improving knowledge and diagnosis of children presenting with cases of suspected NAI (3,25). Children are unique sets of individuals presenting with peculiar needs that require special attention, knowledge and skill to adequately attend to their needs thus the place of further education (sub-specialization) cannot be over-emphasized (27).

Respondents in this study attended to several children weekly presenting with cases of suspected NAI. The commonly requested and performed imaging examinations for children with suspected NAI in this study was skeletal survey. This was in line with the recommendations by the American College of Radiology, the Society for Pediatric Radiology (ACR-SPR), the Royal College of Radiologists, the Royal College of Pediatrics and Child Health (RCR-RCPCH) (28), for imaging children with suspected NAI. A skeletal survey is a series of systematically performed high-quality radiographs demonstrating the entire skeleton and is routine in the assessment of children 2 years and below (3,10,20,29,30). Skeletal surveys can identify latent fractures, and other underlying bony pathologies and aid in fracture dating (3,31). The skeletal surveys are performed using optimally high-quality imaging systems, and strict protocols, with good attention to accurate patient positioning, among others to acquire high-quality images sufficient to depict subtle fractures and keep radiation dose to patient as low as reasonably achievable (10,17,32). The American Academy of Pediatrics (AAP) recommends a repeat of the skeletal survey after 7-10 days after sustaining an injury to reveal the healing of missed fractures during the initial examination (33).

The bone was the common organ of interest in imaging children presenting with suspected NAI, and that fracture was the commonest finding in this study. Previous studies (12,34) also reported similar findings. Fractures are generally the second most common finding in cases of children presenting with suspected NAI after bruises. Fractures can occur in any part of the skeletal system (29,30, 35-38). Abusive fractures are more common in children below 2 years of age (38). The suspicion of NAI increases when findings are not in line with the caregiver's history and the child's developmental stage and when concealed fractures are discovered (36). Conventional radiography and ultrasound were the major imaging modalities used in the imaging evaluation of suspected cases of children with NAI, for identification and management of suspected child abuse both in identifying new cases as well as work-up cases of suspected NAI, in this study. Previous studies (3,10,11,29) reported similar findings. Other imaging modalities like computed tomography (CT) and magnetic resonance imaging (MRI) were also used in imaging children presenting with cases of suspected NAI in this study. However, this was not extensively used as plain radiography, followed by ultrasound in our environment. This could perhaps be due to the availability and affordability of plain radiography and ultrasound imaging compared to CT and MRI which may not be readily available and even affordable for every patient. In similar studies (12,13,17,30,31), different imaging modalities like ultrasound, CT, and MRI, among others were used in imaging children presenting with suspected cases of NAI.

In this study, lateral projections, PA and oblique projections were commonly used during follow-up cases of children with NAI. Several studies on Imaging children with suspected NAI recommend performing a chest radiograph (oblique projections) to identify healing of fractured ribs, projections of the skull, pelvis, and lateral projections of the spines (30,31,39).

It is also important to note that the images for children with suspected NAI should be properly annotated with; name, age, date of examination, patient identification number, hospital number, and anatomical maker, among others for proper identification and possible follow-up imaging requirements or in cases where the images may be used as evidence of abuse in a court of law (17, 38,40).

Only a few of the radiographers in this study had sub-specialty training in pediatric imaging, with a handful having updated their knowledge through in-house seminars and workshops to keep abreast with the current realities and challenges in imaging children with NAI. Similar findings were reported in previous studies (41-43). Good knowledge of clinical and radiological manifestations of children presenting with cases of suspected abuse, good communication skill, and an understanding of the social and legal framework are very essential to the radiographer for the delivery of quality imaging service (41,42).

The majority of the respondents identified the lack of strong legislation and domestication of child protection laws in our society as the major challenges experienced in imaging children with suspected NAI. Nigeria ratified the United Nations Convention on the child right act in 1991, and in 2003, Nigeria enacted and adopted to be implemented with the 1989 Convention on the Rights of the Child and the 1990 African Union Charter on the Rights and Welfare of the Child (44). Several states in Nigeria have domesticated the Act, while several others have not, including Borno state, this is why the implementation of the rights of the child is limited in several states due to the lack of domestication of the child's right act (43,45-47).

Participants in this study also identified the lack of cooperation from the children, and the lack of pediatric facilities and immobilization devices as challenges during imaging children, especially those presenting with cases of suspected NAI. Previous studies (43,48) also reported several challenges encountered during imaging children like anxiety, crying, movement, and phobia of a strange environments, among others. Children are unique and present a conundrum of choices where the use of dedicated equipment that is easy to manipulate while allowing for fast acquisition of images of diagnostic quality, the environment must be captivating to capture their attention and make them calm, and the provisions of toys, murals and stencils can go a long way in helping relax the child during imaging examinations (43).

Participants also identified several cultural practices and traditions of the community as the major challenge in imaging children with suspected cases of NAI. Practices like, corporal punishment or harsh verbal abuse, child apprenticeship, and child labour may be tolerable in one culture but considered abuse in another culture. In some traditional practices, the male folks have an overbearing spousal control, this predisposes women and children to very harsh conditions (49). Domesticating the child rights act in every state in Nigeria with clear and implementable sanctions will help to reduce the spade of child abuse in Nigeria. Adults who were victims of childhood abuse are likely to be depressed, have suicidal tendencies, get involved in substance abuse, have interpersonal problems, and academic and vocational difficulties among others, and are likely to be abusive parents themselves (47, 50-54). Abused children suffer injuries, neurologic deficits, psychological disorders, learning difficulties, conduct disorders and even death (54)

This study is, however, limited in its sample size and also, there is the possibility of reporting bias from the participants during filling out the questionnaire. We hope that subsequent studies will try to overcome these challenges.

Conclusion

Radiographers in this study have good knowledge about NAI in children and are involved in imaging children with suspected cases of non-accidental injury. It is evident from the results of this study that NAI among children occurs in our environment and a majority of these are underreported and may even go unnoticed. Having adequate knowledge of clinical and radiologic manifestations of NAI in children will enable the radiographer to deliver evidence-based practice in line with the international best practice.

Thus, the need for encouragement, training and retraining of radiographers in pediatric imaging.

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The authors declare no conflict of interest exists.

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All the authors contributed to the conceptualization, design, data analysis, drafting, revising, and approval of the final manuscript.

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