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Cultural Appropriateness of the Modified Checklist for Autism for Screening Autism in Ghana

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Abstract

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Dissertation Submitted in Partial Fulfillment

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Abstract

Autism spectrum disorder (ASD) is a neurodevelopmental disorder in toddlers. The prevalence of this disorder continues to increase, necessitating an early screening tool to support early diagnosis and intervention. Although the Modified Checklist for Autism in Toddlers Revised (M-CHAT-R) has been cross-culturally effective for screening ASD, little research has been done on early screening for ASD characteristics in Ghana. In the current study, the M-CHAT-R was completed by parents ($N = 90$) of ASD and non-ASD children between the ages of 16 to 60 months at selected special schools and hospitals in Ghana to determine its sensitivity and specificity to accurately diagnose ASD. Findings from the study confirm that at a cut-off score of 3, sensitivity was 0.98 and specificity was 0.73. Item-by-item analysis was conducted to determine good and poor discriminating items. Overall, Item 7 (Does your child point with one finger to show you something interesting?) was identified as the best discriminating item, whereas Item 13 (Does your child walk?) was identified as the poor discriminating item. Selected healthcare professionals ($N = 40$) who evaluated the screening tool also confirmed that the M-CHAT-R is culturally appropriate for screening ASD characteristics and should therefore be adapted in Ghana. Further investigation is appropriate to consolidate the predictive validity of the M-CHAT-R; however, the overall outcome indicates a step toward validating the M-CHAT-R and its adaptation for future use in Ghana. Adapting the M-CHAT-R will contribute to positive social change as at-risk children will benefit from early diagnosis and intervention, leading to positive impact on their quality of life and well-being.

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Dedication

I dedicate this important study to my sweet mother, Ophelia Oware, and my dear sister Anna Darquah of Blessed Memory. My mother gave me moral support at a point in time when I felt like giving up. My dedication also goes to my wife, Josephine, and children, Melvin, Jadyn, and Bradley who had to forgo their vacation and time with dad. You mean a lot to me and your sacrifices cannot be measured. I cannot forget about my adopted son Emmanuel whose late diagnosis of autism inspired me to choose this important topic. You will forever be in my heart.

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To the special schools, hospitals, nurses, clinicians, doctors, and administrators who in diverse ways have contributed to making this study a success, I say a big thank you. This study wouldn't have been successful without the input of Rahinatu B. Kwota. Rahina's relentless effort in assisting me to secure approval from Ghana Health Services cannot be overlooked.

I would like to thank my late mother Ophelia Oware and my late sister Anna Darquah again for their prayers. How I would have wished my mother and sister had lived to witness the first PhD in the family. May their young souls rest in perfect peace. My thanks go to Josephine Darquah and my children for their never-ending support, love, assistance, and patience during the entire period of my project. They have inspired me to achieve this greater height and I am proud of them.

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Chapter 1: Introduction to the Study

Autism spectrum disorder (ASD) represents a spectrum of disorders that are closely related to a shared core of symptoms. This spectrum of disorders mostly appears during infancy and early childhood, resulting in impairments in many essential areas of development (Bappaditya & Santonish, 2017). Many children with ASD have limited communication and social skills; consequently, they tend to lag behind their age group due to disabilities in several skill areas (Denkyirah & Agbeke, 2010).

The last decade has witnessed a rapid increase in the prevalence and diagnosis of ASD among all groups of people and across the world (Bappaditya & Santonish, 2017). Current studies have confirmed that autism is not exclusive to advanced countries but is rather a global issue (Bakare & Munir, 2011). However, most of the estimation of ASD comes from the Western countries with little information recorded from developing countries (Bappaditya & Santonish, 2017) including Ghana (Dixon, Badoe, & Victoria Owusu, 2015). Available estimations suggest a higher prevalence in the Western countries and lower incidence in developing countries (Al-Shibli & Hamdoun, 2019). But the lower incidence recorded in developing countries might be due to under reporting of the affected children and might not represent the reality. Such under reporting could affect the diagnosis and intervention for affected children (Al-Shibli & Hamdoun, 2019). Epidemiological studies on ASD have focused strongly on Europe and North America (Sotgui et al., 2011) and have resulted in improvements in the early detection and diagnosis of ASD there (Centers for Disease Control and Prevention [CDC], 2016).

However, there are few studies on prevalence of ASD in Ghana, which has affected the detection and intervention effort (Dixon et al., 2015).

The need to facilitate early screening, diagnosis, and intervention of at-risk children with ASD using a screening tool that is culturally appropriate influenced this research. This study aimed to identify whether an ASD early screening tool, Modified Checklist of Autism in Toddlers Revised (M-CHAT-R) developed in the United States (Robins & Barton, 2009) is sensitive to a different cultural group. This was done by evaluating the psychometric properties of the M-CHAT-R against the cut-off score for the original study. Specific emphasis was on the sensitivity and specificity of the screening tool with the Ghanaian population. It was expected that the cultural variations would not affect the validity of the screening tool with the Ghanaian population.

Background

In the area of developmental disabilities, Ghanaians explain any condition using their spiritual beliefs and cultural lens (Anthony, 2009). In Ghana, culture is the primary pillar that shapes behavior, practices, and thoughts of the communities, and Ghanaians have relied on culture and religion to explain the unknown. Thus, although ASD screening, diagnosis, and intervention have attracted global attention, several developing nations like Ghana have been slow to recognize their importance. The low rates of ASD recorded in developing countries have opened a global discussion to ascertain the differences in the rates between developed and developing countries (Maguire, 2013). For instance, empirical evidence confirmed that developed nations have better detection tools for ASD compared to developing nations (Maguire, 2013). However, an estimate of

the prevalence of ASD in Ghana is not readily available due to limited research in this area, though a study by Rural Integrated Relief Service (2010) estimated that 1 in 87 children under the age of 3 has ASD.

Further, knowledge on autism is low among pediatrics and psychiatric nurses in Ghana (Wireko-Gyebi & Ashiagbor, 2018). Spiritual beliefs, the lack of awareness of ASD, the lack of knowledge, and incorrect information from professionals affect the early detection of autism. Many Ghanaians regard ASD to have supernatural causes resulting from sinful behaviors of mothers and angering their ancestors. Children with ASD characteristics are initially taken to traditional healers and when outcomes are unfavorable, they then seek medical assistance at the mainstream hospitals. This potential delay in seeking medical assistance leads to late diagnosis and unfavorable outcomes. These findings suggest the need for early screening and diagnosis of ASD (Ruparelia et al. 2016). Lack of awareness and stigma about ASD among professionals and parents contribute to late diagnosis and delayed intervention (Dixon et al., 2015). Dr. Badoe, the only pediatric neurologist in Ghana, has expressed the need for epidemiological studies to be conducted in Ghana (Marino, 2016). Raising community awareness through engagements, improving public access to training and information increases the chances of at-risk children receiving early screening, diagnosis and treatment (Ruparelia, et al., 2016). Currently, awareness of autism in Ghana is increasing, and having a screening tool to detect the autism characteristics will contribute to the knowledge base of the disease. If diagnostic and intervention strategies are to be consolidated for optimum care, there is a contemporaneous responsibility to ensure early screening for at-risk children in Ghana.

Problem Statement

Limited information, lack of knowledge, and cultural issues have contributed to the reporting of lower rates of ASD diagnosis in Ghana (Dixon et al., 2015) compared to developed countries. The seemingly low numbers and late diagnoses of ASDs recorded in Ghana expose at-risk children to adverse health outcomes that require immediate attention and intervention (Fernell, Eriksson, & Gillberg, 2013). Cultural misunderstanding surrounding ASD as a disorder have contributed to limited knowledge about the disease (Anthony, 2009). Therefore, a screening tool for autism in Ghana might be influenced by the Ghanaian culture.

The prevalence of ASD diagnosis can differ among cultures due to the type of assessment used, culturally determined behavior, and socioeconomic status of a family (Norbury & Sparjs, 2013). Knowing the possible outcomes of a behaviorally formulated screening tool across varied cultures is necessary for screening success (Grinker et al., 2011). For instance, in Ghana, limited eye contact is a sign of respect, but the M-CHAT-R identifies it as an ASD characteristic (Anthony, 2009). Most parents consider deafness, an item on the M-CHAT-R, as a curse resulting from parental or family sin, so getting the perspective of parents on this item on the screening tool is vital. Additionally, pointing, giving, and taking items especially with the left hand is seen as a taboo or a sign of disrespect in the Ghanaian culture (Kita & Essegbey, 2001), which is not mentioned on the screening tool but is equally important to determine parents' viewpoint about these behaviors as ASD characteristics. Furthermore, it is crucial to capture parents' perspectives of the items on the screening tool to determine whether the same impacts the

study outcome. Moreover, validating the test scores across cultures is essential for adaptation. The advantage of this screening tool is that because it is a parental questionnaire, it is likely to reduce some of the possible cultural biases between the researcher and the respondents (Khleinman et al., 2008).

The M-CHAT-R as a screening tool for the early detection of ASD is an improvement of the original M-CHAT, which is a well-recognized screening tool for ASD (Robins et al., 2014). The M-CHAT is in use in several countries including Portugal, Argentina, Spain, Saudi Arabia, China, and Sweden. The M-CHAT versions of these countries have yielded good outcomes similar to the findings of the originators of this screening tool. However, the cut-off score for the adapted versions of the identified countries varies, which suggests the need for optimal validity considering cross-cultural differences (Canal-Bedia et al., 2011). Interestingly, the cut-off score, sensitivity, and specificity values for ASD screening in Saudi Arabia and Spain are similar to that of the original M-CHAT (Canal-Bedia et al., 2011; Eldin et al., 2008). The maximum score of the Japanese and Chinese version of the M-CHAT is 23. The cut-off score for the Japanese version using the 2/23 had the best sensitivity and specificity values of .75 and .89, respectively (Inada et al., 2011). The Chinese version of the M-CHAT items obtained a sensitivity score of .839 and specificity score of .848 when the 3/23 cut-off score was used (Wong et al., 2004). The Swedish version used the original M-CHAT cut-off score with a minor modification to the M-CHAT items and obtained adequate specificity and sensitivity values (Nygren et al., 2012).

The adoption of a screening tool should be carried out cautiously so that it does not test something unrelated (Norbury & Sparks, 2013). It is, however, important to determine the optimal cut-off scores by examining the characteristics of the screening tool in the population of interest. Adapting a test without considering the relevance of the test content to the community at stake might be detrimental to the outcome of the study. However, there is limited evidence on culturally appropriate screening tools that can screen ASD characteristics unique to the Ghana culture.

Purpose of the Study

The M-CHAT-R is not a diagnostic tool but has successfully screened at-risk children for ASD in developed and other countries. Some ASD traits are similar across cultures, which is a good indicator for cross-cultural research (Carruthers et al., 2018). This study examined the cross-cultural validity of the M-CHAT-R in Ghana. The introduction of M-CHAT-R for ASD screening in Ghana is necessary to facilitate early detection, diagnosis, and intervention for at-risk children. Formal training is not needed to administer this screening tool, and its administration is cost effective and less time consuming. Another important aspect of this study was to gather and improve knowledge and understanding of ASD characteristics in Ghana as to potentially pave the way for future modification and adaptation of the screening tool if appropriate.

To address the validity of the M-CHAT-R in Ghana, I tested the sensitivity and specificity of the items on the M-CHAT-R and was able to identify all items that correctly screen for ASD. Parents of individuals diagnosed with ASD and parents of people without ASDs who met the selection criteria completed the screening tool. The

outcome of the study also helped determine that the items (2, 6, 7, and 14) on the screening tool suggested culturally normative behaviors and effectively screened ASD characteristics. Furthermore, I was able to determine the effectiveness of the screening tool in screening ASD characteristics in the older population. Professional opinions were obtained on the relevance of this screening tool with respect to Ghana. I also focused on cultural sensitivity of some of the items and the appropriateness of the language and easiness of scoring by asking parents and professionals to score a relevant questionnaire.

Research Questions

The primary question that guided this study was: How sensitive is the M-CHAT-R in screening children (16-30months) with ASD diagnosis at a cut-off score of 3? Secondary questions that were answered within the study included: How sensitive is the M-CHAT-R in screen ASD characteristics in a slightly older population (31- 60months) at a cut-off score of 3? How do parents and the selected healthcare professionals score the culturally sensitive items 2, 6, 7, and 14 on the screening tool? How do the selected health care professionals score the appropriateness of the items on the screening tool?

Conceptual Framework

The conceptual framework that shaped this study is the cultural universality theory (King & Mclnerney, 2014). Cultural universality refers to common themes that are evident in many cultures. This approach involves researchers translating instruments about their culture into a particular language and using the local culture to test whether assumptions of their models are supported in the new context (King & Mclnerney, 2014).

This important theoretical concept is a major tool for healthcare delivery that seeks to globalize healthcare and also forms the basis of cross-cultural research (Leininger, 2007). This theory suggests the discovery of commonalities and diversities that could contribute to a significant body of new, culturally linked comparative knowledge in healthcare fields and also trigger changes in healthcare delivery (Leininger, 2007). The theory was adopted in this study to explain the sensitivity and specificity of the items on the M-CHAT-R as well as its cultural relevance to the Ghanaian community.

Nature of the Study

The problem statement, purpose of the study, and research questions influenced my decision to use a quantitative study that emphasizes the use of sensitivity and specificity. The use of descriptive statistical tools helped me obtain reliable statistical outcomes to evaluate the presence of ASD characteristics within the selected groups of children using the M-CHAT-R. Through sensitivity and specificity analysis, items on the M-CHAT-R helped me differentiate between children with ASD diagnosis and children without ASD. The sensitivity of the items on this screening tool suggested the presence of positive ASD characteristics in the diagnosed group. Furthermore, the specificity of the items on the screening tool suggested the absence of ASD symptoms among individuals who did not have ASD. Statistical analysis as percentages was used to explain the selected cultural normative behavior items on the screening tool that were scored by parents and professionals.

In this study, data were collected from 90 parents of children. Forty-five of the parents had children with formal ASD diagnosis, and the other 45 were not on the

spectrum. The 90 parents scored the M-CHAT-R, and the collected data were analyzed to determine the sensitivity and specificity of the screening tool. Additionally, the parents scored items on a questionnaire that sought to determine their cultural appropriateness as well as the difficulty level of the language and ease of scoring. Forty selected healthcare professionals with knowledge on autism also scored the M-CHAT-R to determine its appropriateness for screening ASD characteristics in Ghana. The selected healthcare professionals also expressed their opinions on the difficulty level of the language and the ease of scoring.

Definitions

Some key words have been used throughout the study, so it is appropriate to define their meaning in relation to this research.

Autism Spectrum Disorder (ASD): The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) classified ASD as a single disorder. ASD comprises complex neurobehavioral disorders showcased through impairment in communication, social interaction, the presence of stereotypical and repetitive patterns of behavior (American Psychiatric Association, 2013).

The Modified Checklist for Autism in Toddlers, Revised (M-CHAT-R): This is a screening tool that asks a series of 20 questions about a child's behavior. It is intended for toddlers between the ages 16 and 30 months. A total score from 0–2 suggests low risk, a total score from 3–7 suggests moderate risk, and a score of 8–20 indicates high risk. However, Items 2, 5, and 12 have a reverse score.

Assumptions

I assumed that ASD characteristics are similar in all classes of people across the world. I also assumed that cultural beliefs will continue to be important to parents in their explanation for autism. Another assumption is that the information collected from the selected population reflects the concerns of the general population. I believed that respondents would answer questions honestly because they were granted anonymity and confidentiality and could withdraw from the study any time without consequences. Finally, I assumed that the gender of the respondents would not impact the outcome of the study.

Scope and Delimitations

I used quasi-experimental cross-sectional design to gather information from the selected parents and professionals in Ghana even though the study focused on children with an ASD diagnosis and how well the screening tool can effectively screen them. The scope of the study was limited to 90 children, 45 of whom had ASD diagnosis and 45 who were not on the spectrum. Furthermore, 40 healthcare professionals with a minimum of 5 years' experience working with children diagnosed with ASD were also selected for the study. However, this limited sample size might impede the generalization of the study outcomes.

The 90 children were selected from selected ASD schools and selected teaching hospitals in the Greater Accra Region. The limited knowledge on ASD in Ghana compelled me to limit my study to only one region out of the 16 regions there. The Greater Accra Region is the only region in Ghana where ASD is effectively diagnosed

and support is provided for diagnosed individuals. Thus, I recruited participants for the study in Greater Accra due to easy identification of ASD children. Children with ASD living in other regions in Ghana were not captured in this study at this time. However, this region is the capital city of Ghana, is most populated, and is the hub of industries and businesses. Residents of Greater Accra Region come from all parts of Ghana, which forms a diverse group of Ghanaians who participated in the study.

Limitations

The limitation of selecting only one region makes it difficult to transfer the outcome of the study to the other regions. Additionally, stigmatization of children with ASD and culturally entrenched behavior in some of the regions might have impacted the cultural sensitivity items differently. Furthermore, the use of participants' ability to speak the English language as a criterion for selection excluded parents who were willing to participate but could not speak English.

Significance

There is limited research on the early screening of ASD in Ghana. This study is unique in that a screening tool that was developed with a different cultural group was effectively evaluated within the Ghanaian culture to determine its adaptation. Parents and professionals were also given the opportunity to assess this screening tool to determine its appropriateness and applicability to the Ghanaian community. The outcome of this research paves the way for providing continuous education to professionals, parents, healthcare workers, and the general public on the importance of screening and diagnosing ASD at an early stage. Furthermore, this research provides much-needed information so

that at-risk children can be screened early to initiate early diagnosis and intervention by health care professionals. It might also serve as a turning point for developing an early screening tool for ASD that is unique to the Ghanaian community.

At-risk children of ASD in Ghana can benefit from this screening tool due to the ease of its use by parents. This screening tool only requires a parent's ability to read and write and therefore parents can quickly screen their children and refer them to health care professionals for further assessment if required. The study may also help parents and practitioners to identify unique individual symptoms of ASD when compared to other developmental disabilities. It may also serve as a call to the policy makers in Ghana to address the challenges that exist for early screening, diagnosis, intervention, and education of children with ASD.

Summary

Chapter 1 of this study comprises of the introduction, the background of the study, statement of the problem, purpose of the study, research questions, framework, nature of the study, significance of the study, delimitations, and limitations, assumptions of the study, and definition of terms. Chapter 2 presents the relevant literature with emphasis on ASD and cultural belief systems; global presentation of ASD; culture and ASD presentation; culture and ASD in Ghana; ASD diagnosis in Ghana, screening of ASD; early signs, symptoms, and diagnostic criteria for ASD; benefits and limitations of early screening of ASD; sensitivity and specificity outcomes; positive and negative predictive values (NPVs); receiver operating characteristics (ROC); M-CHAT-R

screening; cross-cultural validation of ASD screening tool; and cross-cultural adaptation of M-CHAT-R.

Chapter 3 contains the methodology and the processes that were used to collect the data for the study. It captures the research setting, the research design, participants, demographics, sampling procedure, screening procedure, instruments, ethical consideration, data analysis plan and threat to validity. Chapter 4 discusses the findings and analyses of the results that emerged from the study. Chapter 5 includes a summary of the research findings as well as inferences made out of the findings and recommendations for further studies.

Chapter 2: Literature Review

Introduction

ASD as identified in the DSM-5 is characterized by a sustained deficiency in social communication and social interaction across different contexts (American Psychiatric Association, 2013). This disorder is increasingly recorded across the globe and is shaped by beliefs and cultures of the society (Ennis-Cole, Durodoye, & Harris, 2013). The objective for reviewing the literature was to focus on Ghanaian culture and identify its significant aspects that might be relevant to the behavioral characteristics suggested by the M-CHAT-R for early screening of ASD.

Literature Search Strategy

The literature search strategy that was used for this study centered on keywords in my research questions. Some of the keywords included *M-CHAT-R, autism, autism screening, autistic disorders, culture and autism, ASD characteristics, Cross Cultural adaptation of the M-CHAT-R; benefits of early screening of ASD, autism in Ghana, Culture and autism in Ghana, autism diagnosis in Ghana, cross-cultural application of M-CHAT-R,* and *Sensitivity and Specificity*. Some of these keywords were used in isolation and others in pairs. Some of these keywords were occasionally combined to form search phrases. The strategy consisted of exhaustive search on the Internet, Walden online Library, and Google Scholar. Several databases including SAGE, PsycBooks, PsycINFO, JSTOR, ProQuest Dissertation and Theses, ERIC, Science Direct, and Highbeam Research were explored. Studies that were relevant to this research were accessed, which was limited to articles written in the English language.

Literature Review Related to Key Concepts

Global Presentation of Autism Spectrum Disorders

ASD comprises a group of severe neurodevelopmental disabilities mostly identified during early childhood. This disease is 4 to 5 times more prevalent in boys than in girls (Meek et al., 2013). These disorders disrupt social relationships, play, communications, and academic performance and entail repetitive and restrictive patterns of behavior leading to permanent disability (Kleinman et al., 2008; Samms-Vaughan, 2014). Other symptoms linked to ASD include challenging behaviors, seizures, irregular sleep patterns, emotional challenges, cognitive impairments, and gastrointestinal difficulties (Meek et al., 2013). Any child diagnosed with ASD is expected to exhibit most of these characteristics.

The highest rates of autism recorded in the world are among developed countries (Jevtic, 2015). In the United States, the estimates of toddlers with ASD have continued to increase significantly, and it is the fastest growing developmental disability. The CDC explained that autism is more pronounced in boys than in girls. One in 42 boys and one in 189 girls are diagnosed with ASD during their lifetime (CDC, 2014). Further, ASD affects one child in 88 births (Samms-Vaughan, 2014). Other industrial countries are also experiencing a similar trend of a rising incident of ASD. In the United Kingdom, the presence of ASD increased by 56% in 2012 compared to the last 5 years. However, studies conducted on the prevalence of autism in different parts of the world have suggested a moderate prevalence rate of 62 in 10,000 (Elsabbagh et al., 2012). Comparatively, developed nations have empirical data that emphasize on expanded

diagnostic criteria, the switching of the diagnosis of ASD, and service availability (Elsabbagh et al., 2012). Moreover, physicians, healthcare professionals, and communities are familiar with the disease presentation compared to developing nations (Maguire, 2013).

Culture and Autism Spectrum Disorders Presentation

Family and cultural values are the most important determinants of how a culturally endowed community analyzes a major family challenge such as accepting medical diagnosis and outcomes (Pittens, 2008). Thus, it would be out of place to discuss the characteristics and screening of ASD without first considering the role of culture in this disorder (Pittens, 2008). Families' decisions about ASD are significantly influenced by their cultural background. It is the culture that shapes the family's beliefs about disability in general and ASD specifically (Ennis-Cole et al., 2013). Factors such as culturally accepted behaviors, beliefs, values, and stigma attached to disability, family units, and primary language impacts a child's upbringing (Mendez et al., 2011).

Numerous studies on culture and disease suggest that similarities of characteristics associated with symptoms of developmental disabilities and ASD are found across cultures (Ennis-Cole et al., 2013). However, considerable differences have been recorded on how a cultural group explains the causative factors of ASD characteristics (Tek & Landa, 2012). Current research indicates that ASD traits are typically distributed in the general population and that parents and relatives with or without ASD in their families could identify some of the unique characteristics (Rogler, 1999).

Culture and Autism in Ghana

In Western Europe and the United States, behaviors that are considered potential signs for ASD screening are sometimes considered reasonable or even appropriate in other countries and cultures (Bauer, Winegar, & Waxman, 2016). Throughout Ghana, studies have confirmed that the understanding of ASD is firmly rooted in history, traditions, and culture (Anthony, 2009). In Ghana, cultural misunderstanding surrounding the disease as a disorder as well as the causes, diagnosis, and treatment have all contributed to the limited information about the illness (Anthony, 2009).

History suggests that spirituality is commonly used to understand developmental disabilities in the Ghanaian community (Anthony, 2009). The stigmatization of developmental disabilities and ASD in Ghana is intense. Families might intentionally avoid the diagnosis to prevent any form of embarrassment. The diagnosis of ASD focuses on behavioral factors, the significance of which can vary across cultures. The Western world ASD characteristics suggest that a child who finds it difficult to speak and avoids eye contact is a potential candidate for ASD diagnosis. However, in Ghana, eye contact is considered a sign of disrespect and therefore discouraged. Moreover, there is a general belief among Ghanaian cultural groups that boys develop language skills later, which makes it difficult for parents to associate these symptoms with ASD (Maguire, 2013). Additionally, aloofness and muteness are autistic characteristics that might not be considered problematic by parents or professionals in Ghana (Anthony, 2010). The authoritative and hierarchical social structure in Ghana requires that a well-behaved child be mute or aloof when in the presence of elders.

Additionally, repetitive behavior emerges very early in babies and toddlers who are likely to have ASD. Babies with repetitive behavior at 12 months of age are 4 times at risk of developing ASD (Autism Speak, 2018). But a comparative study on autistic features in the United Kingodm and some African nations revealed an absence of repetitive stereotypical behaviors such as head banging and hand flapping (Anthony, 2010). These typical autistic characteristics are experienced by children with ASD in the Western world (Anthony, 2010). Children with ASD also enjoy playing with toys. In developed countries, children have access to toys, which makes it easier for researchers to determine the likelihood of a repetitive play. However, in the Ghanaian community, children have limited access to toys, which makes it very difficult to assess repetitive play (Anthony, 2010).

Culturally motivated research is necessary for increasing the relevance of early screening and early intervention in countries where ASD is stigmatized, undiagnosed, and misdiagnosed (De-Graft Aikins, 2007). The lack of social recognition as well as stigmatization of disorders like ASD in Ghana might have contributed to limited knowledge of ASD, screening, diagnosis, and intervention. However, Ghanaians are gradually accepting the biomedical model of disease, which could affect their acceptability of early screening for autism (De-Graft Aikins, 2007). There is almost universal agreement among healthcare professionals regarding the impact of ASD on individuals and the society (Camarata, 2014). This permanent severe disabling condition has detrimental outcomes on social integration, communication, and behavior pattern (Camarata, 2014). The presence of ASD is not exclusive to countries but rather an

important global issue. The characteristics of this neurodevelopmental disorder start manifesting during early childhood and are linked to repetitive behavior, restrictive practices, and communication issues (Dixon et al., 2015).

In addition to the lack of research with a cultural lens, the prevalence of ASD estimates in Ghana are not available due to limited research in this area. Dr. Ebenezer Badoe, a pediatrician and neurologist at Kolebu Teaching Hospital, explained that it was not until 2007 that Ghanaians started to recognize the presence of ASD in their community. The absence of current and accurate data on ASD in Ghana poses a problem for ASD research as well as many families in Ghana lacking the understanding of ASD and the associated characteristics (Anthony, 2009). This can affect the early detection of ASD and deprive at-risk children of early intervention. Issues of awareness and stigma about ASD among professionals and parents contribute to late diagnosis and delayed intervention (Bakare & Munir, as cited in Dixon et al., 2015).

Autism spectrum disorder diagnosis in Ghana. The identified factors distinguish the differences between developed and developing countries. In Ghana, there are insufficient published studies on ASD. However, there are several unpublished documents on ASD prepared by non-governmental organizations in the area of education and support. The few published studies on its prevalence might be due to the lack of professionals and cultural perceptions of the disease. However, Rural Integrated Relief Service-Ghana (2010), a nongovernmental organization, estimated that children under the age of three are diagnosed with ASD in a ratio of 1 in 87. This suggested estimate calls for further research into ASD prevalence in Ghana.

Early Signs, Symptoms, and Diagnostic Criteria for Autism

ASD consists of a group of related disorders that are identified by the DSM-5 (American Psychiatric Association, 2013). Studies have confirmed that differences exist between children with ASD and typically developing children (Frye, 2018). The statistical manual captures disorders such as childhood disintegrative disorder, Asperger syndrome, and pervasive developmental disorders not otherwise specified. Even though DSM-5 grouped autism disorders, it did not identify clear-cut boundaries for the group components. The early signs defined by DSM-5 include social communication impairments and the presence of a restricted and repetitive pattern of behavior at the early developmental milestone (American Psychiatric Association, 2013).

Many children with ASD in their first year of life show deficits in social interaction, impairment in language skills, play and motor functions when compared to children their own age (Frye, 2018). Cross-sectional longitudinal studies also suggest that early signs of ASD can be detected before the ninth month of a child's development, but the symptoms become more visible after 12 months (Feldman et al., 2012). Early signs include lack of eye contact and interest in faces, deficit in attention and gestures, problems with fine and gross motor skills coordination, passive mood, repetitive and restricted behavior, social interaction difficulties, and obsessive interest in a specific topic (Feldman et al., 2015).

Screening of Autism Spectrum Disorder Characteristics

ASD screening tools are developed to promote the identification of children who are likely to experience developmental delays. Though these tools do not provide

conclusive evidence of developmental delays or suggest diagnosis, they can indicate the need for thorough assessment (CDC, 2016). It is important to identify the characteristics of ASD at an early stage to facilitate early diagnosis and intervention (Camarata, 2014). In Western countries, several screening tools have been successful in the early detection of ASD characteristics such as Social Communication Questionnaire, Autism Spectrum Screening Questionnaire, Childhood Autism Spectrum Test, Ages and Stages Questionnaire, Communication and Symbolic Behavior Scale, Parents Evaluation of Developmental Status, and the Screening Tool for Autism in Toddlers and Young Children.

The differences in behavior outcomes across cultures throughout the globe might make screening and assessment processes difficult for both parents and professionals. It might be challenging to develop a universal tool for the detection of ASD characteristics across cultures, but M-CHAT has been useful across cultures. Several pieces of evidence suggest that several Arab countries including Kuwait, Jordan, Omar, Saudi Arabia, and Tunisia have adapted this popular Western screening tool M-CHAT for early screening of ASD (Robins et al., 2001). Moreover, the adaptation of the M-CHAT has been successful across countries such as Portugal, Argentina, China, Japan, Spain, Mexico, and Saudi Arabia. The M-CHAT has recorded high sensitivity and specificity scores in these countries (Canal-Bedia et al., 2011; Eldin et al., 2008; Idana et al., 2011; Nygren et al., 2012). The most common screening tool that was able to screen ASD characteristics across cultures is the M-CHAT-R, with a positive predictive value (PPV) of 48% with a diverse population (McPheeters et al., 2016).

Benefits and limitations of early screening of autism spectrum disorders.

Screening tests are mostly used in clinical practices to evaluate the chances of an individual having a health condition (Canal-Bedia et al., 2011). A screening test is not a diagnostic test, but it might help in identifying individuals at risk of certain health conditions. The general acceptance is that ASD should be identified very early in a child's life to enable intervention to start as early as possible (Fernell et al., 2013). The initial screening of ASD might prevent children who might otherwise fall through the cracks to receive an early diagnosis and intervention. Screening triggers early identification of individuals with ASD characteristics and provides opportunities for early diagnosis and intervention (Zwaigenbaum et al., 2013).

The American Academy of Pediatricians has recommended that all children between the ages of 18 and 24 month be screened for ASD during their well-child visit. This is influenced by the presence of ASD symptoms noticed in children aged 18 months. Their recommendation is also directed by data on ASD characteristics that have been effectively screened with ASD screening tools, paving the way for effective intervention for at-risk individuals (Zwaigenbaum et al., 2013). Similarly, random control studies involving children who were screened after their third birthdays and were diagnosed with ASD have shown that they were better off after receiving intervention for their diagnosis compared to their others who were diagnosed later in life. These children experienced improved outcomes in social attention, intelligence quotient, language, and symptoms severity (Zwaigenbaum et al., 2013). The early identification of ASD characteristics set the stage for early diagnosis and intervention. Pediatricians do not easily suspect cases of

ASD without screening, as a study has shown that pediatricians were only able to recognize four out of 21 who had ASD (Robins, 2008).

Involving families in screening. Children grow and develop within the context of a family, and the family is the expert of their own child (Rutland & Hall, 2013). Parental involvement in a child's life is necessary for the realization of the effects on a child's cognitive, physical, and psychological development (Craig et al., 2015). Parental concerns are generally important in a child's development as parents spend more time with their children than any other professional or service provider (Rutland & Hall, 2013). The concerns of parents have mostly provided reliable information to professionals in predicting developmental delays (CDC, 2016). Research has stated it that parental concerns contribute to about 80% detection of children with developmental challenges (CDC, 2016). Screening tools that are evidence based and incorporate parental views and concerns have been found to facilitate structural communication between parents and providers. This relationship enables providers to address parental concerns, increase parental awareness, and facilitate parental and provider observation of a child's developmental milestones (CDC, 2016).

Evaluating Screening Tools

Sensitivity and specificity. Measures of diagnostic accuracy are susceptible to the characteristics of the population in which the test is being evaluated for accuracy (Parikh et al., 2008). Any study that does not strictly follow the methodological requirements might end up over- or under-estimating the test's performance. The outcome of such a study can affect the generalization and the applicability of the results

(Simundic, 2009). Diagnostic accuracy depicts the ability of a tool to discriminate between disease and health (Eusebi, 2013). The most common psychometric measures used in evaluating diagnostic validity are sensitivity, specificity, predictive values, and the area under the ROC curve (Simundic, 2009). Sensitivity and specificity are important in determining the accuracy of a test (Parikh et al., 2008). The sensitive nature of a test suggests that when it is administered to individuals with the targeted disease, the persons with the disease characteristics will screen positive (Eusebi, 2013). Specificity, on the other hand, entails that people without the targeted disease, when tested for its characteristics, will test negative (Sullivan, 2016).

Sensitivity and specificity complement each other in identifying subjects with and without the disease under study. Any appropriate screening test is expected to maximize the sensitivity and specificity of the disorder in question (Simundic, 2009). Sensitivity and specificity are inversely proportional in outcomes meaning that if sensitivity increases, specificity decreases (Parikh et al., 2008). The value of a test above the cut-off score are very suggestive of the presence of the disease while values below the cut-off suggest exclusion of the disease. However, there is no such thing as a perfect score when using a diagnostic tool. Researchers are encouraged to perform their analysis of study outcomes with circumspection (Eusebi, 2013). Moreover, a tester should consider the type of patients to which a test will be applied. A very reliable test might not give useful information if it is assessed in the wrong population (South et al., 2002).

Evaluating a screening tool through the perspective of sensitivity and specificity is crucial. In determining the actual validity of a screening tool, it is important that the

average of sensitivity and specificity are calculated (Eusebi, 2013). The calculation is done through the use of true positive, that is individuals with the disease scoring above the cut-off figure. True negative, on the other hand, represents individuals without the disease who score below the cut-off value. False positive represents individuals without the disease who scored above the cut-off figure, while false negative suggests individuals with the disease who scored below the cut-off figure. Mostly 2 x 2 tables are used to compare the performance of a test (Parikh et al., 2008).

As a standard rule for measuring the accuracy of a test, a true positive is determined when the sample size of the disease group is multiplied with the sensitivity reported in the group. A false negative for each study is also obtained by deducting the newly calculated true positive value from the diseased sample size. Both true negative and false negative are calculated using a similar approach (Parikh et al., 2008). Using the basic equation, sensitivity is expressed in percentages that define the proportion of true positive participants with the disease in the entire group of individuals with the illness (true positive/true positive + false negative). Similarly, specificity is also expressed as the percentage of people without the illness in the total population without the disease (true negative/true negative + false positive). The resulting outcomes are used to develop a summary statistic score for the used instrument (Maxim et al., 2014).

Positive and negative predictive values. The validity of a screening tool can be enhanced with the use of PPV and NPV (Maxim et al., 2014). A relatively high sensitivity and specificity screening test might still have a little PPV if the prevalence of the disease in the population is sufficiently low. It is therefore important to evaluate both

the technical and subject characteristics of a screening test (Maxim et al., 2014). PPV represents the proportion of individuals who still tested positive among individuals with positive results (true positive/true positive + false positive). NPV also suggests the number of individuals who were screened by a test as not having the disease in the total of the individuals who tested negative (true negative/true negative + false negative; Maxim et al., 2014).

However, a significant difference exists between sensitivity, specificity, and predictive values. Predictive values are mostly dependent on the disease prevalence in the sample population, unlike sensitivity and specificity. Accordingly, it is not advisable to transfer predictive values of a study to some other settings which might have a different prevalence of the disease in the sample population (Simundic, 2009). PPV and NPV are affected differently by the prevalence of a disease. While PPV increases, NPV decreases with the prevalence of the disease in the sample population. Moreover, a more substantial change in the PPV might suggest a weaker NPV which is triggered by the disease prevalence (Simundic, 2009).

Receiver operating characteristics. Another approach for enhancing the diagnostic validity is the use of the ROC. Using the ROC involves plotting the outcome of a screening tool that accurately identifies a disease. Sensitivity and specificity values are plotted on a graph with 1-specificity on the X-axis and sensitivity on the Y-axis (Simundic, 2009). The shape of the curve and the area under the curve (AUC) provide information to determine the discriminative power of a screening test. In discriminating between diseased and non-diseased individuals, evidence suggests that the closeness of

the curve to the upper-left hand corner and a large space under the curve indicates that the test is good at discriminating between diseased and non-diseased individuals (Maxim et al., 2014).

On the graph, a test performance can be plotted by placing the sensitivity point on the chart for every cut-off score for the screening tool and joining the points to form the ROC curve (Maxim et al., 2014). The area could have any value ranging between 0 and 1 which is an indicator that the screening tool is useful. However, a perfect diagnostic test is expected to have AUC to be 1.0 while a test that is non-discriminatory is projected to have an area of 0.5 (Simundic, 2009).

The M-CHAT-R Screening

The M-CHAT-R identifies asymptotic toddlers who might have ASD. It is not a diagnostic tool but has successfully identified at-risk children of ASD in developed and developing countries. The M-CHAT-R as a screening tool for the early detection of ASD is an improvement of the original M-CHAT. It is a well-recognized screening tool for ASD and has to be used in its entirety (Robins et al., 2014). Studies have confirmed that relying on subsets of the screening items might not lead to the intended objective. This screening tool requires limited training, and it only takes about 15 minutes to complete the entire 2-stage screener. In less than 5 minutes, parents can complete a 20-item checklist that requires yes/no answers concerning their child's behavior (Robins et al., 2014).

The M-CHAT-R reduces the false positive rates of ASD cases compared to the original M-CHAT for children between 18–24 months and also reduces the number of

required follow-up questions (Robins et al., 2014). The M-CHAT-R has also proved useful in detecting ASD at a higher rate compared to the M-CHAT. The fundamental goal for the M-CHAT-R is to increase its sensitivity by detecting as many incidences of ASD as possible. The M-CHAT-R has a sensitivity of .911, specificity of .955, and PPV of .138 compared to 0.87 sensitivity, 0.99 specificity, and PPV of 0.80 for the original M-CHAT (Robins et al., 2014). Robin et al. (2001) explained that discriminant function analysis was used to revise and maintain some items on the M-CHAT to determine their sensitivity and specificity. The retained items were directly related to important ASD symptoms. However, with the M-CHAT-R, the emphasis is on all the 20 questions on the screening tool.

For the scoring of the items on the M-CHAT-R, 'yes' is a typical response while 'no' represents an at-risk response. However, items 2, 5, and 12 have a reverse score. A total score from 0–2 suggest low risk, 3–7 suggests moderate risk, 8–20 indicates high risk. In a validation study of the M-CHAT-R, researchers used a low-risk sample of 16,115 toddlers out of which 14,916 (92.6%) screened negative and 1,155 screened positive. The toddlers who tested positive on the M-CHAT-R and received follow-up resulted in 598 more screening negative and 348 testing positive. The 348 toddlers who tested positive were further evaluated (Robin et al., 2014).

Robin et al. (2014) who framed the M-CHAT-R argue that sensitivity is necessary for early diagnosis. Therefore, the researchers set the initial cut-off at low levels to decrease the incidence of false negatives and avoid the risk of missing ASD children and reducing the chances of sending children without ASD for further evaluation. In the

validation study, the point at which the cut-off score exceeded 0.90 for sensitivity and specificity was 3 was consistent with the established cut-off score. Any deliberate increase or decrease in the cut-off score could trigger a major drop in sensitivity and specificity (Robin et al., 2014). It is expected that children with ASD will mostly score higher on either of the cut-off scores compared to children without ASD. A child whose score is ≥ 3 after the initial administration and ≥ 2 after follow-up has a 47% risk of ASD diagnosis. Identifying the cut-off scores that maximize the sensitivity and specificity for this culturally different population is necessary for this study (Kozlowski et al., 2012).

Use of M-CHAT-R in other countries. Norbury and Sparks (2012) argued that the adoption of a screening tool should be carried out cautiously so that it does not test something unrelated. It is, however, important to determine the optimal cut-off scores by examining the characteristics of the screening tool in the population of interest. Adapting a test without considering the relevance of the test content to the community at stake might be detrimental to the outcome of the study. Interestingly, the cut-off scores that have yielded the best sensitivity and specificity around the world have seen some variations compared to the original tool. The best cut-off score for sensitivity and specificity values for ASD screening in Saudi Arabia and Spain were similar to that of the original M-CHAT 3/23 (Canal-Bedia et al., 2011; Eldin et al., 2008). The cut-off scores by the Japanese version using the 2/23 cut-off score had the best sensitivity and specificity values of .75 and .89, respectively (Inada et al., 2011). The Chinese version of the M-CHAT items obtained a sensitivity score of .839 and specificity score of .848 when 3/23 cut-off score was used (Wong et al., 2004). The Swedish version used the original

M-CHAT cut-off score with a minor modification to the M-CHAT items and obtained adequate specificity and sensitivity values (Nygren et al., 2012).

Cross-Cultural Validation of Autism Spectrum Disorder Screening Tools

ASD screening tools are developed with the objective of identifying characteristics that suggest the presence of ASD (Robin et al., 2014). A selection tool is expected to have important psychometric properties such as significant levels of reliability, predictive validity, sensitivity, and specificity (Lee & Haris, 2005). One of the most important considerations for a screening tool is the degree to which it correlates with the outcome measures such as sensitivity and specificity. An important aspect of a screening tool's psychometric properties that cannot be overlooked is the limitations it encounters due to the differences in race, culture, ethnicity, and the socio-economic issues across the globe (Harris, Durodoye, & Ceballos, 2010). The relevance of culture, ethnicity, and the age at which ASD is diagnosed increases the importance of evaluating the psychometric properties of a screening tool. The finding suggests that the prevalence and variation of ASDs among cultural groups requires a unique screening tool that might be sensitive to that cultural group (Harris et al., 2010).

If all cultures are homogenous and a screening tool that is formed in a different culture produces similar results with a different cultural society, it can be potentially erroneous. A study conducted on the Hopi culture using a diagnostic interview schedule with participants in the U.S. triggered psychometric challenges. The Diagnostic Interview Schedule questionnaire that combined various symptoms including shame, guilt, and sinfulness as synonymous had to be altered. With the Hopi culture, each of the identified

symptoms is treated as unique and the uniqueness necessitated the questionnaire to be modified to conform to the Hopi culture (Rogler, 1999). The researchers explained that relying on the first Diagnostic Interview Schedule without considering the cultural variables of the group could have negatively affected the outcome of their study (Rogler, 1999).

Similarly, a study in Ethiopia aimed at understanding meanings that participants attach to a standardized assessment had an important outcome (Rogler, 1999). The emphasis was to determine the content validity of the World Health Organization's Self-Reporting Questionnaire. Even though the Self-Reporting Questionnaire was developed based on the Western culture, the researchers were confident that it was universally applicable. The study had 110 clinical and nonclinical respondents who completed the Self-Reporting Questionnaire consisting of 24 questions requiring yes/no answers. Digesting the meaning of the 846-positive response to the Self-Reporting Questionnaire revealed that 26% were invalid due to the differences associated with the Western researcher’s conceptualization and the Ethiopian respondent.

In an epidemiological study in Puerto Rico, the researchers intentionally incorporated the cultural knowledge of the interviewees into the Diagnostic Interview Schedule and their strategy reduced any error (Rogler, 1999). The finding explains that it is inappropriate to conduct an assessment using a tool that is normed on a different cultural group without initially analyzing its psychometric challenges. There are chances that some questions on the questionnaire might be inappropriate and/or difficult to understand for the respondents (Rogler, 1999).

Cross-Culture Validity and Adaptation of the M-CHAT-R

The original M-CHAT has enjoyed cross-cultural application with likely outcomes. In some countries that have adopted this screening tool, few modifications were made to reflect the host culture (Robin et al., 2014). Evidence suggests that more international studies on the validation of the M-CHAT are published. What has become very clear is that the screening tool has important differences in items that parents endorse more frequently (Robin et al., 2014). The concept behind this phenomenon is considered confusing, and it is likely that differences in parenting style, culture, and social behavior could have influenced the pattern (Robin et al., 2014). In a related study on the M-CHAT, the researchers observed that some of the participants' parents had difficulty understanding all the questions (Canal-Bedie et al., 2011). The low educational level of the parents impacted their ability to understand the questions on the screening tool (Canal-Bedie et al., 2011). Moreover, it was established that the elusiveness and bizarreness of some of the symptoms might not have caught the attention of some parents (Canal-Bedie et al., 2011).

The M-CHAT is in use in Mexico, Portugal, Argentina, Spain, Saudi Arabia, China, and Sweden (Canal-Bedia et al., 2011; Eldin et al., 2008; Idana et al., 2011; Nygren et al., 2012). Albores-Gallo et al. (2012) attempted to determine the cross-cultural properties of a Mexican version of the M-CHAT and analyzed it for validity, reliability, and some cultural considerations. The Mexican study included 456 children of both sexes between the ages of 18 and 72 months. The M-CHAT was translated into Spanish with minor cultural adjustments. The modified M-CHAT was able to discriminate between

typically developing children and children with ASD (Canal-Bedia et al., 2011). The outcome of the study suggested that even though the tool had excellent psychometric properties, there were, however, evidences of cultural differences in the responses obtained (Canal-Bedia et al., 2011). However, the researchers indicated that the differences in the replies were due to the variation of critical items in the study that were different from what was proposed by the originators of the M-CHAT (Albores-Gallo et al., 2012). The study questioned the total adaptation of the M-CHAT without major cultural considerations (Albores-Gallo et al., 2012).

In another study in Mexico assessing the M-CHAT adaptation, the researchers used a case-control design made up of a large clinical group of children who were seen by a specialist before a diagnosis was made. The M-CHAT was able to discriminate between typically developing children and the ASD group (Albores-Gallo et al., 2012). The study credited the M-CHAT with moderate interval consistency and convergent validity. The researchers inferred that the parenting style and social behaviors might have been the contributing factors for the differences obtained in the outcomes (Albores-Gallo et al., 2012). Some of the critical items in the screening tool were inconsistent with that of the original M-CHAT, especially the sample composition, age range, and statistical procedure.

In Argentina, the M-CHAT was assessed. The assessment was to determine its cultural appropriateness in screening out individuals with ASD. Through a pilot study, the researchers modified some of the wordings in items 11, 14, and 16 to enhance its adaptation. The outcome of the study suggested a good level of internal consistency and

satisfactory reliability (Cuesta-Gómez et al., 2016). More than half of the items on the M-CHAT contributed to identifying children with ASD characteristics (Cuesta-Gómez et al., 2016).

The Chinese translated the M-CHAT to evaluate its effectiveness in screening ASD characteristics (Wong et al., 2004). The translated screening tool was used in a cross-cultural study involving 212 children with ages between 18 to 24 months. Out of the sample population, two groups were created, children with and children without autistic characteristics (Wong et al., 2004). The outcome of the study suggested that more than half of the children with ASD characteristics were diagnosed with ASD (Wong et al., 2004). A discriminant functional analysis on seven key questions with a fail in any two of them yielded a sensitivity score of 0.931 and specificity score of 0.768. Failing in any six of all the 23 questions also yielded a sensitivity score of 0.839 and specificity of 0.848 (Wong et al., 2004).

The adaptation of the M-CHAT by Spain has also proved successful. The M-CHAT was translated into a Spanish-Spain version for the study. The tool was administered to two different samples made up of 4535 high-risk and low-risk children aged between 18 to 36 months. The result of the survey is consistent with that of the original M-CHAT. The effectiveness of the M-CHAT in detecting ASD cases showed a sensitivity score of 1 and specificity of 0.98 with a PPV of 0.35 and a NPV of 1 (Canal-Bedia et al., 2011). Thai adaptation and validation of the M-CHAT used 841 high-risk and low-risk children between the ages of 18 to 48 months. The researchers determined the sensitivity and specificity of each of the items in the screening tool. Summarizing the

outcome of the study, they explained that the whole scoring method produced a sensitivity score of 0.97 and specificity of 0.99. The PPV was 0.96 and the NPV 0.99. Further analysis of the study supports the M-CHAT as a promising screening tool that can be effectively utilized to screen ASD characteristics in the Thai community (Srisinghasongkram, Pruksananonda, & Chonchaiya, 2016).

Challenges with Cross-Culture Adaptation

The most current form of the M-CHAT-R is adapted for use in Serbia (Carakovac et al., 2016). 148 children between the ages of 16 to 30 months were used in the adaptation study. Two groups made up of 20 at-risk children, and 128 control children. It was noted that 80% of the children in the high-risk group screened positive for ASD and 3.1% of the controlled group also screened positive. The adapted M-CHAT-R has shown adequate reliability and internal consistency for the early diagnosis of ASD in Serbia (Carakovac et al., 2016). Importantly, the recognition and promising results that the adaptation of the M-CHAT has received across cultures add some credence to its possible success as a useful tool for ASD screening in Ghana.

However, other countries have challenged the usefulness of adapting this screening tool for their population. The usage in Sri Lanka did portray a different picture (Perera, Wijewardena, & Aluthwelage, 2009). The initial evidence with its usage confirmed its ability to discriminate between ASD and non-ASD characteristics. Evidence available confirms that the overall effectiveness of the M-CHAT as a general population screening tool had not been effective with Sri Lanka as compared to its usage in other countries (Perera et al., 2009). The specificity of the M-CHAT with the Sri

Lanka population was acceptable (0.70). However, the sensitivity (0.25) and the PPV (.12) make it clear that the screening tool was not very successful. The NPV stood at 0.85 (Perera et al., 2009).

Explaining the poor performance of the screening tool, the researchers argued that some of the statements on the M-CHAT were culturally inappropriate (Perera et al., 2009). Most mothers in Sri Lanka do not consider social and communication impairment, a major screening component of ASD, as a problem. It is regarded as part of normal development. This perception compounded the false negative results (Perera et al., 2009).

Secondly, parental responses to the screening statements lacked discriminatory power to establish ASD characteristics. The 'yes' or 'no' possible answers for the M-CHAT might have posed some difficulty for parents to make decisions especially when they are doubtful (Perera et al., 2009). Having broader choices of response might have added a deeper meaning to the screening tool. To a larger extent, parental responses to the questions are influenced on their perception that their child is normal. Stigmatization might have clouded participating parent's willingness to provide accurate information about their child's development (Perera et al., 2009).

Summary and Conclusion

The review of the cross-cultural application of M-CHAT in other countries has confirmed that the cross-cultural adaptation of this screening tool has mostly been successful. Most countries made minor changes to the M-CHAT to meet their cultural needs as explained in the literature. The M-CHAT has proved to have reasonable validity and reliability with its adaptation in different cultures and ethnic groups.

Conclusions drawn from studies suggest that acceptable behavior is very subjective to any population that is studied. Therefore, adapting a test in its original form might not yield its intended objective. A screening tool that focuses on behavior characteristics of a different cultural group might, to some extent, require modifications to suit the target group. The adaptation of the M-CHAT in most cultures have been successful to a larger extent but other challenges still linger. Making a screening tool valid and reliable requires some validation steps. Ghana, for example, is rooted in cultural practices and beliefs. Therefore, it is important for a screening tool such as the M-CHAT to be validated to enhance its effectiveness in screening ASD characteristics. Juxtaposing the successful outcomes of using M-CHAT in different cultural environment gives some credence that this tool can be useful in screening ASD characteristics within the Ghanaian population.

Chapter 3: Research Method

Introduction

The M-CHAT-R questionnaire has been used extensively in several countries across the globe but not within the Ghanaian population. This study involved a quasi-experimental cross-sectional design to gather and improve knowledge and understanding of ASD characteristics in Ghana by examining the cross-cultural validity of the M-CHAT-R on high-risk groups in Accra, a city in Ghana. The M-CHAT-R was assessed for its effectiveness in differentiating ASD characteristics from non-ASD characteristics. Across age, ranges of 16 to 30 months and 31 to 60 months were used to analyze the potential use of this screening tool with the originally intended population and an older population. A similar study supported the screening of slightly older children aged 18 to 43 months compared to 16 to 30 months used by the original screeners (Weitlauf, Vehorn, Stone, Fein, & Warren, 2015).

The responses of participating parents and selected health care to selected questions were compared using correlation to determine whether patterns exist. The outcome helped determine whether the items on the M-CHAT-R (2, 6, 7, and 14) could suggest culturally normative behaviors or are merely regular ASD screening items. Furthermore, I was able to compare the outcome of my study with the original sensitivity and specificity of the M-CHAT-R and draw my conclusion. The selected health care professionals were able to determine the appropriateness of the language and easiness of scoring by answering the questionnaire.

The goal of this chapter is to explore the methodology for this study. This chapter presents the description of the research setting, research design, study sample, and the data collection methods. This methodology was used to determine sensitivity and specificity of the M-CHAT-R and the cultural appropriateness for the future adaptation of the M-CHAT-R in Ghana.

Research Design

This study was guided by a primary research question that sought to determine the sensitivity and specificity of the M-CHAT-R with children diagnosed of ASD and children without ASD in Ghana. Secondary research questions were used to determine the cultural appropriateness of the screening tool by parents and selected healthcare professionals. In this study, I used quasi-experimental cross-sectional design to compare group outcomes. The focus was on children with ASD diagnosis and children without ASD diagnosis in Ghana. The study assessed how effective the M-CHAT-R, which has been cross-culturally effective in screening ASD characteristics, is able to screen children with ASD diagnosis.

Target Population

Data were collected from pediatricians, nurses, and psychologists who work with ASD children from selected teaching hospitals in Greater Accra. Like other hospitals in Greater Accra, their Departments of Child Health are of tertiary standard and are referrals for children with medical needs and ASD. The selected hospitals receive high patronage both locally and internationally.

Data were also collected from parents who had their children in four selected ASD schools in Greater Accra. The selected schools provide education to children with ASD and other developmental disabilities in a vibrant, inclusive, and specialized environment. Professionals at the schools provide specialized services to children with ASD and their families.

The Greater Accra Region was purposively selected for the study because it has the highest number of medical professionals, psychologists, and professional nurses, and it is also among the regions with the highest number of health facilities. Moreover, it was the only place where ASD is formally diagnosed and has the highest number of schools for ASD population than all the ASD schools in the other 15 regions combined.

Sample Size Determination

Data for the study were collected from 90 parents for the sensitivity and specificity analysis. The sample size for this study was selected with reference to an article on sensitivity and specificity by Bujang and Adnan (2016). They explained that using some rough guidelines or target is important when there are no benchmark studies to refer to. For example, the value of sensitivity in the null hypothesis for screening studies could be set at 50% as a rough guideline with the condition that the values should increase to reflect that the screening tool is sensitive in predicting the disease.

I used a predeveloped table for sample size determination. The developers of the predetermined table used SPSS to arrive at the sample sizes for sensitivity and specificity studies. The minimum sample size required for a sensitivity or specificity study is influenced by pre-specified values of the power of the screening test, its corresponding

type one error, and the effect size (Bujang & Adnan, 2016). Fifty percent of my study sample was recruited from the ASD population and the other 50% from non-ASD population, which fit with recommendations for the sensitivity predetermined to be at least 50% within the null hypothesis (Bujang & Adnan, 2016). This indicates that the probability for an instrument to detect a true positive outcome is in balance with at least 50%.

With this estimation, a minimum sample size of 90 subjects (including 45 having the disease) was required to achieve a minimum power of 80% (actual power 83%) for detecting a change in the sensitivity percentage of the screening test from 0.6 to 0.8 based on a target significance level .05 (actual $p = 0.32$). Data were also collected from 40 selected healthcare professionals who met my selection criteria on their perception of the M-CHAT-R. Out of the 90 parents, 45 had children with an official diagnosis of ASD, and the remaining 45 had typically developing children. For a child to have a formal diagnosis of ASD, the child had to have been assessed by an experienced medical professional like Dr. Badoe. The medical professional is expected to confirm that the assessed child encounters significant social, emotional, communication, and behavior challenges based on any of the diagnostic tools such as ICD-10, ADI-R, ADOS-G, DSM-IV-TR and DSM-5. The study focused more on parents of children within the age brackets 16 to 30 months ($n = 70$; 35 with ASD and 35 without ASD) as suggested by creators of the M-CHAT-R. However, the study equally assessed the screening effectiveness of the M-CHAT-R on few older children (31–60 months, $n = 20$; 10 with

ASD and 10 without ASD) to determine its potential use with this population as there is no clearly identified screening tool for this group.

The 40 health care professionals selected for this study included (n = 5) pediatricians, (n =15) pediatrician nurses, (n = 5) clinical psychologists, and (n = 15) psychiatric nurses. The selected health care professionals had a minimum of 5 years working experience with children with and without ASD diagnosis. All the research participants were selected from the Greater Accra Region (parents and professionals). Only parents who could express themselves in English were selected for the study and informed consent was acquired.

Sampling Procedure

The perceived negative attributes associated with ASD made it difficult to screen an entire population to represent the country. This potential challenge made the use of random sampling method extremely difficult for participants' identification especially those with ASD diagnosis. Consideration was made for the use of purposive sampling method in recruiting participating parents and professionals for the study.

Recruitment. Schools administrators of selected institutions helped distribute flyers to parents whose children attend their schools. The flyer briefly described the research study. I went to the schools on selected dates and interacted with parents and sought their consent for participating in the study. The interaction took place in a private area designated by the school.

Similarly, administrators of selected health institutions also helped distribute flyers to parents who are their patrons and health professionals who work with normally

developing children and children with ASD at their facility. The flyer briefly described the study. I went to the health facility on selected dates and interacted with parents and professionals individually and sought their consent to participate in the study in a private area designated by the hospital and special school.

Inclusion/exclusion criteria. Parents who had their children in the selected schools and were present on the days the researcher visited were included. Parents who sought treatment for their children in the selected hospitals and were present on the days the researcher visited were also included. Furthermore, parents were selected based on their child's age range of 16–60 months and whether the child was diagnosed with ASD or is a normally developing child. Selected parents also needed to be able to express themselves in English. Pediatricians, nurses, and psychologists were also interviewed on the researcher's visiting days at the hospitals. The selected health care professionals had a minimum of five years working experience with children with and without ASD diagnosis.

Questionnaires Used

Sociodemographic questionnaire. The first measure is a social demographic questionnaire that was required to be completed by parents and professionals. The parents' questionnaire included date of assessment, age, level of education, relationship with the child, and questions on ASD diagnosis. The socio-demographic questionnaire was used to describe the characteristics of the sample. Parents also provided information on their child and indicated whether their child has a formal diagnosis of ASD or not. The

professionals' questionnaire included date, age, type of profession, the level of education, and years of experience in their field.

Yes /No responses were attached to each of the items on the M-CHAT-R for the parents and professionals to complete. A second set of Yes/ No responses was provided for parents and professionals to determine the easiness of scoring and cultural, and language appropriateness of the M-CHAT-R.

M-CHAT-R Screening. The primary objective of the M-CHAT-R was to correctly detect as many cases of ASD characteristics as possible among toddlers between 16 to 30 months of age. The M-CHAT-R also screens asymptotic toddlers who might have ASD. This screening tool requires limited training, and it takes less than 5 minutes for parents to complete a 20-item checklist that requires yes/no answers. For the scoring of the items on the M-CHAT-R, 'yes' is a typical response while 'no' represent an at-risk response. However, items 2, 5, and 12 have a reverse score. Answers associated with at-risk behaviors receive a point and answers not associated with at-risk behaviors receive zero points. The total score is calculated by adding the scores of all the individual questions. A total score from 0–2 suggests low risk, a total score from 3–7 suggests moderate risk, and a score of 8–20 indicates high risk requiring immediate referral for diagnostic evaluation.

In the West where the test was developed, the M-CHAT-R has a sensitivity of .911, specificity of .955, and PPV of .138. The M-CHAT-R is credited with high validity and reliability for screening toddlers. A child has a 47% chance of being diagnosed with ASD if their initial screening score is greater than 3 and the follow-up screening score is

greater than 2. I evaluated the sensitivity and specificity of this test in Ghana against the original sensitivity, specificity, and predictive values of the test.

Screening Procedure

The researcher spoke to parents of children with ASD, parents of children without ASD, and professionals at the selected children hospitals and centers. I explained the purpose of the study to the participants after which they were encouraged to ask any question for clarifications. Participants were invited for the interview. All participants were required give written informed consent. Participants were given socio-demographic, M-CHAT-R, and cultural concerns questionnaires to complete. The screening tool was scored by selected health care professionals and parents who could read and write in English.

Ethical Procedures

In conducting this study, I was guided by the American Psychological Association Ethical Standards. I obtained approval from Walden University IRB before conducting this study. My IRB approval number is 03-19-19-0057984. This study was carried out in Ghana and I obtained ethical approval from Ghana Health Service Ethics Review Committee with an approval number GHS-ERC-020/05/19. Another approval was obtained from Korle Bu Teaching Hospital – Scientific and Technical Committee /Institutional Review Board. The approval number is KBTH-STC/IRB/00092/2019. The nature of the study was explained to the participants and informed consent was obtained from all participants. Participants had the right to withdraw from the study at any time without punitive outcome.

Data Handling

Data collection was 100% anonymous. The physical data collected was locked in a cabinet at the researcher's house. Data will be stored for 5 years according to Walden's data storage policy and after which the documents shall be shredded.

Statistical analysis. SPSS was used for the statistical analysis. Throughout the analysis, assumptions for logistic regression such as absence of multicollinearity, linearity of independent variables, and normality were investigated. In the analysis, it was established that the screening tool is effective in screening ASD characteristics.

Score comparisons. Mann-Whitney U test was used to compare the total scores within each group. This helped explain whether the M-CHAT-R could accurately identify the 45 individuals with ASD characteristics within the groups. The internal consistency of the 20 items on the M-CHAT-R was estimated using the Cronbach's alpha. This helped establish how closely related the items were on the questionnaire. This approach helped establish whether the questions on the screening tool could measure ASD characteristics in the Ghanaian population.

Comparing M-CHAT-R scores for autism spectrum disorder and non-autism spectrum disorder groups. Percentages was used to compare the respondents score of those who screened positive for ASD characteristics within the two groups. This helped establish whether there was a significant difference between the two outcomes.

Evaluating the predictive validity of the M-CHAT-R. A two-way table was also used to determine the extent to which the screening tool could correctly identify an

individual having ASD (sensitivity). The screening tool was equally expected to correctly classify an individual as ASD free (specificity).

Table 1

M-CHAT-R Indicator

	No	Yes
Non-ASD	a True Negative	b False Positive
ASD	c False Negative	d True Positive

Using this analysis, the sensitivity of the study was calculated as (d/ {d+c}), specificity was also calculated as (a/ {b+a}), total of ASD successfully screened was calculated as (c + d), and the total number of non-ASD successfully screened as (a+b). The positive likelihood ratio (sensitivity/1- specificity), negative likelihood ratio (1 – sensitivity) /specificity), PPV (d/ (d +b), and the NPV (a/ (c + a) were also computed to confirm the effectiveness of the screening tool prediction outcomes.

Receiver operating characteristics and cut-off score. The cut-off score in this study helped determine the number of individuals who screened True Positive, True Negative, False Positive, and False Negative. ROC analysis will be performed to determine the optimal cut-off score that suggests the best sensitivity and specificity outcome of the study (Unal, 2017). This study planned to use the cut-off score suggested by the originators of the screening tool. For the researchers, a fail in the three items on the screening tool had adequately predicted ASD characteristics with very few false positive results.

The precision of a screening tool is determined by the AUC. In performing the ROC analysis, the full test was used. The associated curve provided a factual demonstration of the cut-off points for sensitivity and specificity to support the outcome of the binary logistic regression. It was expected that if the AUC is significant then the screening tool could accurately predict ASD and non-ASD characteristics rather than by chance. A graph was computed with the false positive rate (1 – specificity) plotted on the X-axis and the true positive rate (1 – false negative rate) plotted on the Y-axis.

Data Analysis for the Selected Health Care Professionals

The selected health care professionals scored all the items on the M-CHAT-R to determine the appropriateness of the items for screening ASD characteristics in Ghana. The scoring helped determine the importance that each health care professional attaches to each item on the screening tool. Percentage score within each professional group was calculated. Through this approach, I was able to determine which items received the highest scores and which items received the lowest scores among the professionals. The results indicate the items that were very relevant in screening ASD characteristics within the Ghanaian population.

Analyzing parents' and health care professionals' scores. To assess the views of parents and professionals concerning the appropriateness of language, cultural concerns, and easiness of scoring the M-CHAT-R, parents and professionals completed a questionnaire gauging these characteristics. For both groups, item-by-item analyses were performed using percentages to determine which item was of significant concern and which item was of less concern. Moreover, parental total scores and professionals' total

scores were compared to determine whether there was a correlation between the two on how they viewed the M-CHAT-R questionnaire.

Summary

This chapter captured the methodology for the study. In this chapter I explained the research design, the role of the researcher as related to participants selection, sampling size, demographic, data collecting strategy, data handling, statistical analysis and ethical consideration. In Chapter 4 the results of the analyzed data is presented.

Chapter 4: Results

Introduction

This chapter provides the statistical analysis of the data collected and results. Emphasis was on the sensitivity and specificity of the M-CHAT-R for screening ASD characteristics among selected Ghanaian children between the ages of 16 months to 60 months. The study further determined whether some of the items on the screening tool were culturally sensitive to the Ghanaian community. Parents and selected healthcare professionals scored items on the screening tool to determine their appropriateness for screening ASD characteristics

Results

Outcome of the Screening (M-CHAT-R)

This study assessed and analyzed the outcome of the research with a size of (n = 130) participants, which consisted of 90 children and 40 health care professionals. The aim was to determine the clinical viability of the M-CHAT-R for screening autistic characteristics in Ghana. The study confirmed that the M-CHAT-R can effectively screen ASD characteristics in Ghana notwithstanding the fact that this tool was developed based on a different cultural group. A sample size of 90 children was evaluated to determine the sensitivity and specificity of the screening tool of which 45 children had official ASD diagnosis and the other half had no diagnosis. The outcome of the study suggests that out of the 90 children, 56 (62%) met the ASD diagnosis and 34 (38%) did not meet the diagnosis at a cut-off point of 3. However, 44 out of the 45 children who had official diagnosis of ASD were successfully identified by the screening tool at a cut-off point of

3. One child with official ASD diagnosis was not identified at the cut-off point of 3. He was identified at a cut-off point of 6. This was due to how his parents filled the questionnaire. The study also recorded 11 (12%) children as false positive and one child as false negative. The 11 children with the false positive results were part of the normal 45 individuals. I observed that some of the children who had no official diagnosis of ASD were showing symptoms of ASD, which was supported by 11 of the non-ASD group screening positive at the cut-off score of 3. Overall, the screen tool was sensitive in distinguishing ASD characteristics within the Ghanaian population. The cultural sensitiveness of the screening tool was assessed to determine whether it could impact the outcome of the study. Evidence from the study confirmed that it had no major impact on the study outcome.

Table 2 shows the characteristics of (n = 90) parents who were selected to rate children on the screening tool. Half of the 90 parents had with children who have a formal diagnosis of ASD and the other half with children without ASD diagnosis. The mean age for the 90 parents was 35.73 years. Out of the 90 participants, 28 (31%) were males and fathers of the children, and the remaining 62 (69%) were females and mothers. Most of the parents of non-ASD children in the 16–30 months category (23, 66%), which had a similar percentage to those in the 31–60 months category (7, 70%). For those with ASD children, most (22, 63%) had high school education in the 16–30months category, whereas those with children 31–60 months mostly had tertiary education (7, 70%).

Table 2

Sociodemographic Factors of Parents and Children

Sociodemographic	Non-ASD *N* = 35	ASD *N* = 35	Non-ASD *N*= 10	ASD *N* = 10
Age of children	16–30	16–30	31 – 60	31–60
Mean Age of Parents	35.11 ± 1.30	37 ± 1.32	30.7 ± 1.37	38.5 ± 2.99
Gender:				
Father	9 (26%)	8 (23%)	4 (40%)	7 (70%)
Mother	26 (74%)	27 (77%)	6 (60%)	3 (30%)
Level of Education:				
High school	12 (34%)	22 (63%)	3 (30%)	3 (30%)
Tertiary	23 (66%)	13 (37%)	7 (70%)	7 (70%)

Logistic regression was performed to establish whether age, gender, level of education, and parents' relationship with a child could influence the screening outcome (see Table 3). All the predictor variables were entered in a simple logistic regression with an adjusted odds ratio (AOR) and a cut-off score of 3. The outcome suggested that all the other predictable variables were not statistically significant except for the parental level of education which was statistically significant.

Computing the data, ASD children were coded as 1 and non-ASD as 2. The AOR was introduced to measure the association between the confounding variables. The gender of the parents did not influence the scores obtained for using the M-CHAT-R screening tool (AOR = 2.00; 95% CI = 0.09–46.38). The parents aged between 30–40 years did not influence the M-CHAT-R screening score compared to parents who were less than 30 years (AOR = 2.73; 95% CI = 0.86 – 8.60). Parents aged more than 40 years did not influence the M-CHAT-R screening score compared to parents aged less than 30 (AOR = 3.38; 95% CI = 0.93–12.21). Merely being the father or mother of the child and completing the screening did not influence the M-CHAT-R screening diagnosis (AOR =

0.73; 95% CI= 0.28 – 3.63). The educational level of the parents was statistically significant (AOR = 0.37; 95% CI = 0.14 – 0.95). It was observed that a positive relationship existed between parents' level of education and ASD screening diagnosis of their children. See Table 3 for a full summary of these data.

Table 3

Logistic Regression

Sociodemographic	AOR	p-value	95% CI
Gender			
Male	1		
Female	2.00	0.67	0.09 – 46.38
Age			
Less than 30years	1		
30 – 40	2.73	0.09	0.86 – 8.60
Greater than 40	3.38	0.06	0.93 – 12.21
Level of Education			
High school	1		
Tertiary	0.37	0.04	0.14 – 0.95
Relationship with Child			
Father	1		
Mother	0.73	0.84	0.28 – 3.63

Table 4 shows the characteristics of the children in the study. Most of the children who participated in the study were boys (60, 67% for both ASD and non-ASD). For the age ranges, the number of those with and without a diagnosis were close, though more had a diagnosis in each range (69% and 80%, respectively). Out of the 30 (33%) girls, there was a higher percentage in each age group without a diagnosis (40% and 30%, respectively).

Table 4

Demographic Characteristics of Children

Age range	Non ASD 16–30	ASD 16–30	Non ASD 31–60	ASD 31–60	Total
Gender:					
Boys	21 (60%)	24(69%)	7(70%)	8 (80%)	60(67%)
Girls	14 (40%)	11(31%)	3(30%)	2 (20%)	30(33%)
Total	35(100%)	35(100%)	10(100%)	10(100%)	90(100%)

The percentage response for individual items of the M-CHAT-R for ASD and non-ASD children between the ages of 16 to 60 months were analyzed to determine the good and bad discriminating items (see Table 5). Each of the 20 items compared the scores of the 45 children with ASD diagnosis and 45 without ASD diagnosis. Some of the items were good in distinguishing ASD characteristics, especially Item 7 (Points with one finger to show). Other good discriminating items arranged in order of relevance include Item 3 (Does your child play pretend or make?), 19 (Does your child respond to your emotions?), 17 (Does your child get your attention?), 16, (Does your child turn to look around after you?), 15 (Does your child try to copy you?), 8, (Is your child interested in other children?), and 9, (Does your child bring things to you?). Other items performed poorly in discriminating ASD characteristics among the groups. Item 13 (Does your child walk) was identified as the weakest discriminating item. Other poorly discriminating items include Items 2, (Have you ever wondered if your child?), 10 (Does your child respond when you call his or her name?). and 20 (Does your child like movement activities?).

Table 5

Screening 90 Autism Spectrum Disorder and non-Autism Spectrum Disorder Children

Screening outcomes for 90 children 16–60 months and % of children who failed an item				
Items	ASD $N = 45$	%	Non-ASD $N = 45$	%
Q1. If you point something across the room	22	49	2	4
Q2. Have you ever wondered if your child	14	31	3	7
Q3. Does your child play pretend or make	33	73	6	13
Q4. Does your child like climbing on things	24	53	5	11
Q5. Does your child make unusual finger	21	47	12	27
Q6. Points with one finger to get help	25	56	3	7
Q7. Points with one finger to show	36	80	4	9
Q8. Is your child interested in other children	29	64	1	2
Q9. Does your child bring things to you	28	62	3	7
Q10. Does your child respond when you call his or her name	16	36	2	4
Q11. Does your child smiles back	21	47	1	2
Q12. Everyday noise gets your child upset?	21	47	12	27
Q13. Does your child walk	13	29	4	9
Q14. Does your child look you in the eye	24	53	6	13
Q15. Does your child try to copy you	30	67	3	7
Q16. Does your child turn to look around after you	30	67	3	7
Q17. Does your child get your attention	31	69	3	7
Q18. Does your child understand directives	24	53	6	13
Q19. Does your child respond to your emotions	32	71	11	24
Q20. Does your child like movement activities	16	36	5	11

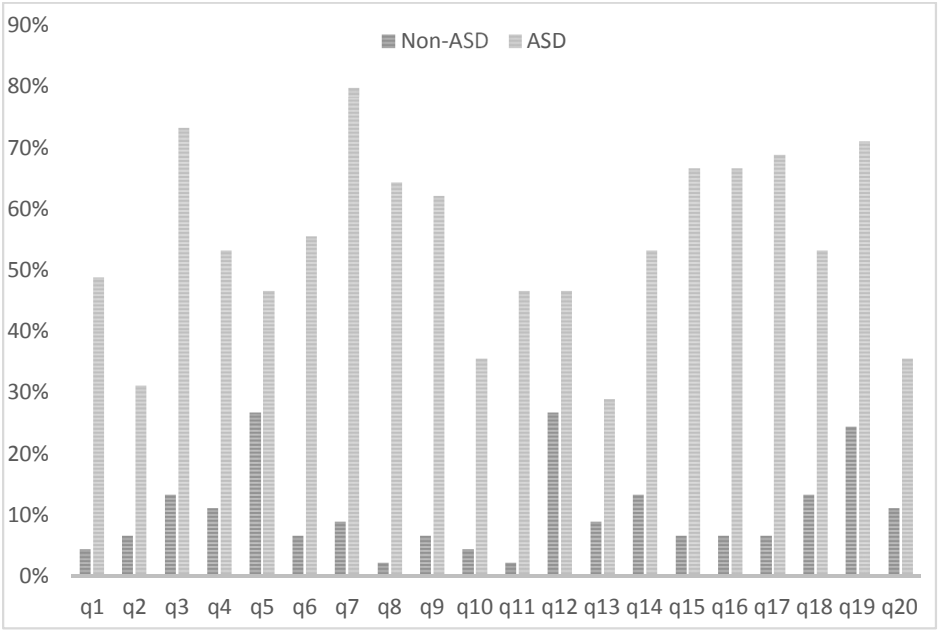

Figure 1. Bar graph of the percentage of children who failed the items.

Test for Internal Consistency

The reliability test of the 20-item M-CHAT-R score using the Cronbach's alpha showed that the screening tool had a higher reliability outcome. The reliability coefficient was $\alpha = 0.90$. This indicates that the internal consistency of the composite scale is good and reliable in measuring the underlying concept of ASD characteristics. Therefore, all the 20 items are worth retaining.

Mann-Whitney U test was used to compare the differences between the ASD and the non-ASD group scores because the data collected was ordinal and non-normally distributed. Table 6 represents the Mann-Whitney test for comparing the rank sum between the two groups of ASD and non-ASD children. The results indicate that the concentration of ASD characteristics among children with ASD diagnosis was

statistically significant compared to the non-ASD group, $U\ (N_{\text{non-autistic}} = 45, N_{\text{autistic}} = 45) = 000, z = -8.17, p < .001$.

Table 6

Comparison of Autism Spectrum Disorder and non-Autism Spectrum Disorder Using Mann-Whitney Test

Type of children	Observation	Mean Rank	P-value
NON-ASD	45	68	<0.001
ASD	45	23	

Table 7

Comparing Males and Females Using Mann-Whitney Test

Type of children	Observation	Mean Rank	P-value
Male	60	34.25	<0.001
Female	30	68	

A Mann-Whitney test on ASD characteristics present among the male and female groups suggested that the characteristics prevalent in the female population was statistically significant $U\ (N_{\text{males}} = 60, N_{\text{females}} = 30,) = 225.00, z = -6.67, p < .001$. A 2 x 2 contingency table was used to determine whether the screening tool can determine all the ASD individuals at a cut-off point of 3. The M-CHAT-R was able to detect 44 out of the 45 children who had official diagnosis of ASD with one identifying as false negative. Similarly, the screening tool was able to properly identify 34 out of the 45 children who did not have ASD diagnosis with 12 children identifying as false positive. Overall, the screening tool identified 56 children as qualifying for ASD diagnosis.

Table 8

Contingency Table for M-CHAT-R

	CLINICAL DIAGNOSIS		
M-CHAT-R	ASD	NON-ASD	TOTAL
ASD	44	12	56
NON-ASD	1	33	34
Total	45	45	90

Evaluating the predictive validity of the M-CHAT-R scale at a cut-off score of 3, this table shows that the sensitivity of the scale is 97.78% at detecting children who have ASD. Additionally, a specificity of 73.33% at detecting children who do not have ASD was established. The positive likelihood ratio for the scale was 3.67 and the negative likelihood ratio was 0.03. The M-CHAT-R has a PPV of 0.79 and an NPV of 0.97. The AUC for the ROC curve analysis was 0.9649. From the ROC curve, the cut-off point should be six with a sensitivity and specificity of 93.33%. Similarly, the predictive validity of the screening tool for the slightly older children 31 – 60 months had a sensitivity score of 100% at detecting children who have ASD. Additionally, a specificity of 80% at detecting children who do not have ASD was determined.

Table 9

Evaluating the Predictive Validity of the M-CHAT-R

Sensitivity at cut-off score of 3	97.78%
Specificity at cut-off score of 3	73.33%
positive likelihood ratio	3.67
negative likelihood ratio	0.03
positive predictive value	0.79
negative predictive value	0.97
ROC	0.9649
Cut-off from ROC curve analysis	6
index for cut-off determination	185.66
Sensitivity at cut-off score of 6	93.33%
Specificity at cut-off score of 6	93.33%

Below is a figure for ROC analysis for the M-CHAT-R screening tool. The figure explains how well the tool can screen autistic characteristics among children aged 16–60 months. According to the figure, the curve is the true positive rate (sensitivity) plotted in function of the false positive rate (1-specificity). It is apparent that the area under the ROC curve is 0.96 which indicates of how well the test result can distinguish between children with and without diagnosis of ASD. This suggests that the screening tool has a high overall accuracy.

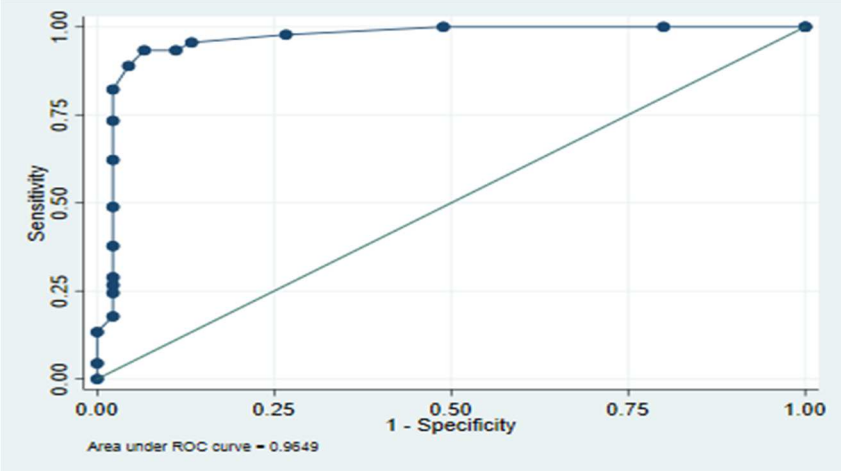

Figure 2. Receiver operating characteristic analysis graph for M-CHAT-R tool for children 16–60 months.

A Mann-Whitney U test was conducted to determine whether there is a difference in ASD characteristics between ASD children between 16–30 months and ASD children 31–60 months (see Table 10). Results from the analysis indicates that the ASD characteristics were statistically significantly higher among ASD children 16–30 months than children 31–60 months, z = -4.778, $p < 0.006$. ASD children 16–30 had an average rank score of 805, while the ASD 31–60 months had an average rank score of 230.

Table 10

Comparing Test Score of 45 Autism Spectrum Disorder Children

ASD Children	Observation	Expected Rank Sum	Rank Sum	P-value
ASD (16–30)	35	805	903.5	0.0069*
ASD (31–60)	10	230	131.5	

Table 11 presents the percentage response for an item of the M-CHAT-R between N = 35 ASD children between 16 to 30 months and N = 10 ASD children between the

age of 31–60 months. Item-by-item analysis was conducted to determine which item failed the most. Item 7 *'Does your child point with one finger',* Item 15 *'Does your child try to copy',* Item 19 *'If something new happens',* and Item 3 *'Does your child pretend or make-believe'* performed poorly within the 16–30 months group. Each of these items scored above 70%. Out of the 20 items, only two items recorded a higher percentage failure among the 31–60 months age group. Item 5 *'Does your child make unusual finger movements?'* and Item 12 *'Does your child get upset?'*

Table 11

Percentage Response of Items Failed by 45 Autism Spectrum Disorder Children

Items	16–30months		31–60months	
	N = 35	%	*N* = 10	%
Q1. If you point something across the room	18	51	4	40
Q2. Have you ever wondered if your child	13	37	1	10
Q3. Does your child play pretend or make	27	77	6	60
Q4. Does your child like climbing on things	20	57	4	40
Q5. Does your child make unusual finger	15	43	6	60
Q6. Points with one finger to get help	22	63	3	30
Q7. Points with one finger to show	29	83	7	70
Q8. Is your child interested in other children	23	66	6	60
Q9. Does your child bring things to you	23	66	5	50
Q10. Does your child respond when you call	13	37	3	30
Q11. Does your child smiles back	17	49	4	40
Q12. Everyday noise gets your child upset	16	46	5	50
Q13. Does your child walk	12	34	1	10
Q14. Does your child look you in the eye	21	60	3	30
Q15. Does your child try to copy you	28	80	2	20
Q16. Does your child turn to look around after you	24	69	6	60
Q17. Does your child get your attention	25	71	6	60
Q18. Does your child understand directives	22	63	2	20
Q19. Does your child respond to your emotions	28	80	4	40
Q20. Does your child like movement activities	13	37	3	30

This table explains parents' response to the cultural sensitivity and appropriateness of the use of the M-CHAT-R in Ghana. All the parents (n = 90) who completed the screening tool also completed the cultural sensitivity questionnaire. According to the responses, 92% of parents, confirmed Q2 '*Have you ever wondered if your child is deaf*' was not difficult to score. Furthermore, 89% of the parents regard Q1, '*The language in which the screening tool'* was developed to be appropriate. About 66% of the parents considered Item 4 '*Item 2 on the screening tool is culturally'* the most culturally sensitive. Furthermore, Q7, *Item 14 on the screening tool is culturally sensitive'* was considered culturally sensitive by 56% and Q6, '*Item 7 on the screening tool is culturally sensitive'* on the screening tool was considered culturally sensitive by 28% of the parents. On the other hand, 31% of the parents considered Q3, '*All items of the screening tool to be culturally sensitive*.'

Table 12

Cultural Appropriateness of the M-CHAT-R by Parents

Question	Cultural Sensitivity	Parents (*N* = 90)	Percentage Agreed
1.	The language was simple	80	89
2.	Scoring the items was easy	83	92
3.	All items were culturally sensitive	28	31
4.	Item 2 is culturally sensitive	54	66
5.	Item 6 is culturally sensitive	30	33
6.	Item 7 is culturally sensitive	25	28
7.	Item 14 is culturally sensitive	50	56

Table 13 explains the sociodemographic characteristics of the professionals who participated in the study. Most (*n* = 30) were females. Mean ages ranged from 33 to 50.

Mean years of experience ranged between 7 and 11. All the professionals had tertiary education.

Table 13

Sociodemographic Characteristics of Health Care Professionals

TOTAL N = 40	Pediatric Nurse *N* = 15	Dr. Pediatrician *N* = 5	Clinical Psychologist *N* = 5	Psychiatric Nurse *N* = 15
Mean Age	33.2	49.6	49.0	36.47
Gender				
Male	0 (0%)	2 (40%)	3 (60%)	5 (33.33%)
Female	15 (100%)	3 (60%)	2 (40%)	10 (66.67%)
Years of Experience	8.13	11.2	10.2	6.73

Table 14 presents the (n = 40) selected health professionals' scores ascribed to the relevance of each item of the M-CHAT-R screening tool. Each professional scored the M-CHAT-R tool to determine the relevance of the items in identifying ASD characteristics among children between the ages of 16–60 months. Analyzing the relevance of each question on the screening tool, 93% of all professionals selected Q7, '*Points with one finger to show'*, Q9 '*Does your child bring things to you'* and Q17, '*Does your child get your attention'* as the most relevant questions toward identifying ASD characteristics. About 90% of the professionals selected Q5, *'Does your child make unusual finger',* Q6, '*Points with one finger to get help',* and Q15, '*Does your child try to copy you'* as the next most relevant questions for screening ASD characteristics. Only 5% of the professionals selected Q13, '*Does your child walk'* as relevant to screening ASD characteristics.

With the specific professionals, 100% of the pediatric nurses selected Q6, *'Points with one finger to get help',* and Q15'*Does your child try to copy you'* as most relevant and 7% selecting Q13, '*Does your child walk'* as the least relevant to ASD screening. Q7, '*Points with one finger to show'*, Q8, *'Is your child interested in other children'* Q9, '*Does your child bring things to you'* Q10, *Does your child respond when you call his or her name',* and Q16, '*Does your child turn to look around after you',* were selected by the pediatricians as most relevant for screening ASD characteristics with none selecting question Q13, '*Does your child walk.'*

Similarly, questions Q1, *'If you point something across the room'* Q3, *'Does your child play pretend or make',* Q5, *'Does your child make unusual finger'* Q6, *'Points with one finger to get help',* Q7, *'Points with one finger to show'* Q9, *'Does your child bring things to you'* Q10 *'Does your child respond when you call his or her name*,' Q11, *'Does your child smiles back'* and Q12, *'Everyday noise gets your child upset?'* were selected by 100% of the clinical psychologists as the most relevant for ASD screening with none of the clinical psychologist selecting Q13, *'Does your child normally walk'*. Questions 5, *'Does your child make unusual finger'* and Q18, '*Does your child understand directives'* were selected by 93% of the psychiatric nurses as most relevant for ASD screening with 7% selecting question Q13, *'Does your child normally walk'* as relevant.

Table 14

Percentage of Professionals' who Scored the Screening Items as Appropriate

	Pediatric Nurse *N* = 15	Pediatrician *N* = 5	Clinical Psychologist *N* = 5	Psychiatric Nurse *N* = 15	Total % *N* = 40
	%	%	%	%	%
Q.1	87	40	100	80	80
Q.2	80	80	80	60	73
Q.3	93	40	100	87	85
Q.4	93	0	40	47	58
Q.5	93	60	100	93	90
Q.6	100	60	100	80	90
Q.7	93	100	100	80	93
Q.8	93	100	80	73	85
Q.9	93	100	100	87	93
Q.10	93	100	100	73	88
Q.11	93	80	100	73	85
Q.12	80	80	100	73	80
Q.13	7	0	0	7	5
Q.14	93	80	100	80	88
Q.15	93	80	100	87	90
Q.16	93	100	100	87	80
Q.17	100	80	100	87	93
Q.18	100	40	100	93	90
Q.19	93	60	100	87	88
Q.20	13	60	100	20	33

Table 15 represents professionals' response to the cultural sensitivity of the screening tool, suggesting whether any item being scored does not affect the values and accepted norms of the Ghanaian population. Most scored Question 2 (Have you ever wondered if your child might be deaf?) and Item 14 (Does your child look you in the eye when you are talking to him or her) as culturally sensitive, but Question 7, (Does your child point with one finger to ask for something or get help?) only received 25% agreement from the professionals, similar to Item 3 (all items on the screening tool culturally sensitive). Other questions that were asked to determine the appropriateness of the screening tool include item1, *'the language in which the screening tool is written'* received 100% score from the professionals. Two items that also quizzed the professionals on recommendations were Item 8, '*This screening tool should be recommended to the health ministry* and Q9, *will you recommend this screening tool to parents and other professionals.'* These two items received 100% score each from the professionals.

Table 15

Professionals' Responses on Cultural Sensitivity

Items	Professionals ($N = 40$)	% Agreed
1. The language was simple	40	100
2. Scoring items on the screening tool	38	95
3. All items are culturally sensitive	9	23
4. Item 2 is culturally sensitive	26	65
5. Item 6 is culturally sensitive	12	30
6. Item 7 is culturally sensitive	10	25
7. Item 14 is culturally sensitive	23	58
8. This Screening tool should be recommended	40	100
9. Will you recommend this tool to parents & pro	40	100

Summary

The result of the study is published in this chapter. The chapter focused on the statistical tools that assessed the appropriateness of the M-CHAT-R for screening ASD characteristics in Ghana. Major items reported includes the sensitivity and specificity of the screening tool and the cultural appropriateness of the tool. Chapter 5 will focus on discussing the results, concluding the study and making recommendations

Chapter 5: Discussion, Conclusions, and Recommendations

Summary of M-CHAT-R and its Cultural Appropriateness

Currently, there is no estimation of ASD prevalence rate in Ghana. However, the CDC (2020) puts the current ASD estimation at 1 in 54 children in the United States, and the global estimation of ASD is at 1 in 160 children (World Health Organization, 2019). This suggested estimate represents an average number of ASD diagnoses across the globe. However, reported cases of ASD prevalence vary largely across studies (World Health Organization, 2019). This study focused on validating the original M-CHAT-R with the Ghanaian population with children aged 16–60 months. The M-CHAT-R has never been used in Ghana, and this study is the first of its kind to assess the relevance of this tool in screening ASD characteristics within the Ghanaian population.

The M-CHAT-R was used in its original form to screen ASD characteristics in Ghanaian children aged 16–60 months at selected locations. The study also assessed whether the screening tool developed in the United States is culturally appropriate. The outcome suggested that the screening tool has excellent reliability $\alpha = .90$ compared to the original M-CHAT-R $\alpha = 0.79$ (Robins et al., 2014). The analysis of cultural appropriateness of some of the items on the questionnaire confirmed that the items did not affect the screening outcomes with the Ghanaian population. The sample used for this study is small ($n = 130$) compared to the sample on which the original tool was tested ($n = 15{,}612$). However, due to the sampling technique, the response rate was very high. A total number of 90 parents and 40 health professionals completed the study.

At the standard cut-off score of 3, the screening tool was sensitive with a higher number of false positives. The specificity was better with a cut-off score of 6. The number of false positives out of the 45 non-ASD individuals was 12 (27%). This finding indicates that there might have been several children at risk of ASD, but the parents had not presented these children for early screening and diagnosis. There were instances where I visually observed when three of the non-ASD children who participated in the study showed clear ASD characteristics, yet their parents denied that they are autistic. My observation was that parental denial or unwillingness to send their children who were at risk of autism for screening and diagnosis was influenced by their family cultural background (Ennis-Cole et al., 2013). There was evidence that some of the children would have benefited from early intervention if their parents had taken them for early screening and diagnosis. Adjusting the cut-off score to 6, almost all ASD and non-ASD children were detected; thus, the screening tool was shown to be highly sensitive and highly specific. It accurately screened all the non-ASD children and 44 out of the 45 ASD children.

Demographics of the Parents and Their Logistic Regression Analysis

All the parents (n = 90) who participated in the study completed two sets of questionnaires. All the parents willingly participated in the study. In fact, more parents were willing to participate in the study, but the nature of the study and the limited study size did not allow their involvement. Children were selected from special schools and selected hospitals in the Greater Accra Region. The gender of the parents and their ages did not influence their scoring of the screening tool. However, parental level of education

was associated with the screening score. This indicates that the ASD diagnosis of children has a relationship with the level of parental education and not necessarily by chance. This outcome needs further investigation to ascertain the extent of the relationship.

The demographic variables were assessed to determine whether they impacted the outcome of the study. The mean age for the 90 participant parents was 35.73 years, and the mean age for parents with ASD diagnosis of their children was 37.33 years and slightly higher than the mean age of parents of non-ASD children, which was 34.13years. Therefore, the parental age and its relationship with ASD diagnosis was not statistically significant, and there is insufficient information to confirm whether the age of the parents increase ASD risk. Other studies like one conducted by Sandin et al. (2016) established that advancing paternal and maternal age has been linked to autism risk. The study was carried out in five countries and consisted of about 5.8 million children with ASD diagnosis. But even though a relationship between increasing age and the risk of autism was established, the extent of this association was not determined including that of joint association. Other findings of the study explained that increasing risk of ASD is also associated with differences in parental ages including older and younger and similar and dissimilar aged parents (Sandin et al., 2016).

Out of the 90 participants, 28 representing 31.11% were fathers, and the remaining 62 participants representing 68.89% were mothers of the children. My observation of parental relationship with their children indicates that mothers were more involved with the children in both ASD and non-ASD groups. The parents of children

without ASD diagnosis had the following characteristics. Out of the 45 parents who completed the questionnaires, 15 were fathers and 30 were mothers of the children. Research has suggested that fathers are more reluctant in providing care to their autistic child than mothers and mostly end up having little involvement in the child's life (Soltanifer et al., 2015). Other research has suggested that fathers of autistic children are either totally absent, withdrawn, or very involved with professionals (Naseef, 2015). Mothers have mostly played the role as the primary caregiver of an autistic child (Eisenhower, Baker, & Blacher, 2005). However, studies on parental involvement with ASD children have focused on mothers and couples with little research on fathers. In this study, 67% of the parents with ASD children who completed the questionnaire either at the child's school or the hospital were mothers. This supports the assertion that more mothers are involved with caring for their autistic children. However, major benefits attributed to increased fatherly involvement has resulted in improved cognitive competence, better self-control, high levels of empathy, and limited sex-stereotyped beliefs (Naseef, 2015).

Considering the parents' educational background of the children with ASD diagnosis, 56% of them had tertiary education. The results from the analysis were statistically significant. This suggests that the relationship between parental education and ASD diagnosis is caused by something other than chance. According to a study by University of Utah, parental level of education is related to ASD. Similarly, a report by Hamilton (2011) confirmed a link between the level of education of parents and ASD risk. Children with highly educated parents are more likely to have ASD characteristics.

Xin et al. (2013) also argued that parents with higher education in science, technology, engineering, and mathematics are more likely to have children with ASD risk factors. The established relationship between parental level of education and ASD risk in other studies calls for further studies within the Ghanaian ASD population to determine whether such relationship exists.

I also observed that the level of education of the parents did not adversely affect the scoring of the screening tool. Forty-four out of the 45 (97%) parents of children diagnosed with ASD scored the screening tool accurately to confirm their child's diagnosis. Only one child with ASD diagnosis was missed as a result of how the parent scored the items on the tool. Even though the child was showing clear ASD characteristics such as making unusual finger movements, not responding to his name, and not responding to directives, the scoring of the tool failed to identify him. The inability to correctly screen him could be attributed to the parent's poor comprehension of the items on the screening tool. The child scored 2 out of the 20 items, whereas the other 44 children scored between 8–20 of the screening items. The developers of the screening tool have suggested that minimal education is required by parents to adequately score the screening tool (Robins et al. 2014).

Gender Analysis of the Children Diagnosed with Autism Spectrum Disorder

Out of the 45 children with ASD diagnosis, there were 32 boys and 15 girls representing 71% of males and 29% of females. This sampled population supports previous studies suggesting that ASD research is grounded in a male-dominant sample, establishing a ratio of 3 males to 1 female diagnosed with ASD (Geelhand et al., 2019),

which is similar to this ASD sampled group. The subgroups for children with ASD diagnosis also had a similar presentation. Within the 16–30 months group, 24 were boys and 11 girls. Similarly, with the 31–60 months group, 8 were boys were and two were girls.

After administering the screening tool, 56 children screened positive at the standard cut-off score of 3. Out of the 56 children, 40 were boys representing 71% and the remaining 16 were girls representing 29%. Out of the 40 boys, 31 (77.5%) had official ASD diagnosis and the other nine (22.5%) screened false positive. Similarly, out of 16 girls who screened positive, 13 (81.25%) had official diagnosis of ASD while three (19.75%) screened false positive.

From the general analysis, more boys who participated in the study had official ASD diagnosis than the girls. More boys (n = 9) within the non-ASD group than girls (n = 3) within the same group screened positive. Although detailed statistical analysis was not carried out due to the low numbers in the group, it is evident that more boys than girls participated in the study. Available statistics in the Western world suggest more prevalence of ASD in males than in females. The CDC (2018) claimed that boys are 4 times more likely than girls to be diagnosed with autism. The higher prevalence of ASD among boys might suggest why more boys were present at the hospital and special schools at the time of data collection. Increasing attention should be placed on boys to assess the high prevalence of ASD characteristics and to determine whether ASD characteristic is presented differently among boys. It is equally important to explore

whether sociocultural factors such as gender expectations have a role in ASD presentation (Geelhand et al., 2019).

Data Analysis for Autism Spectrum Disorder and non-Autism Spectrum Disorder Children

The analysis that was performed on the 20 items of the screening tool to evaluate each item's ability contribution to the clinical diagnosis revealed that some of the items had strong predictability and some had poor predictability for ASD screening. Using statistical analysis on the 20 items, the percentage score of each item on the screening tool was established. This approach helped determine which items frequently failed and which items hardly failed and whether it will be necessary modify the screening tool specifically for the Ghanaian population.

A complete analysis was carried out on the scores for the (n = 90) children to determine the good and bad discriminating items. Item 7 (Points with one finger to show you something interesting) stood out as the most effective item in screening ASD characteristics. Eighty percent of the parents with children diagnosed with ASD scored Item 7. Other good discriminating items arranged in order of percentage scores include Item 3 (Does your child play pretend or make?), which received a 73% score; Item 19, (Does your child respond to your emotions?),which received a 71% score; Item 17 (Does your child get your attention?), which received a 69% score; Item16 (Does your child turn to look around after you?), which received a 67% score; Item 15 (Does your child try to copy you?), which scored 67%; and Item 8 (Is your child interested in other children?). Other items also performed poorly in discriminating ASD characteristics among the

groups. Item 13 (Does your child walk?) received a 29% score and is identified as the weakest discriminating item. Other poorly discriminating items includes Item 2 (Have you ever wondered if your child?), which received a 31% score; Item 10 (Does your child respond when you call his or her name?), which received a 36% score, and Item 20 (Does your child like movement activities?), which received a 36% score.

Comparing my study outcome with other studies, Items 7, 3, 19, 17, 15, 16, 8 and 9 were very good in discriminating ASD characteristics whereas Items 13, 2, and 10 were bad discriminators. A similar study in Albania where item-by-item analysis of the M-CHAT-R was conducted, 12 items were identified as having strong predictability for ASD: 1, 10, 11, 9, 18, 16, 17, 19, 14, 15, 8, and 7. Items 1 and 10 were identified as the most predictive, whereas Items 4, 13, and 20 were identified as bad discriminators of ASD (Brennan et al., 2016). A study using M-CHAT-R in Singapore, China, and Japan identified Items 3, 1, 7, 15, and 8 as the best items for distinguishing ASD characteristics (Brennan et al., 2016). The similarity in the best discriminating items in the mentioned studies and my study indicates a higher degree of universality of early ASD symptoms.

The Internal Consistency of the 20 Items

Internal consistency is a form of assessment that is used to evaluate how test items that developed to measure a construct actually perform (Sideridis, Saddaawi, & Al-Harbi, 2018). It therefore measures the reliability of a scale. If the items on the M-CHAT-R consistently measure the ASD characteristics that they are designed to measure, then the scale is reliable. The Cronbach's alpha is commonly used for measuring internal consistency. The acceptable value for this scale is from 0.7 to 0.9. A higher degree of

internal consistency indicates that items designed to measure the same construct yield similar scores.

In this study, the internal consistency of the 20 items were investigated by using item responses. Cronbach's alpha was used to determine whether all the items measured the same construct of ASD characteristics. The reliability coefficient was ($\alpha = 0.91$) which suggests a very strong internal consistency for the tool. Therefore, the M-CHAT-R is reliable for screening ASD characteristics within the Ghanaian population.

2 x 2 Contingency Table

This table was used to understand how well the M-CHAT-R captured the true presence or absence of the disease within the selected group using the cut-off score of 3 as used by the developers of the screening tool. The outcome confirmed that using the standard cut-off score of 3, a total number of 56 of the children were detected as having ASD characteristics or qualifying for ASD screening or diagnosis. The tool also identified 34 children as not meeting ASD screening or diagnosis. However, the tool was able to correctly detect 44 out of the 45 children with the official diagnosis of ASD but failed to detect 11 children without ASD diagnosis. The evaluation of the predictive validity of the screening tool using the cut-off score of 3 yielded a sensitivity of 97.8% and specificity of 73.3%. To determine how this test is doing, the PPV was calculated to establish true positive. The PPV observed was 0.79, and the NPV was also 0.97. Research has confirmed that a more sensitive test improves the NPV. Deducing from the outcome of this study, it can be argued that the tool is sensitive. The validation of the M-CHAT-R in China using 7928 toddlers aged between 16 to 30 months using the standard

cut-off score of 3 produced a sensitivity score of 0.963 and specificity of 0.865 (Guo et al., 2019).

A similar study with the Chilean population where the M-CHAT-R was validated had a promising outcome (Coelho-Medeiros et al., 2019). A sample of 20 children suspected to have ASD and randomly selected100 healthy children aged between 16–30 months were recruited for the study. The screening tool was able to identify all the 20 children suspected of having ASD. The discriminant sensitivity of the tool was 100% with a specificity of 98%. The Chilean study results thus classified the tool as very sensitive, specific, and reliable similar to that in the original study. Results from my study compared to that of China and Chile confirm that the M-CHAT-R is sensitive in discriminating ASD characteristics.

Using Receiver Operating Curve Analysis

Further analysis was conducted to determine the cut-off score at which the sensitivity and specificity of the tool is optimized. This analysis focused on the (n = 90) children. Using the ROC curve allowed the diagnostic performance of the M-CHAT-R to be assessed on how accurately it can discriminate dichotomous cases. It also supports a visual presentation of the cut-off points. In this group, the AUC that yielded a strong sensitivity and specificity for the tool was 0.96. Sensitivity and specificity outcomes were very similar, 0.933 and 0.933 respectively, using the cut-off score of 6. Even though at the standard cut-off score of 3, 44 out of the 45 children with ASD diagnosis were screened, there were false positive incidents of 12 (21%). However, after adjusting the cut-off point to 6, the screening tool was very effective in reducing the false positive

outcomes. Therefore, this tool has a very high diagnostic accuracy in discriminating between ASD children and non-ASD children. The AUC is significantly better than happening by chance.

Studies suggest that a screening tool that yields high sensitivity will flag almost every person who has the disease and high specificity will accurately rule out almost everyone who does not have the disease (Parikh et al., 2008). High sensitivity screener is desirable with screening suspected ASD population. This current study will recommend the standard cut-off score of 3 which yields a sensitivity score of 97.8% and specificity score of 73.3% as compared to the cut-off score of 6, which had a sensitivity score of 93.3% and specificity score of 93.3% in usage in Ghana. At the cut-off score of 3, the individuals who screen false positive will be encouraged to follow up with further screening to determine whether they actually have ASD characteristics or any other underlying developmental issues.

Comparing the Outcome of the Autism Spectrum Disorder Children by Age

There is no validated screening tool for screening ASD characteristics for older children in Ghana. This study evaluated the M-CHAT-R with a slightly older children (31–60 months) to determine whether the screening tool can effectively screen ASD characteristics in older children when compared to younger children. The outcome if successful will open the door for its consideration for adaptation for this group. Some ASD characteristics occur later in older children and become noticeable when children reach the school age. A study by Sturner et al. (2017) explained that some ASD symptoms emerge gradually which might lead to a limited number of endorsed ASD

characteristics in younger children. The study further argued that because ASD behaviors indicate delays in development, there are chances that some M-CHAT-R items screen ASD in younger children who might end up developing normally later (Sturner et al., 2017).

A Mann-Whitney test was conducted to determine which group within the ASD population had a higher presentation of ASD characteristics. From the data, it was evident that ASD characteristics among the 16–30 months group were higher than the 31–60 months group. A similar study conducted by Sturner et al. (2017) using the M-CHAT to screen younger and older toddlers concluded that younger toddlers received higher rates of overall failure irrespective of their ages compared to the older children. The M-CHAT-R is designed to screen early ASD characteristics among younger children (16–30 months) and the outcome of this analysis was an attestation that the screening tool is indeed appropriate for this age group.

Item-by-Item Analysis by Age group

This analysis was conducted to determine the quality of each item among the 20 items and how well the items performed among the ASD-diagnosed groups. The outcome of the analysis suggested that items 7, *'Points with one finger to show you something interesting?'* Item 15, *'Does your child try to copy you',* Item 19, '*Does your child respond to your emotions'* and Item 3, *'Does your child play pretend or make*' performed strongly with the 16–30 months age group. All the identified items received 70% and above scores. Only Item 5, '*Does your child make unusual finger'* and Item 12, '*Everyday noise gets your child upset',* performed better with the 31–60 months. Out of

the 20 items, 18 performed better with the 16–30 months age group than the 31 – 60 months age group. From the item's analysis, it can be argued that the screening tool is very effective in screening ASD characteristics among the 16–30 months children as suggested by the developers of the M-CHAT-R.

Comparing the outcomes for the two ASD groups 16–30 months and the 31–60 months, it was clear that the older children might have had enough time to allow for improvement in potential areas of development hence the improved scores. These children who participated in the study were at the special school and were receiving some form of intervention. These interventions might have contributed to the improved score of the older children. Moreover, some characteristics associated with ASD become conspicuous as the child becomes older and this favors ease of identification (Sturner et al., 2017). One of the parents of the older children confirmed that Item 5 '*finger movement'* was initially performed intermittently but now occurring noticeably with her child's growth. The outcome of this analysis confirms that the M-CHAT-R can effectively screen ASD characteristics among older children but since it was designed for children between 16–30 months, it should be used with older children with caution.

Professionals and Parental Cultural Sensitivity Scores

The awareness that cultural differences and similarities between people exist was important for this study. The researcher assessed whether the M-CHAT-R that was developed in the USA to screen ASD characteristics was appropriate for screening ASD characteristics in Ghana. The screening tool was evaluated for its appropriateness in the Ghanaian sociocultural context. Some items on the screening tool were selected to test

their cultural relevance and to determine whether cultural factors could negatively impact the outcome of the study. There are some items on the M-CHAT-R that represent ordinary behaviors for screening ASD characteristics in the USA. However, these behaviors suggest different meanings in the Ghanaian culture. These culturally sensitive items (deafness, eye contact, using the fingers and lack of interest in diagnosing autism) in the study include Item 2, '*Have you ever wondered if your child might be deaf',* Item 6, '*Does your child points with one finger to ask for something or to get help',* Item 7*, Points with one finger to show you something interesting',* and Item 14, *Does your child look you in the eye when you are talking to him or her, playing with him or her, or dressing him or her?* Twenty-three percent of the 40 professionals who participated in the study believed that the tool is culturally sensitive. On specific items, 65% of the professionals are of the opinion that Item 2 *'Have you ever wondered if your child might be deaf'* is mostly culturally sensitive. Similarly, 58% of the professionals selected Item 14 *'Does your child look you in the eye'* to be culturally sensitive while 30% and 25% respectively selected items 6 *'Points with one finger to ask for something or to get help'* and 7 *'Points with one finger to show you something interesting'* to be culturally sensitive. On the easiness of scoring, almost 95% of the professionals confirmed that the tool is easy to read and score. Essentially, all the professionals who participated in the study confirmed that the screening tool should be recommended to the ministry of health for adaptation and to parents and other relevant professionals to be used for the early screening of ASD characteristics.

Similarly, 31 % of the parents who participated in the study viewed the screening tool as culturally sensitive, and 66% and 56% of the parents respectively selected Item 2 *'Have you ever wondered if your child might be deaf'* and 14 *'Does your child look you in the eye'* as culturally sensitive. Further analysis confirmed that 33% of parents classified Item 6 *'Points with one finger to ask for something or to get help'* as culturally sensitive with 28% of the parents also selecting Item 7 *'Points with one finger to show you something interesting?'* Regarding the appropriateness of the language and scoring, 89% and 92% respectively believed that the language is appropriate, and the scoring is easy. The impact of the culturally sensitive items were not immediately noticed as the screening tool was sensitivity for screening ASD characteristics.

Professionals' Scoring of the Items

Forty professionals comprising pediatricians, pediatric nurses, clinical psychologists, and psychiatric nurses scored the 20 items on the screening tool to determine their relevance for screening ASD characteristics within the Ghanaian population. Out of the 20 items, three items (7, '*Points with one finger to show you something interesting?'* 9, '*Does your child bring things to you'* 17, '*Does your child get your attention'*) were scored by 93% of the professionals as very relevant for the discrimination of ASD characteristics. Only 5% of the professionals scored Item 13, *'Does your child walk'* as relevant for ASD screening. Except for items 2, *'Have you ever wondered if your child might be deaf',* 4, *'Does your child like climbing on things'* and 13, *'Does your child walk,'* all the other items received at least a 100% score.

There are limited studies published in Ghana on health professional's knowledge on ASD. The only published study was conducted by Wireko-Gyebi & Ashiagbor (2018) which assessed the knowledge of pediatric and psychiatric nurses on ASD in Ghana. These nurses were sampled from five public hospitals in Kumasi Metropolis. The outcome of the study revealed that psychiatric nurses were more knowledgeable regarding ASD than pediatric nurses. However, the current study which assessed pediatric nurses and psychiatric nurses' perspective on M-CHAT-R screening tool, which has been widely accepted to be cross-culturally effective in screen ASD characteristics, had pediatric nurses scoring higher than the psychiatric nurses.

Comparing Pediatric and Psychiatric Nurses' Scores

Out of the 20 items on the screening tool, items 6, 17, and 18 received perfect scores from the 15 pediatric nurses as discriminating items. Only items 13 and 20 were identified as poor discriminating items. One pediatric nurse (7%) identified Item 13 as relevant while 2 (13%) identified Item 20 as relevant. None of the 20 items on the screening tool received a perfect score from the psychiatric nurses. However, about 16 of the items received more than 70% score from the psychiatric nurses as relevant. Only items 13 and 20 were identified as poor discriminating items by 1 (7%) and 3 (20%) of the psychiatric nurses, respectively. Comparing the scores of the two group of nurses, the data suggest that more pediatric nurses scored the items as relevant. However, a study by Wireko-Gyabi and Ahiagbor (2018) on comparative knowledge on autism among pediatric nurses and psychiatric nurses in Ghana revealed that the latter were more knowledgeable on autism than the former in general. They argued that in lieu of their

training and previous encounter with ASD children, psychiatric nurses are likely in better position to identify autism characteristics among children.

Views of a psychiatric nurse. A psychiatric nurse shared her opinion on autism in Ghana. She explained that little information exists on autism and to create awareness of this disorder, information should be disseminated through the social media, workshops, and trainings. She further argued that the lack of knowledge about this disorder negatively has impacted children and families with ASD-diagnosed children. She recommended that more information on autism should be out there and parents should be directed as to where to seek assistance. Moreover, to break some cultural barriers, teachers, students, market women, opinion leaders, and traditional rulers should be educated on autism. She believes that such an approach will reduce some of the stigma attached to autism, paving the way for more acceptance of such children and less discrimination.

Pediatricians' Scoring

Out of the 20 items on the screening tool, 5 items received perfect score from the pediatricians as relevant for discriminating ASD characteristics. Items 4 and 13 received 0 scores from the five pediatricians as relevant. Considering pediatricians in Ghana who use their vast experience and knowledge in diagnosing and treating various types of sicknesses, diseases, and disorders in children, the scoring of two items as not relevant requires further evaluation in the future.

Clinical Psychologist Scoring

Clinical psychologists in Ghana are skilled in performing assessment, diagnosis and evaluating individuals with mental disorders and ASD. Out of the 20 items, 16 received perfect scores from these clinicians. Only Item 13, received 0 score from all the 5 clinical psychologists. The scoring of the clinical psychologist confirmed that most of the items on the screening tool are able to discriminate ASD characteristics in Ghana.

Views of clinical psychologists. One of the clinical psychologists with whom I had a conversation explained that many parents do not look for help early due to the stigma associated with the ASD. Most parents who visit him for the assessment of their children feel embarrassed that they have children with ASD. Another clinician observed according to his experience working with parents that the level of education of some parents and the limited knowledge and information on ASD significantly impacts ASD screening, diagnosis, and treatment. Furthermore, one of the clinicians pointed out that healthcare workers need more information and training on the early symptoms of autism to better assist the parents in need.

Comparing Parents and Professionals' Response on Cultural Sensitivity

The sensitive nature of some of the items received similar scores from both professionals and parents; 66 % of the parents and 65% of the professionals considered Item 2 *'Have you ever wondered if your child might be deaf'* mostly culturally sensitive. The historic stigma attached with deafness is rapidly decreasing in Ghana. However, in some parts in the Ghanaian society, deafness is still considered a curse and punishment for earlier sins (Kusters, 2012). Item 14 *'Does your child look you in the eye'* also

received similar scores from both professional and parents. The screening tool considers a child not looking directly in the eyes of a parent as exhibiting ASD risk characteristic but this mostly does not apply to Ghanaian culture. Within the Ghanaian cultural context, when a child is talking to an elderly person, it is important to avoid direct eye contact. A child who maintains direct eye contact might be considered disrespectful or rude. Fifty-eight percent of the professionals and 56% of the parents selected Item 14. Overall, there were similarities in scoring by all parents and professionals regarding the cultural sensitivity and the difficulty level of the screening tool.

Limitations of the Study

This study considered parents of children with official diagnosis of ASD as participants for the study. However, there were other children who showed clear ASD characteristics but were not classified as ASD participants. It was therefore not surprising that a considerable number of non-ASD children had a false positive outcome. It would have been interesting if the study had screened ASD characteristics among children whose parents had concerns about their development. The anonymous nature of the study also made it very difficult for the researcher to recommend further assistance to parents whose children screened positive. In this case, at-risk children might not benefit from early screening, diagnosis, and intervention.

The cultural perception of ASD within the Ghanaian population made it difficult for the random sampling method to be used for this study. Very few parents were interested in taking their children for screening and ASD assessment. Furthermore, the limited data on ASD compelled the researcher to use a limited sample size as well as to

delimit the study to the Greater Accra Region, the only place in Ghana where autism is officially diagnosed. The study is therefore reflective of the opinions of only a limited number of parents and professionals.

The study screened 11 non-ASD children as having ASD diagnosis. However, the anonymous nature of the study did not provide the researcher with the contact of the participants to suggest follow-ups to the parents. This limitation thus denies these at-risk individuals' early diagnosis and intervention. Moreover, the study only focused on the initial questionnaires. No follow-up screening was conducted to confirm or reject the false positives and false negative outcomes. Comparing the socio-economic status of the participants would have confirmed whether discrepancies exist within the poor and the rich in relation to their access to services and autism awareness.

Strength of the Study

Despite the limitations, the study has some strengths that need to be emphasized. A major strength is that the study adds to the research on ASD screening in Ghana and explores the cultural issues associated with autism in Ghana. The study has also confirmed that the tool which was developed in the USA is culturally appropriate for screening ASD characteristics in Ghana. The study also performed item-by-item analysis of the tool to understand the response pattern, paving way for future modification of the tool as necessary. Furthermore, the study considered the diagnostic accuracy and the predictive power of the M-CHAT-R. Finally, the sample was well characterized to determine the sensitivity and specificity of the study.

This study also encouraged parents to mention some of the challenges they were facing with their children's condition. Some parents mentioned that less resources were available to support them in understanding their children's condition. Others also expressed frustrations in obtaining answers to their children's strange behaviors in the initial stages and expressed how this study had deepened their understanding of autism.

Clinical Implications

This study provides useful evidence that the parents completing the screening tool can appropriately discriminate ASD characteristics from non-ASD characteristics with little effort. Using a screening tool that parents can effectively complete is more cost effective than using more technical and time-consuming tools such as the EEG and eye tracking methods. Individuals who screened positive but are not diagnosed with ASD are very likely to receive other diagnoses requiring intervention. I also plan to recommend a cutoff score of 6, which proved to be much better for sensitivity and specificity. Judging from the concerns raised by some professionals, it will be appropriate to include ASD as a major component in the clinical training curriculum and continuous professional education for healthcare workers.

Implications for Social Change

The presence and lack of ASD screening tools within the Ghanaian population suggests the need for robust early screening, diagnosis, and intervention for at-risk children. Early screening, diagnosis, and intervention is crucial for promoting positive social change. This change will lead to reducing the social and behavioral gaps that exist between normally developing and ASD children. This study has also made available

valuable knowledge on early ASD characteristics to parents, professionals, and opinion leaders. Previous studies have extensively argued that early screening leads to early detection, intervention, and an overall wellbeing of diagnosed individuals. This study also provides important insights into the cultural appropriateness of the screening tool, confirming that the tool is not culturally biased.

Future Directions

Future research should be carried out to address the limitations identified in the study. Future research should follow up with false positive and false negative cases to confirm or reject ASD diagnosis. Due to the cultural perception of ASD within the Ghanaian community, future research should explore family dynamics, traditions, socio-economic status, and parental depression and how these impact autism diagnosis and intervention. Additionally, it is recommended that opinion leaders, educators, families, and communities conduct frequent workshop focused dispelling the myths associated with autism. In doing so, some of the guilty feelings attached with autism diagnosis will be reduced and parents will gain confidence in seeking help for their children with autism. Furthermore, research should include a larger sample size selected across all the regions in Ghana. Future research should also consider translating the M-CHAT-R into the Ghanaian language.

Conclusion

The goal of this quantitative study was to assess the effectiveness of the M-CHAT-R for screening ASD characteristics in Ghana. This screening tool that has proved to be effective in screening ASD characteristics in the United States and other countries.

The result of the study confirmed that the screening tool is sensitive for screening ASD characteristics in Ghanaian children. The outcome of study will be made available to policy makers and health professions for their consideration for adaptation. Empirical evidences suggest that early screening and diagnosis of at-risk children could lead to early intervention. Intervening early is critical for making a difference in the communication, social, cognitive functions, motor skills and responsibility in the child's life. Adapting this screening tool for screening ASD in Ghana will benefit at-risk children, their families and the society.

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Appendix A: Parents' Socio-Demographic Questionnaire

Date: _____

Age: _____

What is your highest level of education? _____

What is your relationship to the child? _____

Section B

Child's Information

Date of Birth of the child (day/month/year) _____

Gender: Male Female

Does your child have formal diagnosis of ASD? Yes No

If you selected YES, please complete the following questions

At what age did you notice that your child was having developmental issues?

_____

What was the age of your child when you first seek help?

_____

Where did you seek your initial help?

_____

Appendix B: Assessing the Cultural Appropriateness of the M-CHAT-R by Parents

This questionnaire seeks to assess your views on the easiness of the language in which the M-CHAT-R is written and scored. It also aims seeks your view whether the screening tool raises any cultural concerns.

Date: _____ Gender: _____

To what extents to do you agree or disagree to the following statements about the M-CHAT-R questionnaire.

The language in which the screening tool is written is very easy to read and understand.
Yes No

Scoring the items on the screening tool is easy to do.
Yes No

All the items on the screening tool are culturally sensitive to the Ghanaian community?
Yes No

Item 2 on the screening tool is culturally sensitive
Yes No

Item 6 on the screening tool is culturally sensitive
Yes No

Item 7 on the screening tool is culturally sensitive
Yes No

Item 14 on the screening tool is culturally sensitive
Yes No

Appendix C: Professionals' Sociodemographic Questionnaire

This questionnaire is designed to capture basic information about professions who participated in this study.

Date of Assessment: _____

Age: _____

Please select your profession:

□Psychiatric nurse

□Pediatrician

□Pediatrician Nurse

□Clinical Psychologist

What is your highest level of education? _____

How long have you worked with children? _____

Appendix D: Assessing Cultural Appropriateness of the M-CHAT-R by Professionals

This questionnaire seeks to assess your views on the easiness of the language in which the M-CHAT-R is written and scored. It also aims seeks your view whether the screening tool raises any cultural concerns.

Date: _____ Gender: _____

To what extents to do you agree or disagree to the following statements about the M-CHAT-R questionnaire.

The language in which the screening tool is written is very easy to read and understand.
Yes No

Scoring the items on the screening tool is easy to do.
Yes No

All the items on the screening tool are culturally sensitive to the Ghanaian community?
Yes No

Item 2 on the screening tool is culturally sensitive
Yes No

Item 6 on the screening tool is culturally sensitive
Yes No

Item 7 on the screening tool is culturally sensitive
Yes No

Item 14 on the screening tool is culturally sensitive
Yes No

This screening tool should be recommended to the health ministry for its adaptation for ASD screening in Ghana.
Yes No

Will you recommend this tool to parents and other professionals for the early screening of ASD characteristics?
Yes No