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Reliability and Availability of Secondary Forensic Identification Markers in Ibadan, Nigeria

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Abstract

Human identification is essential in forensic science, particularly in medico-legal investigations and disaster victim identification (DVI). Primary identifiers including DNA, fingerprints and dental records are highly reliable, while secondary identifiers such as scars, tribal marks, surgical history amongst others, complement evidence when primary identifiers are compromised or unavailable. However, evidence regarding their availability and forensic usefulness among Ibadan population remains limited. This study assessed the availability, reliability and forensic usefulness of secondary identification markers among adults in Ibadan, Oyo State, Nigeria. A cross-sectional descriptive study was conducted among 422 adults aged 18 years and above. Data were collected using the Secondary Forensic Identification Markers Questionnaire (SFIMQ), supplemented by physical examination. Written informed consent was obtained before participation. Assessment focused on the presence, anatomical location and distinguishing characteristics of visible markers, alongside self-reported secondary identifiers. Self-reported information was compared with examiner observations where verification was possible. The Secondary Identifier Availability Score (SIAS) and Forensic Distinctiveness Index (FDI) assessed marker availability and potential forensic usefulness. Data were analysed using descriptive and inferential statistics with statistical significance set at $p < 0.05$. Permanent scars were the most prevalent marker (41.5%), followed by surgical history (22.5%), birthmarks (17.8%), tattoos (13.0%) and tribal marks (9.5%). Agreement between self-report and examiner verification was almost perfect for scars ($\kappa = 0.975$) and surgical history ($\kappa = 0.932$) and substantial for birthmarks ($\kappa = 0.639$). The SIAS demonstrated good internal consistency (Cronbach's $\alpha = 0.766$). Sex was significantly associated with scars, tattoos and tribal marks; however, age, sex, ethnicity and occupation were not independent predictors of overall forensic usefulness. The study concludes that permanent scars and surgically acquired anatomical characteristics are valuable secondary identification markers. Routine documentation in healthcare and medico-legal records is recommended to strengthen human identification and DVI capacity in Nigeria.

Keywords: Forensic; Scars; Identification; Ibadan; Markers

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Abbreviations

DVI: Disaster Victim Identification; AM: Ante-Mortem; PM: Post-Mortem; SIAS: Secondary Identifier Availability Score; FDI: Forensic Distinctiveness Index; SFIMQ: Secondary Forensic Identification Markers Questionnaire.

Introduction

Human identification is a central component of forensic science and is essential in medico-legal investigations, missing-person cases, unidentified human remains and disaster victim identification (DVI). In DVI operations, identification is undertaken through the systematic comparison and reconciliation of ante-mortem (AM) information concerning a missing person with post-mortem (PM) findings obtained from recovered remains. The International Criminal Police Organization (INTERPOL) identifies friction ridge analysis, forensic odontology and DNA analysis as the primary methods of identification because of their established scientific reliability and capacity to provide positive identification when suitable comparative material is available [1].

The availability and performance of these primary methods, however, may be affected by circumstances surrounding death and recovery. Severe thermal injury, decomposition, fragmentation, commingling and other forms of post-mortem alteration can compromise particular anatomical structures or make conventional comparisons difficult. In addition, successful comparison requires appropriate ante-mortem reference information. Where such information is unavailable, incomplete or difficult to retrieve, the identification process may be delayed even when potentially informative characteristics are present on the remains [2,3].

These circumstances have sustained interest in so-called secondary or non-primary identifiers. They include physical, anatomical, medical and personal characteristics such as scars, tattoos, birthmarks, surgical alterations, medical implants and other distinctive morphological features. INTERPOL's DVI framework includes physical indications such as tattoos, scars and surgical implants among information that may be collected during post-mortem examination and compared with ante-mortem information [1]. Importantly, contemporary forensic literature has questioned the assumption that the term "secondary" necessarily denotes low evidential value. Blau, et al. [2] argue that non-primary identifiers can contribute substantially to the development of identification hypotheses, particularly when interpreted in combination with other available evidence and within the context of the victim population. Their evidential contribution therefore depends not simply on whether a characteristic is classified as primary or secondary, but on its population frequency, specificity, quality of documentation, persistence and concordance with other evidence.

The forensic usefulness of a secondary identifier can consequently be considered in terms of availability, reliability and distinctiveness. Availability concerns whether a characteristic is present and whether useful ante-mortem information about it exists. Reliability concerns the consistency with which the characteristic can be described, documented and recognized during comparison. Distinctiveness concerns the extent to which the characteristic, alone or in combination with other characteristics, helps differentiate one individual from others. These dimensions are important because prevalence alone does not establish forensic value. A characteristic may occur frequently within a population but contribute relatively little individualizing information, whereas an uncommon feature or combination of features may provide greater discriminatory value [2]. Contemporary forensic anthropology similarly emphasizes the integration of multiple lines of evidence rather than dependence on a single morphological characteristic [3].

Permanent scars illustrate this distinction. Scars resulting from trauma, burns or surgical procedures may persist for long periods and can provide useful information about an individual's previous injuries or medical history. Their value, however, depends on characteristics such as anatomical location, morphology, size and the availability of a sufficiently detailed ante-mortem description or clinical record. Similarly, surgically acquired alterations may be particularly informative where they can be linked to medical records, radiographs or other documented clinical information. Recent forensic case literature has demonstrated how ante-mortem trauma, pathological changes and implanted medical devices can contribute to identification when evaluated together with other points of concordance [4].

Other physical characteristics may also provide useful complementary information. Tattoos, for example, can contain highly variable combinations of images, text, colour, anatomical location and design features. Recent work has emphasized the importance of systematic tattoo documentation and standardized coding to improve the usefulness of these characteristics during comparisons [5,6]. Likewise, facial nevi and other minor skin features have been investigated using frequency and spatial-distribution approaches, with recent evidence suggesting that particular combinations of features may possess useful discriminatory information, although their practical forensic validity requires further validation [7].

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The importance of population-specific evidence is particularly relevant to forensic identification. Anatomical characteristics and their frequencies may vary between populations, while cultural practices can influence the occurrence of particular acquired physical features. Research in Nigeria, for example, has demonstrated population-related variation in anatomical characteristics with potential forensic applications. Fakorede, et al. [8] reported differences in ear morphology and morphometry among Hausa, Igbo and Yoruba populations, illustrating the importance of generating empirical forensic data within African populations rather than assuming that findings from other populations are directly transferable.

Nigeria also presents important operational considerations for human identification. DVI investigations require the collection, preservation and reconciliation of both ante-mortem and post-mortem information, and the quality of this process is influenced by the availability of reliable records and forensic infrastructure. INTERPOL emphasizes that all available AM and PM information should be collected and documented because the characteristics recoverable from remains and the information available for comparison cannot always be predicted in advance [1]. Consequently, systematic documentation of physical and medical characteristics during life may have value beyond routine clinical care by creating potentially useful ante-mortem information for future identification.

Despite the recognized contribution of non-primary identifiers to forensic investigations, empirical evidence concerning their population-level availability and reporting reliability in Nigeria remains limited. In particular, there is insufficient evidence describing how frequently different secondary identification markers occur among community-dwelling Nigerian adults and how consistently reported characteristics correspond with examiner verification. This gap is important because the usefulness of a marker during a forensic investigation depends not only on whether the feature exists, but also on whether it can be reliably described and subsequently recognized during comparison.

Ibadan provides an appropriate setting for such an investigation because of its large and heterogeneous urban population and its concentration of healthcare, educational and occupational communities. Generating local evidence on secondary identification markers can provide a baseline against which ante-mortem information may be interpreted and can help identify characteristics that warrant more systematic documentation.

Accordingly, this study assessed the availability, reliability and forensic usefulness of secondary forensic identification markers among adult residents of Ibadan, Oyo State, Nigeria. Specifically, the study examined the prevalence of selected anatomical and medically acquired markers, evaluated agreement between participant-reported and examiner-verified characteristics, assessed their distribution using the Secondary Identifier Availability Score (SIAS) and Forensic Distinctiveness Index (FDI), and examined whether selected socio-demographic characteristics were associated with their forensic usefulness.

Materials and Methods

Study Design and Setting

This was a community-based cross-sectional descriptive analytical study conducted among adults in selected communities within Ibadan, Oyo State, Nigeria. Recruitment occurred in areas around Challenge (Oluyole LGA), Alao-Akala (Egbeda LGA), and Sango (Ibadan North LGA), including accessible higher institutions, healthcare facilities, and surrounding communities.

Study Population and Sample Size

The intended study population comprised Nigerian adults aged 18–60 years who were resident, studying, or working within the selected study areas. The minimum sample size was calculated using the single-population proportion formula with a 95% confidence level, 5% precision, and a conservative prevalence estimate of 50%, yielding 384 participants. A 10% allowance for non-response produced a target of 422 participants, and 422 respondents were analysed.

Sampling and Eligibility

A multistage approach combining purposive and convenience recruitment was used. Selected locations were purposively identified based on accessibility, population diversity, and feasibility. Eligible participants were enrolled through convenience sampling until the required sample was reached. The supplied draft also describes nomination of a next-of-kin or close associate for proxy reporting; however, the results presented primarily report self-report/examiner-verification analyses. Next-of-kin analyses should therefore be retained only if the underlying dataset and statistical output support them.

Research Instrument

Data were collected using the Secondary Forensic Identification Markers Questionnaire (SFIMQ), developed for the study. It contained sections covering socio-demographic characteristics; visible physical markers; medical and surgical identifiers; cultural and personal identifiers; reported identification information; proxy reporting; and examiner

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verification. Response formats included dichotomous, categorical, and checklist items.

Validity and Reliability

Content and face validity were established through expert review and pilot testing. The draft reports that approximately 10% of the calculated sample size was used for pilot testing in a population similar to, but separate from, the main study population. Internal consistency was assessed using Cronbach's alpha, while agreement between reported information and examiner verification was assessed using Cohen's kappa.

Data Collection and Examiner Verification

After informed consent, participants completed the SFIMQ under supervision of the research team. Observable physical markers were subsequently assessed by the researcher through non-invasive examination in a private setting. Completed instruments were checked for completeness before coding and data entry.

Variables and Study-Specific Indices

Markers assessed included permanent scars, history of surgery, birthmarks, tattoos, tribal marks, limb deformity/body asymmetry, noticeable gait abnormality, fractures with residual deformity, amputations, permanent jewellery, and other distinguishing anatomical characteristics. The Secondary Identifier Availability Score (SIAS) was used as a composite measure of marker availability. The Forensic Distinctiveness Index (FDI) was used as a study-specific measure of relative distinctiveness. These indices are exploratory study measures and are not substitutes for established positive identification methods.

Statistical Analysis

Data were coded, cleaned, and analysed using IBM SPSS Statistics. Descriptive statistics included frequencies, percentages, means, and standard deviations. Prevalence estimates were reported with 95% confidence intervals where available. Agreement between reported information and examiner verification was assessed using Cohen's kappa. Chi-square tests examined associations between categorical socio-demographic variables and selected markers. Binary logistic regression examined socio-demographic predictors of high forensic usefulness. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained (LCU/FBMHS/ANA/REC/2026/051) from the Departmental Committee on Human Research, Department of Anatomy, Lead City University, Ibadan, Nigeria, before data collection. Permission was obtained from relevant community authorities. Participation was voluntary and based on written informed consent. Confidentiality and privacy were maintained, and physical verification was conducted non-invasively in private settings.

Results

Socio-Demographic Characteristics

A total of 422 respondents were analysed. Most respondents were aged 18–25 years (66.1%), followed by those aged above 35 years (23.7%) and those aged 25–35 years (10.2%). Females constituted 58.1% of respondents, Yoruba respondents 83.6%, and students 56.6%. The mean age reported in the study materials was 26.8 ± 9.4 years.

Characteristics	n	%
18–25 years	279	66
25–35 years	43	10
Above 35 years	100	24
Male	172	41
Female	245	58
Prefer not to say	5	1.2
Yoruba	353	84
Igbo	48	11
Hausa	16	3.8
No response	5	1.2
Student	239	57
Self-employed	80	19
Civil servant	53	13
Healthcare worker	50	12

Table 1: Socio-demographic characteristics of respondents (n = 422).

Prevalence of Secondary Forensic Identification Markers

Permanent scars were the most prevalent assessed marker (41.5%; 95% CI: 36.9–46.2), followed by history of surgery (22.5%; 95% CI: 18.8–26.7), birthmarks (17.8%; 95% CI: 14.4–21.7), and tattoos (13.0%; 95% CI: 10.2–16.6). Limb deformity/body asymmetry and noticeable gait abnormality were each reported at 13.0%. Tribal marks were present in 9.5%. Fractures with residual deformity, amputations, and permanent jewellery were described as

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relatively uncommon, but their exact frequencies are not provided in the current draft.

Marker	Prevalence (%)	95% CI
Permanent scars	41.5	36.9–46.2
History of surgery	22.5	18.8–26.7
Birthmarks	17.8	14.4–21.7
Tattoos	13	10.2–16.6
Limb deformity/ body asymmetry	13	Not reported
Noticeable gait abnormality	13	Not reported
Tribal marks	9.5	Not reported
Fracture with residual deformity	Relatively uncommon	Not reported
Amputation	Relatively uncommon	Not reported
Permanent jewellery	Relatively uncommon	Not reported

Table 2: Prevalence of selected secondary forensic identification markers.

Reliability of Selected Markers

Agreement between reported information and examiner verification was almost perfect for permanent scars and surgical history. Permanent scars showed 98.8% agreement with Cohen's κ = 0.975; surgical history showed 97.6% agreement with κ = 0.932; and birthmarks showed 90.1% agreement with κ = 0.639, indicating substantial agreement.

Marker	Agreement (%)	Cohen's κ	Interpretation
Permanent scars	98.8	0.975	Almost perfect
Surgical history	97.6	0.932	Almost perfect
Birthmarks	90.1	0.639	Substantial

Table 3: Agreement between participant report and examiner verification for selected markers.

SIAS and FDI

The SIAS distribution showed that 264 respondents (62.6%) were classified as low, 131 (31.0%) as moderate, and 27 (6.4%) as high; none were classified as very high. The SIAS demonstrated good internal consistency (Cronbach's α = 0.766). For the FDI, 320 respondents (75.8%) were classified as low, 87 (20.6%) as moderate, and 15 (3.6%) as high.

SIAS category	n	%
Low	**264**	**63**
Moderate	**131**	**31**
High	**27**	**6.4**
Very high	**0**	**0**
FDI category	**n**	**%**
Low	**320**	**76**
Moderate	**87**	**21**
High	**15**	**3.6**

Table 4: Distribution of Secondary Identifier Availability Score and Forensic Distinctiveness Index.

Associations Between Sex and Selected Markers

Sex was significantly associated with permanent scars (χ^2 = 11.12, p = 0.004), tattoos (χ^2 = 48.46, p < 0.001), and tribal marks (χ^2 = 21.55, p < 0.001). Associations were not statistically significant for birthmarks (χ^2 = 3.48, p = 0.176) or history of surgery (χ^2 = 3.16, p = 0.205).

Association	χ^2	p-value	Interpretation
Sex × Permanent scars	11.1	0.004	Significant
Sex × Tattoos	48.5	<0.001	Significant
Sex × Birthmarks	3.48	0.176	Not significant
Sex × History of surgery	3.16	0.205	Not significant
Sex × Tribal marks	21.6	<0.001	Significant

Table 5: Associations between sex and selected secondary forensic identification markers.

Binary Logistic Regression

The reported binary logistic regression model found no statistically significant independent predictors of high forensic usefulness among the socio-demographic variables examined. Available estimates were: male sex, adjusted OR 0.74 (95% CI 0.35–1.53; p = 0.412); age 25–35 years, adjusted OR 2.16 (95% CI 0.66–7.13; p = 0.204); and age above 35 years, adjusted OR 1.76 (95% CI 0.60–5.13; p = 0.300). Complete estimates for ethnicity and occupation should be retrieved from the original SPSS output before submission.

Predictor	Adjusted OR	95% CI	p-value
Male sex	0.74	0.35–1.53	0.412
Age 25–35 years	2.16	0.66–7.13	0.204
Age >35 years	1.76	0.60–5.13	0.3

Table 6: Binary logistic regression of socio-demographic predictors of high forensic usefulness.

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Discussion

The principal findings of this study indicate that secondary forensic identification markers are relatively common among adults in Ibadan, but their forensic usefulness cannot be inferred from prevalence alone. Permanent scars were the most frequently observed marker, followed by surgical history, birthmarks and tattoos, while most participants had low Secondary Identifier Availability Scores (SIAS) and low Forensic Distinctiveness Index (FDI) scores. This distinction between availability and discriminatory value is consistent with contemporary forensic scholarship, which challenges the assumption that non-primary identifiers are inherently weak and emphasises that their evidential value depends on the circumstances of the case, the victim population and the characteristics being assessed [2]. Thus, the present findings support a contextual approach in which secondary identifiers are considered according to their permanence, reliability, morphology, anatomical location, documentation and relationship with other available evidence [2,3].

Permanent scars were present in 41.5% of respondents, making them the most prevalent assessed marker. This finding is consistent with evidence that acquired body marks are sufficiently common to have practical forensic relevance when systematically documented [9]. Kulshreshtha, et al. [9] in their study of acquired body marks in an Indian population, demonstrated considerable variation in the occurrence and distribution of scars, tattoos and other acquired characteristics and highlighted their potential contribution to forensic identification. However, prevalence alone does not establish individualising value. A scar described simply as being "present" provides substantially less information than one documented according to anatomical location, laterality, shape, orientation, dimensions, colour, texture and associated clinical history. The present finding therefore supports systematic documentation of scars primarily because of their availability, rather than because scars in isolation can establish identity.

The high agreement observed for permanent scars strengthens this argument. The 98.8% agreement and κ = 0.975 indicate almost perfect agreement between participant report and examiner verification within this living sample. This should, however, be interpreted as agreement between two information sources rather than as a measure of forensic identification accuracy. In actual DVI investigations, scars may be obscured or altered by decomposition, burning, trauma, fragmentation or post-mortem treatment, while ante-mortem records may provide incomplete descriptions. The importance of combining such information was demonstrated by Gunawardena, et al. [10] following the Meethotamulla disaster in Sri Lanka, where limitations in ante-mortem data and resources constrained the use of primary identifiers, and identification was achieved through combinations of secondary characteristics, including scars, tattoos, jewellery, morphological descriptions and circumstantial evidence. This experience illustrates that the practical value of scars is greatest when they form part of a structured combination of evidence rather than being interpreted as isolated observations [10].

History of surgery was reported by 22.5% of respondents and showed 97.6% agreement with examiner verification (κ = 0.932). Surgically acquired characteristics may provide particularly useful forensic information because an observed anatomical alteration can potentially be linked to a documented medical history, operative procedure, implant or radiological finding. Evidence from Japan supports this potential. Following the 2011 East Japan earthquake and tsunami, Numata, et al. [11] demonstrated that surgical histories and orthopaedic implants could contribute to identification, although the usefulness of such evidence could be affected by post-mortem processes, including cremation. Orthopaedic implants may be particularly informative when implant characteristics, serial numbers, fixation patterns or associated medical records can be compared with ante-mortem information [11]. These findings support the inclusion of surgical history within structured forensic documentation while emphasising that its evidential strength depends on the specificity and accessibility of associated medical records.

Birthmarks were present in 17.8% of respondents and demonstrated substantial agreement between participant report and examiner verification (90.1%; κ = 0.639). The lower agreement compared with scars and surgical history may reflect the greater subjectivity involved in recognising and describing some cutaneous features. Nevertheless, contemporary research demonstrates that the forensic value of such characteristics can increase considerably when their number, size and anatomical position are systematically recorded. Cappella, et al. [7] using three-dimensional facial models from 1,039 Italian individuals, showed that patterns of facial pigmented skin lesions could be described according to their frequency and anatomical distribution and that combinations of characteristics could provide potentially informative evidence for personal identification. Importantly, the authors described their approach as preliminary and cautioned against direct application to real forensic cases without further validation [7]. Similarly, Black, et al. [12] demonstrated that the incidence and anatomical distribution of melanocytic nevi could contribute to forensic image comparison. These studies explain why the 17.8% prevalence observed in the present study should not be interpreted as a direct measure of forensic value. More detailed morphological information would be required to determine how distinctive individual birthmark patterns are

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within the Nigerian population.

Tattoos were present in 13.0% of respondents. This finding is particularly relevant in the context of recent African forensic evidence. Keyes, et al. [13] examining 634 unidentified decedents in Johannesburg, South Africa, reported tattoos in 20% of cases and found that many tattooed individuals had multiple tattoos, with the arms representing an important anatomical location. The authors emphasised the forensic importance of documenting and classifying tattoos in unidentified decedents [13]. The higher prevalence in the Johannesburg study should not, however, be interpreted as a direct population difference because the studies involved fundamentally different populations: the present investigation involved living community adults, whereas the South African study involved unidentified decedents processed through a medico-legal system. Nevertheless, both studies demonstrate that the forensic value of tattoos extends beyond their mere presence. Precise documentation of location, design, dimensions, colour, wording, symbols and photographic appearance can make tattoos more useful for comparison with ante-mortem information [13]. The significant association between sex and tattoos observed in the present study is also broadly compatible with evidence of sex-related variation in acquired body marks reported by Kulshreshtha, et al. [9] although the present cross-sectional design does not permit causal interpretation.

Tribal marks were identified in 9.5% of respondents. Their lower prevalence compared with scars does not necessarily indicate lower forensic usefulness because the evidential value of scarification depends substantially on pattern, anatomical distribution and morphology. Contemporary forensic literature emphasises the importance of population-specific reference information when assessing morphological characteristics because frequencies and patterns may vary between populations [2,3]. This is particularly relevant in Nigeria, where culturally patterned anatomical characteristics may differ across ethnic groups. Fakorede, et al. [8] for example, demonstrated the importance of population-specific anatomical data in evaluating potential forensic identification characteristics among Nigerian populations. The present study did not undertake detailed morphological classification of tribal marks; therefore, the observed prevalence should be interpreted as evidence of availability rather than as a direct estimate of discriminatory power.

The significant associations between sex and permanent scars, tattoos and tribal marks, alongside the absence of significant associations for birthmarks and surgical history, further demonstrate that individual markers may have different population distributions. Similar sex-related variation in acquired body marks has been reported elsewhere [9]. However, the absence of significant independent effects of sex and the examined age categories on overall forensic usefulness in the adjusted regression analysis suggests that demographic variables alone are inadequate predictors of an individual's combined forensic distinctiveness. This is consistent with the broader forensic principle that identification depends on the total evidential profile rather than on demographic characteristics considered in isolation [2,3].

The SIAS and FDI findings provide an important contribution by separating the concepts of availability and distinctiveness. Although secondary identifiers were common, 62.6% of participants had low SIAS scores and 75.8% had low FDI scores, while only 3.6% had high FDI scores. These findings reinforce the argument that possessing several secondary characteristics does not automatically produce a highly distinctive identification profile. [2] similarly argued that the evidential value of non-primary identifiers depends on context and victim population rather than on a universal hierarchy of identifiers. Cappella, et al. [7] provide an empirical illustration of this principle: the presence of facial pigmented lesions was not itself sufficient to establish strong individualisation, but combinations involving their number, size and anatomical position generated potentially more informative patterns. Future Nigerian studies should therefore move beyond simple presence-or-absence recording towards structured morphological descriptions and probabilistic evaluation of combinations of characteristics [7,2].

The reliability findings also require careful methodological interpretation. The high kappa coefficients for scars and surgical history demonstrate close correspondence between participant reports and examiner observations in the present living population, but they cannot be interpreted as evidence that these markers would maintain equivalent visibility or reliability in post-mortem circumstances. Actual DVI environments may involve decomposition, burning, fragmentation, commingling and incomplete ante-mortem information, all of which can affect secondary identifiers [10]. Evidence from South Africa further illustrates the continuing importance of integrating secondary information within a broader identification system. Keyes, et al. [14] reporting on a South African Human Decedent Identification Unit, showed that systematic identification services can achieve positive identifications while continuing to rely heavily on primary methods such as fingerprinting. This supports the view that secondary identifiers should complement rather than replace DNA, fingerprints and dental evidence [2,14].

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The Cronbach's alpha of 0.766 for the SIAS provides preliminary evidence of internal consistency, but it should not be interpreted as proof that the heterogeneous physical characteristics included in the index represent a single underlying construct. Scars, tattoos, birthmarks, surgical alterations and gait abnormalities have different biological and forensic properties. Cronbach's alpha evaluates consistency among measured items but does not establish construct validity or demonstrate that the index accurately measures forensic identification performance [15]. Accordingly, the SIAS and FDI should be regarded as exploratory, study-specific indices. Future research should assess their criterion validity against actual identification outcomes, inter-rater reliability across independent examiners, test-retest reliability and the discriminatory performance of combinations of markers.

The practical implications are particularly important in Nigeria, where ante-mortem medical information may be distributed across hospitals, clinics and personal records. Kolude, et al. [16] writing from Ibadan, emphasised the importance of preparedness, standardised DVI procedures, training and accessible ante-mortem information for disaster victim identification. The present findings extend this principle to the systematic documentation of secondary anatomical and medical identifiers. Clinical records should, where appropriate, document the anatomical site, laterality, morphology and dimensions of scars, tattoos, birthmarks, tribal marks and other distinctive features, while surgical histories should be linked to relevant operative and imaging records. Such documentation can convert otherwise informal personal characteristics into structured ante-mortem information that may support candidate generation and corroboration during medico-legal investigations [2,16].

Overall, the findings demonstrate that secondary forensic identification markers are neither uniformly weak nor automatically individualising. Evidence from South Africa, Sri Lanka, Japan, Italy and other forensic settings similarly indicates that non-primary characteristics may become useful when they are persistent, adequately documented, sufficiently specific and interpreted in combination with other evidence [2,7,10,11,13]. The central implication is therefore not that secondary identifiers should replace primary identification methods, but that they should be systematically documented and appropriately integrated into multidisciplinary identification workflows. For Nigeria, improving ante-mortem documentation of scars, tattoos, birthmarks, tribal marks, surgical alterations and other distinctive anatomical characteristics could strengthen the information available for candidate generation and corroboration during unidentified-person investigations and DVI operations.

Strengths and Limitations

Strengths of the study include the community-based design, inclusion of 422 adults, assessment of multiple categories of secondary identification markers, direct examiner verification of selected features, and use of quantitative agreement statistics. The study also makes an explicit conceptual distinction between marker availability and distinctiveness through the SIAS and FDI.

Several limitations should be considered. The study was conducted in selected communities in Ibadan and therefore may not represent the wider Nigerian population. Its cross-sectional design precludes assessment of changes in markers over time. Some information relied on participant report, while rare markers had limited frequencies for inferential analysis. Most importantly, the study was conducted among living participants and did not test the markers in actual post-mortem, missing-person or DVI cases. The SIAS and FDI are study-specific exploratory measures and require external validation before use in forensic decision-making.

Conclusion

Permanent scars were the most prevalent assessed secondary forensic identification marker, followed by surgical history, birthmarks and tattoos. Permanent scars and surgical history demonstrated almost perfect agreement between participant report and examiner verification, while birthmarks demonstrated substantial agreement. The findings also show that availability should not be equated with forensic distinctiveness: most respondents had low SIAS and FDI classifications, indicating that common markers may require detailed description and combination with other evidence to achieve meaningful discriminatory value. Secondary identifiers should therefore be treated as complementary components of a multidisciplinary identification process. Strengthening the routine documentation of anatomical, surgical and other persistent personal characteristics in Nigerian healthcare and medico-legal systems could improve the ante-mortem information available for human identification and DVI.

Conflict of Interest

The authors declare no conflict of interest.

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