

# Validation of Age Determination with Historical Events in Birnin Kebbi, Northwest Nigeria

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## Abstract

**Context:** Birth registration is not universal and remains elusive for some people living in developing countries, such as Nigeria; hence, age determination for healthcare and health-related research is often problematic. **Aims:** The aim is to validate the use of a historical events' scale as a tool for estimating the age of Nigerian adults residing in Birnin Kebbi, Northwest Nigeria. **Settings and Design:** A cross-sectional survey was conducted in Birnin Kebbi, a metropolitan capital city of Kebbi state, Northwest Nigeria, and included adults aged 18 years and older with a valid document indicating their year of birth. **Subjects and Methods:** Seven historical events comprising major national events were cross-referenced to the individual's personal history to estimate their ages, which were then compared to their documented ages. **Statistical Analysis Used:** Relationship of the documented and estimated ages was assessed with the Spearman's rank-order correlation and intraclass correlation coefficient (ICC) analyses. **Results:** A total of 288 subjects (63.2% males) with a mean documented age of  $34.5 \pm 11.3$  (range 18–75) years were surveyed. The mean estimated age was  $32.5 \pm 11.18$  years. Spearman's rank-order correlation analysis showed a statistically strong positive correlation between the actual and estimated ages ( $0.953, P < 0.001$ ). The ICC between documented and estimated ages was  $0.968$  (95% confidence interval =  $0.959-0.975$ ). **Conclusions:** The use of this tool in Nigerian adults provides a reasonably accurate age estimation. Its use in populations and communities with inadequate birth registration may improve the quality of age-related health data in Nigerian adults.

**Keywords:** Age determination, demography, epidemiology, Sub-Saharan Africa

## INTRODUCTION

Age, a key demographic variable, is a basic requirement in healthcare and health information systems for the purposes of proper medical records, clinical assessment, therapeutic formulation, and prognostic stratification. Age ascertainment is also pivotal for epidemiological surveys such as dementia and other neurodegenerative disorders.<sup>1</sup>

Although birth registration has a near-universal coverage in some parts of the world, it is not well adopted in many low- and middle-income countries.<sup>2-4</sup> Insufficient number of registration centers, lack of awareness of the importance of birth registration, ignorance and illiteracy, and poor access to maternity centers for women have been identified as limitations to birth registration in Nigeria.<sup>5</sup> As a result of poor registration of births and high illiteracy rates, age determination constitutes a significant obstacle in accurate documentation for clinical and research purposes in developing countries such as Nigeria.<sup>6</sup> National estimate in 2006 showed that less than a third of 5 million annual

births were registered in Nigeria. Urban areas had 50.3% birth registration while rural areas had only 21.2% birth registration.<sup>5</sup> On a global scale, almost 230 million children younger than 5 years do not have a birth certificate globally.<sup>7</sup>

Hence, alternative reliable and accurate age estimation methods are crucial for various legal and health-related matters. Some methods have been described which require relatively difficult and not readily accessed techniques such as dental radiographs.<sup>8</sup> However, a noninvasive, cheap, and easy-to-administer method has been the use of historical events for age determination, which have been shown to be both reliable and consistent.<sup>9,10</sup> The only

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published validated method in Nigeria – the Ajayi-Igun 1963 listing’s historical events are no longer relevant in contemporary times because the reference events are outdated. There was therefore a need for an up-to-date historical event scale that will be widely applicable and socially relevant in the Nigerian context for age estimation for individuals without appropriate birth documentation. To address this need, we proposed a new simple historical scale and validated this instrument to determine its test properties. Development, validation, and adoption into practice of a culturally relevant historical tool are likely to improve healthcare and health research needs.

## SUBJECTS AND METHODS

### Study population and sampling

This was a cross-sectional validation study carried out in Birnin Kebbi, the capital city of Kebbi state, and has an estimated population of 125,594. It is administratively divided into two local governments; this city has a majority Hausa and Fulani population.

Birnin Kebbi metropolis is made up of two local government areas (LGAs). Multistage sampling was employed. One of the LGAs, Birnin Kebbi North was selected. The wards were entered into a ballot and one ward was selected. Further, a sampling frame of one in two houses was utilized and all consenting adults were interviewed.

### Inclusion criteria

Consenting adults (at least 18 years as at last birthday) with birth certificate and/or declaration of age were included.

### Historical events used as a landmark

The historical events that served as markers were world wars, Nigerian independence, and deaths of Nigerian president, which are considered landmark events to Nigerians [Table 1].

Consenting subjects, with evidence of age documentation, were asked to indicate which event they best remembered. They were then presented with a list of 6 age categories that aptly described them at the occurrence of the historical event.

### Statistical analysis

The data were recorded on a designed pro forma and analyzed with SPSS software v20.0 (SPSS Inc., Chicago, IL, USA). The quantitative variables were expressed as means, standard deviations, and ranges. The qualitative variables were described as frequencies and percentages.

Spearman’s rank-order correlation was run to determine the relationship between the actual and estimated ages while the agreement between estimated and actual age was assessed by the intraclass correlation coefficient (ICC) with a 95% confidence interval (CI).

## RESULTS

### Characteristics of respondents

There were 288 study participants, i.e. 182 men and 106 women. The mean age was 34.5 ± 11.3 (range 18–75) years and young

people (<45 years) constituted majority of the study population [Table 2]. About half of the respondents had completed tertiary education while only 14.5% of the study population had either received primary or no formal education. This study sample had a varied ethnic composition although Hausa/Fulani comprised half of the population. Other major Nigerian ethnic groups such as Yoruba and Igbo were represented among participants.

### Agreement between actual and estimated ages of respondents

The mean documented age was 34.5 ± 11.3 (range 18–75) years while the mean estimated age was 32.5 ± 11.18 (range 16–76) years.

Spearman’s rank-order correlation analysis showed a strong positive correlation between the actual and estimated ages, which was statistically significant ( $r_s(8) = 0.953, P < 0.001$ ).

The intraclass correlation between actual and estimated age by the use of Nigerian historical landmarks was 0.968 (95% CI: 0.959–0.975), i.e., an excellent concordance [Table 3].

**Table 1: Historical events and indicator listing**

Which of these do you remember clearly?	
1914	World War 1
1945	World War 2
1960	Nigeria Independence
1966	First Coup (Assassination of Sardauna, Akintola, etc.)
1976	General Muritala assassination
1998	death of General Sani Abacha
2010	Death of President Musa Yaradua
Which of these describe you at the occurrence of the event?	
Child	2-5 years
Child	6-10 years
Adolescent	11-15 (prepubertal)
Adolescent	16-20 years (postpubertal)
Adult	21-25 years
Adult	26-30 years

**Table 2: Sociodemographic data of the study population**

Variables	Categories	n (%)
Sex	Males	182 (63.2)
	Females	106 (36.8)
Age document	Birth certificate	158 (54.9)
	Age declaration	130 (45.1)
Education	None/primary	43 (14.9)
	Secondary	110 (38.1)
	Tertiary/above	135 (46.8)
Cognitive screen	Incorrect	78 (27.0)
	Correct	210 (72.9)
Ethnicity	Hausa/Fulani	149 (51.7)
	Yoruba	43 (14.9)
	Igbo	14 (4.9)
	Others	82 (28.5)
Age group (years)	Young (10-44)	229 (79.5)
	Middle (45-64)	55 (19.1)
	Elderly (≥65)	4 (1.4)

**Table 3: Reliability analysis - Intra class correlation coefficient(ICC)**

Variables	ICC (95% CI)
Overall	0.968 (0.959-0.975)
Age (years)	
18-44	0.918 (0.894-0.937)
45-64	0.830 (0.699-0.907)
≥65	0.852 (-0.105-0.990)
Education	
None/primary	0.967 (0.939-0.982)
Secondary	0.884 (0.834-0.920)
Tertiary/above	0.974 (0.962-0.982)
Cognitive screen	
Correct	0.967 (0.957-0.975)
Incorrect	0.964 (0.942-0.978)

CI – Confidence interval

In the subgroup analyses, the ICC between actual and estimated age was also excellent for younger respondents (0.918, 95% CI: 0.894–0.937) compared to older subjects while education and response to cognitive screening questions did not appear to have any significant impact on ICC.

## DISCUSSION

This study showed that the use of Nigerian historical events for age estimation in Birnin Kebbi adult residents closely correlates with documented ages. It also represents a contextually relevant update to the Ajayi-Igun listing. Furthermore, larger sample size and community-based setting of this work lend credence to its real-life applicability.

A similar study conducted in Benin enrolled only elderly subjects while this study included all adults eligible.<sup>10</sup> Due to the pyramidal population structure of developing countries such as Nigeria, the elderly subgroup in this study was rather small. In spite of this, the ICC within the elderly population suggested an excellent agreement between actual and estimated age (ICC 0.852, 95% CI: -0.105–0.990).

Recall of events is a test of an individual’s intellect and cognitive function: memory domain; thus, we employed two screening questions from Montreal cognitive assessment which assessed other domains: calculation and abstract reasoning.<sup>11</sup> This was done to observe the impact of below-average intellectual capability or subclinical cognitive dysfunction. The ICC in subjects who responded appropriately to the two screening questions was identical to those who got one or both questions wrong (0.967 vs. 0.964). This implies an excellent performance and acceptability of this tool across varying intellectual capabilities and cognitive functioning. A review

of the ICC scores across varying educational attainments also reiterates the fairly uniform performance in subgroups with none or basic education (0.967, 95% CI: 0.939–0.982) and tertiary/posttertiary education (0.974, 95% CI: 0.962–0.982).

## CONCLUSIONS

The use of this tool in Nigerian adults provides a reasonably accurate means of age estimation. Its use in populations and communities with inadequate birth registration may improve the quality of age-related health data and age-dependent research findings in Nigerian adult populations.

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## Conflicts of interest

There are no conflicts of interest.

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