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MRI age verification of U-17 footballers: The Ghana study

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ABSTRACT

Background: A fair playground is absolutely necessary in any age limited sports. Age determination in countries where birth registration is not compulsory can often be difficult making it a challenge to determine ages of people born in such countries.
Objective: To determine correlation between chronological ages of under 17 Ghanaian footballers and the FIFA MRI grading.
Method: The degree of radial epiphyseal fusion was evaluated in 286 male Ghanaian footballers aged 13–16 years over a 4 year period (June 2012–November 2016) using 1.5 T Magnetic Resonance Imaging. The ages of the participants used in the study were those provided by the football players and confirmed with their national passports.
Results: Over 48% of these Ghanaian players below the age of 17 years had completely fused radial epiphysis. No significant correlation between the given chronological ages and the degree of fusion was found. The Spearmans correlation was given as ($r = 0.069$; $p = 0.540$).
Conclusion: There was no correlation between chronological age and degree of radial fusion among Ghanaian players. Normative study among Ghanaian/black African players is long overdue to ensure the U-17 players from these countries are not unfairly disadvantaged.

1. Introduction

Accurate age determination is vital in any competitive age-restricted sport such as football. Inconsistencies in age lead to unequal chances and counter both the spirit of the game and 'fair play'. The determination of skeletal maturity has an important place in the practice of pediatrics, especially in relation to endocrinological problems and growth disorders [1]. Standard radiographs of the wrist are widely used for assessment of skeletal age, although they are also associated with radiation risk [2,3].

Whereas standard radiographs with the associated radiation risk cannot be justified as a screening tool in soccer populations, age estimation on the basis of grading of fusion of the distal radial epiphysis by magnetic resonance imaging (MRI) has been shown to be a reliable and valid method in 14–19 year-old soccer players [3].

In Ghana, the identification of chronological age has often been a difficult challenge, as registration at birth is not compulsory [4]. This gives room for falsification of true age, which could lead to cheating

[2]. It has been suggested that age, experience, body size and stage of puberty contribute considerably, in different combinations, to the variance of some football skills such as dribbling with a pass, ball control with the body and shooting accuracy [5]. Also, players with a greater relative (or possibly false lower) age are more likely to be identified as 'talented' because of the likely physical advantages that they have over their 'younger' peers [5].

Because of lack of normative studies in black African populations especially Ghana, discrepancies seen in age of players and the MRI results often present an age dilemma.

The aim of this study therefore is to evaluate the age of aspiring Ghanaian under-17 (U17) footballers using the degree of fusion of the distal radius on MRI and to compare it with Federation of International Football Associations (FIFA) MRI grading.

2. Method

A cross-sectional study design was employed using 1.5 T MRI scans

of the left wrist of 286 male football players. The ages of the participants were determined by what was provided by the players and confirmed on their national passports. These players were aspiring to play for the national U17 football team and were mandated to undergo compulsory MRI scan to determine if they qualify to play by comparing the grades of their radial bone epiphyseal fusion to a previously developed FIFA Medical and Research Centre (F-MARC) standard.

Per the ages, participants with chronological ages of 14–16 years were recruited during a series of 'justify your inclusion tournaments' organised by the Ghana Football Association (GFA) between June 2012 and August 2016. The study was conducted at the C and J Mediclinic and the Korle-Bu Teaching Hospital, both in Accra. This was mandatory because it was part of the criteria to have this MRI scans as a basis for qualification into the team. The MRI examinations of the left wrists were acquired using a protocol by the Confederation of African Football (CAF).

2.1. CAF/FIFA protocol

The wrist was positioned above the head or at the side of the body. The third metacarpal was placed as close as possible to the same axis as the radius. Coronal sequences were planned parallel to the distal volar radial surface. The imaging parameters were not pushed to the level of the top of the line magnets in order to allow protocol transfer to the equipment available worldwide. The following parameters were applied: T1weighted spin echo, TR 350–500 ms, TE 12–20 ms, slice thickness 3 mm, interslice gap .3 mm (1.1 distance factor), pixel size ≤ 0.5 mm (eg 12 cm field of view with a 256 matrix), 2–4 acquisitions and 9 images (to cover the entire distal radius from anterior to posterior).

2.2. Grading system

CAF/FIFA grading parameters for evaluating footballers were used as the grading tool in evaluating the participants in this study. The grading parameters are as follows:

Grade I; T1weighted spin echo images of completely unfused distal left radius
Grade II; T1weighted spin echo images of early fusion of distal left radius showing minimal hyperintensity within the physis.
Grade III; T1weighted spin echo image of distal left radius showing trabecular fusion of < 50% of the radial cross sectional area.
Grade IV; T1weighted spin echo image of distal left radius showing trabecular fusion of > 50% of the radial cross-sectional area.
Grade V; T1weighted spin echo image of distal left radius showing residual physis < 5 mm on any one section.
Grade VI; T1weighted spin echo image of complete fusion of distal left radius.

The degree of fusion of the left distal radius was determined by a team comprising three consultant radiologists who were double blinded and reported images independently. Their inter rater agreement were assessed prior to accepting the results.

2.3. Statistical analysis

All data were entered into Excel and later analysed with SPSS version 20.0. The Spearman's correlation was used to assess the relationship between the MRI grading and the chronological ages. The level of significance was chosen at p-value < 0.05.

3. Results

3.1. Age and degree of fusion

A total of 286 football players ranging between of 13 and16 years

Table 1
Characteristics of MRI machines used for the study.

	Center 1/C & J Mediclinic	Center 2/Korle-Bu
MRI make	GE	Toshiba
Strength of Magnet	1.5 T	1.5 T
Model	Brivo355	Vintage
Type of coil	Wrist	Wrist

Table 2
Chronological ages and the corresponding MRI grade of radial epiphyseal fusion.

Grade/Age	13	14	15	16
I	0	4	0	0
II	0	4	24	12
III	0	0	8	0
IV	0	4	20	4
V	8	12	28	20
VI	0	24	40	74

participated in the study. The mean age of the players was 15.16 years (SD ± 0.8). The median age was 15. Table 2 below shows the chronological ages and the corresponding MRI grade of radial epiphyseal fusion. Out of those who participated in the study, the majority 120(41.9%) gave their ages as 15 years while 8(2.8%) were 13 years (Table 3). The proportion of players who qualified and those who did not is presented in Fig. 1. Fig. 1 shows that all 8 (100%) of the players who gave their ages as 13 years were below grade IV category, however, half 24(50%) of the 14 year old players were in Grade VI while the other half were ≤ Grade V. Also, 40 (41.7%) of the 15 year old and 74(44%) of the 16 year old players were in the grading category of Grade VI. The characteristics of the MRI machines used for the study are also given in Table 1. In addition, the variance of distribution results of the grade and the age categories are presented in Fig. 2.

3.2. Inter rater agreement

Inter rater agreement: kappa was calculated to determine the level of agreement between the three radiologists who were double blinded and reported images independently. A kappa value of 0.95(95%) was registered indicating very good agreement (Table 4).

3.3. Correlation between chronological age and MRI grade of fusion

No significant correlation between the given chronological ages and the degree of fusion was found. The Spearmans correlation was given as ($r = 0.069; p = 0.540$)

4. Discussion

Since the acceptance of MRI as a valid and a reliable method for estimating age in 14–19 year-old soccer players in a normative population [3], FIFA continues to use it as a mandatory test before and during U17 regional and world cup football tournaments. In this study, 286 football players with self-reported and passport-**verified** age range of 13–16 years underwent MRI scans and the results were evaluated and

Table 3
Age frequency of participant.

Ages/years	Total no (%)
13	8(2.8)
14	48(16.8)
15	120(41.9)
16	110(38.5)
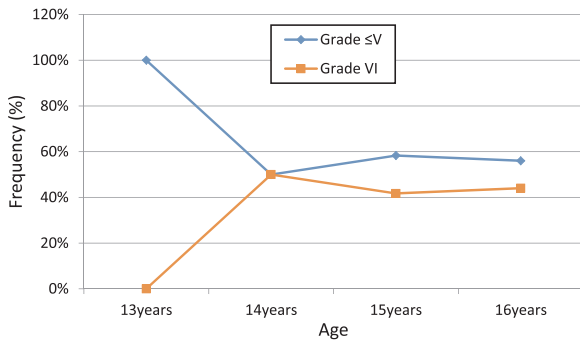
Fig. 1. Showing players who qualified (≤ V) and those disqualified (grade VI).

Grade	Total n (%)	
I	4(1.4)	148(51.7%)
II	40(13.9)	
III	8(2.8)	
IV	28(9.8)	
V	68(23.8)	
VI	138(48.3)	138(48.3%)

compared with a previously established FIFA grading system. The mean age of the players was 15.16 (Sd ± 0.5 years) with 16 year old being the oldest group among the participants. The distribution of the variance from the median for each age category and grade (Fig. 2) shows that the MRI grades were widely dispersed for ages except the 13 year old.

By the FIFA U17 grading system it should have been expected that all those below 17 would have qualified, however, a good number (48.3%), of these players were classified as grade VI and therefore did not qualify to play in the tournament. For the 14 year old, half of them were classified as grade VI. About 42% and 44% of the 15 and the 16 year old respectively were also classified as grade VI and therefore failed to qualify. There was also no correlation ($r = 0.069$; $p = 0.540$) between the ages of the players and their MRI grading, consistent with a similar report by Sarkodie et al. [4]. However, the finding conflicts that of Dvorak et al. [3] which demonstrated a strong correlation between age and grade of fusion ($r = 0.69$. $p = 0.001$).

It is unclear the cause of the lack of correlation, however, it is known that for lack of proper registration of birth in some countries including Ghana, there is room for falsification of true age, which could lead to cheating [4] since the players self-reported their ages. Dvorak et al. [3] indicated in their study that "U-17" soccer players seem to be more mature than a normative population of the same age category. Thus, prospective players are more motivated to falsify their ages compared to normal population. Therefore, the lack of correlation between age category and degree of fusion in U-17 players supports the suspicion that the age reported by the U-17 players examined might not

be correct in all cases." Notwithstanding, it has to be indicated that in this study there was no prove to suggest that the players falsified their ages since their ages were confirmed with their passports, except there was a way to alter their ages in the national passport. Alteration of age in the Ghanaian passport is possible because registration at birth is not compulsory and so birth certificates which are later obtained and used to acquire passports can be falsified. It also has to be mentioned that, the MRI grading itself is considered to be 99% accurate for under 17 years and hence the current grading may be unjust to 1% of all examined players.

Factors affecting the chronological ages are many. Dvorak et al. [6] have suggested that socioeconomic and environmental factors as well as possibly nutritional habits may have influences on the true ages of players and the FIFA MRI grading. There is also some evidence that gender has an effect on the fusion of the distal radial epiphysis, although this study focused on males. Tscholl et al. [7] found a weak correlation ($r = 0.27$) between chronological age and epiphyseal fusion among female football players due to earlier osseous maturity in female adolescents. Consequently, the authors do not recommend MRI pretournament age determination for females 17 years and younger [7]. Ethnic differences related to these changes have also been shown by several authors and also with controversial results for the same ethnic group [3].

Sarkodie et al. [4] have suggested that the promulgation of this grading by FIFA has been based on scientific studies. The main study on which the current grading is based on is the research paper by Dvorak et al. [6]. In that research the authors attempted to account for ethnic differences, by using healthy male adolescents from Switzerland, Malaysia, Algeria and Argentina; however a huge gap exists in this study as no people of black African descent were involved in the study. Therefore, the observed lack of correlation between the ages of the players
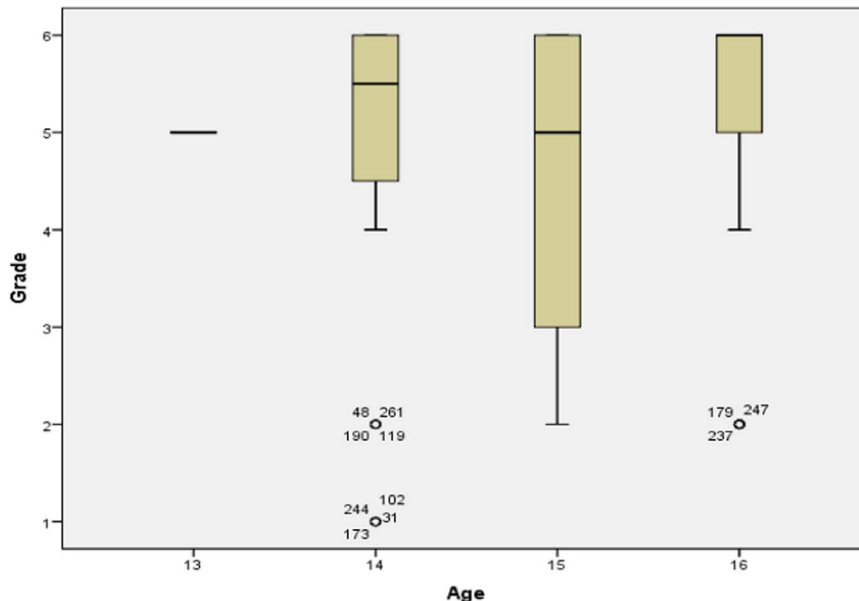

Fig. 2. A box plot showing the distribution of variance with respect to grade and age of participants.

and their MRI grading in this study could suggests that the current FIFA grading system may be unduly disqualifying Ghanaian players who are actually 17 years and below.

Different studies that used the atlas of Greulich and Pyle and Tanner standards to determine skeletal maturity and epiphyseal closure across many continents have presented different results. The European population in Denmark [8], Spain [9] and Holland [10] presented good correlation with Greulich and Pyle and Tanner standards while Turkish boys advanced in their skeletal age faster [11]. The South American [12], population presented good correlation using the TW2 technique, whereas a sample in sub-Saharan Africa showed slower skeletal age development [13]. These reports together with the findings of this study suggest there are variations in the chronological age across continents and races.

Ghana and Nigeria have won the under 17 world football championships a record seven times (the latter five times). In 2014, the Ghana team was disqualified after a player was found to be over-aged. In 2013, Nigeria suffered a similar fate when almost half of the team were found to be grade VI [14]. The aforementioned factors affecting MRI grading and the persistent discrepancies in MRI-chronological age of football players call for a normative study among indigenous black Africans to make sure that the current grading system by FIFA is not unfairly disqualifying players from Africa.

In Ghana, even though registration at birth is not compulsory, there are birth records of people born in all the major regional and teaching hospitals kept at the national births and deaths registry. A normative study using the proper records of such people from the births and deaths registry is warranted. If the discrepancies found in the study are due to falsification of ages this can be eliminated as the normative study can look at healthy male adults who are not necessarily professional footballers and who will have no motivation to falsify their ages.

5. Conclusion

Out of 286 footballers who came for MRI examinations and gave ages ranging from 13 to 16 years, close to half (48.3%) of them were disqualified. This is because they failed to pass the FIFA/CAF grading system that used MRI to assess the level of fusion of the epiphyseal plate of their left wrists. Although it could be argued that because the players self-reported their ages, there could be some age falsification, however, their ages were confirmed with their passports. Therefore, the alarming rate of disqualification of Ghanaian players requires more normative studies among black Africans including Ghanaians to either confirm or make ethnic-sensitive adjustments to the current grading system which

has come under some criticism from disqualified players and some part of the scientific family/community. This will help to ascertain that the current MRI grading scale is not unduly disqualifying players, especially of Ghanaian origin. Hence, a normative study involving Ghanaian and other African nationals would be very helpful.

Conflict of interest

None.

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