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Bruise Ascertainment and Documentation in People With Darker Skin Tones Exposed to Violence: A Scoping Review

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Abstract

Bruising is among the most common physical consequences of violence and a critical form of injury evidence in health, child protection, and criminal justice contexts. Yet for survivors with darker skin tones, bruises are measurably harder to detect and act upon. This disparity has received insufficient research attention but has significant consequences for health, protection, and access to justice. This scoping review mapped the available evidence on bruise ascertainment and documentation in people with darker skin tones exposed to violence, drawing on 21 studies published between 1995 and 2024 across clinical, forensic, and investigative settings. Findings confirm that chromatic contrast between bruised and unbruised tissue decreases at higher melanin levels, rendering standard white-light visual examination unreliable. Alternate light source imaging, cross-polarised photography, and infrared techniques significantly improve detection, yet have not been evaluated in real-world settings with survivor populations. Validated assessment tools, including the Bruise Visibility Scale and TEN-4-FACEsp, have not been comprehensively established across skin tones and remain underused in routine practice. Racially and ethnically minoritised survivors face compounded barriers to disclosure and documentation, and inadequate injury evidence has consequences for charging decisions, prosecution outcomes, and sentencing. Police officers appear significantly less likely to identify injuries in Black survivors, and documentation failures reproduce existing inequalities in health and justice. The review identifies critical gaps in practitioner training, interagency protocols, and only limited real-world evaluation of available technologies. A coordinated programme of primary research, including development and evaluation of a complex intervention co-designed with survivors and practitioners, is urgently needed to address these systemic disparities.

Keywords

bruise, contusion, violence, documentation, survivor, abuse, harm, ethnic minority, trauma, assault, skin tone

Introduction

Bruising is a routine marker of physical abuse and interpersonal violence in adults and children (Royal College of Paediatrics and Child Health, 2020; Ziminski et al., 2013), yet its recognition is shaped by unequal social and institutional conditions. Where skin pigmentation is greater, the vascular changes responsible for bruising may be less apparent on visual examination, because melanin in the epidermis attenuates the transmission of reflected light in ways that reduce surface colour contrast (Deutsch et al., 2017; Santiago et al., 2022; Tyr et al., 2024). For practitioners working under time pressure and with incomplete information, this creates an under-acknowledged challenge: injury may be present but not immediately visible, and the absence of visible injury may be misread as an absence of harm. Across health care, adult and child protection, police, and forensic practice, visible injury

often carries disproportionate weight in assessments of credibility, decisions about safety and welfare, and initial and ongoing clinical and investigative responses (Douglas et al., 1997; Grady et al., 2018). Bruising is therefore not only a

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clinical symptom but part of the evidential infrastructure through which violence is recognised and responded to in practice.

This has implications for racially and ethnically minoritised survivors with darker skin tones. The reduced visibility of bruising in this population is not a neutral problem of observation. It reflects broader epistemic conditions in which some accounts of harm are more readily recognised than others because the injury does not conform to normative expectations of what violence should look like (Fricker, 2007). Where harm is not documented, initial and ongoing health care decisions, safety assessments, and legal responses are all shaped by an incomplete record. The consequences can be significant: violence tends to escalate over time (Kennedy et al., 2023), and missed injury at the point of first contact is not merely a documentation failure but a mechanism through which harm may go unrecognised, and institutional responses and protection may be delayed or withheld.

Those exposed to violence already encounter significant barriers, including stigma, fear for personal safety, mistrust of services, limited awareness of available support, and institutional obstacles (Cuerden & Blakemore, 2020; Hamilton et al., 2025; Keeling & Fisher, 2014; Peckover, 2003; Robinson & Spilsbury, 2008). These barriers are exacerbated for racially and ethnically minoritised communities (Thiara & Roy, 2020). Survivors from these communities may experience institutional mistrust that generalises from law enforcement to health care practitioners, encounter expectations of self-reliance in relation to mental health and help-seeking, and face post-injury symptoms including depression, post-traumatic stress disorder, and ongoing safety concerns that further impede engagement with services (Liebschutz et al., 2010; Lipsky et al., 2006). For women and girls, additional barriers include cultural gender role expectations, including those associated with the Strong Black Woman schema, which frames resilience as the expected response to adversity and can discourage disclosure (Thomas et al., 2022). The adultification of Black girls, whereby their right to protection is implicitly undermined, can further negatively affect wellbeing and introduce bias within child protection and safeguarding (Brissett et al., 2025; Davis, 2022). When harm goes undocumented, these existing inequities may be further compounded, deepening health and justice inequality for survivors already navigating the intersecting barriers, potentially rendering them even more invisible within the systems designed to protect them (Bernard & Gupta, 2008; Chantler et al., 2023; Sanchez et al., 2024; Walby et al., 2010; Widanaralalage et al., 2024).

These patterns are consequential in cases involving non-fatal strangulation (NFS), a common form of violence against women and girls in which bruising and petechiae can be the only signs of injury despite significant internal harm (Institute for Addressing Strangulation, 2023; Sorenson et al., 2014). Poor ascertainment of injury in strangulation cases has implications for safety: prior NFS is a known predictor of subsequent intimate partner homicide (Kennedy et al., 2023), and

the health consequences include neurological injury that may not be initially apparent (Bichard et al., 2022; Victoire et al., 2022). The challenge of detecting injury in individuals with darker skin tones adds a further layer of risk in this context.

Despite the importance of equitable injury documentation, research and professional guidance have not adequately addressed the specific challenges posed by bruise ascertainment across skin tones. Studies concerned with bruising predominantly focus on individuals with lighter skin tones (Thavarajah et al., 2012), and clinical and forensic reference materials disproportionately illustrate presentations in lighter-skinned populations (Diao & Adamson, 2022; Ji-Xu et al., 2023; Long et al., 2023; Mukwende et al., 2020; Sagoo et al., 2021). Systematic reviews evaluating bruising in suspected child abuse find that presentation across ethnic groups is insufficiently described in the existing literature (Royal College of Paediatrics and Child Health, 2020). Guidance for documenting bruising in survivors of violence, where it exists, does not consistently address the needs of those with darker skin tones (Anderson, 2024; Institute for Addressing Strangulation, 2024). The result is significant gaps in practitioner knowledge, inconsistent implementation of available guidance, and poor-quality documentation overall, with systemic consequences for the ascertainment of harm, provision of follow-up care, and access to justice for racially and ethnically minoritised survivors (Brady et al., 2023; Donaldson et al., 2023; Francis, 2023).

Taken together, these conditions constitute evidential inequality: a structural situation in which the recognition of, and institutional response to, violence depends partly on what is visible and recordable. For racially and ethnically minoritised survivors with darker skin tones, this means that the threshold for being believed, protected, and supported is effectively higher, not because their experiences differ, but because the systems designed to recognise harm are not designed with them in mind. Addressing this requires both technical improvements in injury documentation and structural change in the training, guidance, and institutional practices through which harm is recognised and acted upon. However, no synthesis of the existing evidence exists to map what is currently known, identify where the gaps are greatest, and inform the development of equitable practice.

This scoping review addresses three interrelated questions: (1) what methods and technologies are currently used to ascertain and document bruising associated with violence in individuals with darker skin tones, and what is known about their effectiveness; (2) what barriers do practitioners face in detecting and documenting bruising in this population, and what structural and institutional factors shape those barriers; (3) what are the consequences of inadequate bruise documentation for survivor safety, access to health care, and access to justice. The findings are intended to map the current evidence base, identify gaps in research and guidance, and inform the development of professional training, policy, and practice, with relevance to the design of complex interventions aimed at improving equitable injury documentation in frontline practice settings.

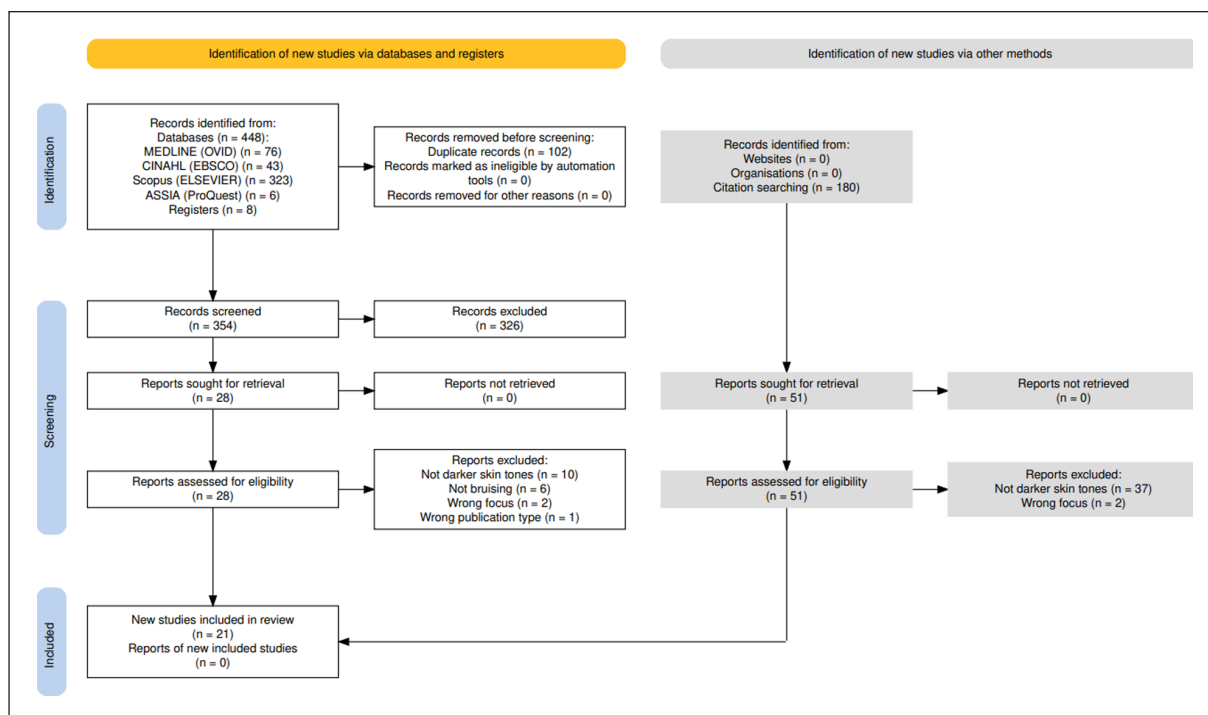


Figure 1. PRISMA-ScR flow diagram illustrating the study selection process.

Methods

This scoping review was conducted in accordance with the JBI methodology for scoping reviews (Peters et al., 2020) and reported in line with the PRISMA-ScR checklist (Tricco et al., 2018) (Figure 1). A protocol was developed and pre-registered on the Open Science Framework prior to data extraction (osf.io/ukvsj; registration finalised October 2025). The search was conducted between April and October 2025; the protocol was registered in the final month of the search period and prior to synthesis. The search strategy followed the JBI three-stage approach (Peters et al., 2022). First, an initial limited search was undertaken to identify relevant articles and index terms. Second, a comprehensive search was conducted between April and July 2025 and repeated in October 2025 to identify additional records; no new eligible studies were identified. Third, the reference lists of included studies were screened for further sources. Searches were conducted in MEDLINE (Ovid), CINAHL (EBSCO), Scopus (Elsevier), and ASSIA (ProQuest). These databases were selected to capture literature across medicine, nursing, forensic science, social science, and victimology. Search terms were developed in consultation with an expert librarian and subject matter experts and adapted for each database. Given the variability in terminology used to describe skin tone, bruising, and violence-related injury, a broad search strategy was used to maximise sensitivity. The full search strategy is provided in Supplemental 1, and the PRISMA-ScR checklist is provided in Supplemental 2. Grey literature and practice-based sources were identified through

searches of Overton, the King's Fund Library (searched for health policy and guidance documents), relevant organisational websites, and advanced web searches. Forward and backward citation searching was also undertaken. No date restrictions were applied. The review was limited to English-language publications; however, this did not result in the exclusion of any otherwise eligible studies.

Eligibility Criteria and Study Selection

Eligibility criteria were informed by the Population–Concept–Context framework (Aromataris et al., 2024). Sources were eligible if they (a) included people with darker skin tones, or racially and ethnically minoritised groups characterised by darker skin tones; (b) examined the presentation, identification, assessment, or documentation of violence-related bruising; and (c) were conducted in any country or setting. Studies were excluded if they focused exclusively on White participants or White skin tones, or if bruising was unrelated to violence or injury. A protocol deviation was made to include studies in which bruising was experimentally induced in participants to examine the forensic or clinical identification of bruises related to violence.

All records were imported into EndNote 21 (Clarivate) and duplicates removed prior to screening in Rayyan (Ouzzani et al., 2016). Two reviewers independently screened titles and abstracts against the eligibility criteria. Full texts were retrieved for records that appeared to meet the inclusion criteria or where eligibility was unclear. Following full-text

assessment, 79 articles were reviewed in detail. Two reviewers independently assessed each full text for inclusion. Disagreements were resolved through discussion and, where necessary, consensus with the wider author team. Citation searching of included studies identified additional records, which were also screened for eligibility. In total, 21 studies met the inclusion criteria and were included in the review.

Data Extraction and Synthesis

Data were extracted using the JBI data extraction tool (Aromataris et al., 2024), with additional fields added to capture review-specific variables. Extracted data included study design, concept, context, population, country, methods, adaptations, key findings, and reported barriers or facilitators to bruise identification or documentation. One reviewer (CN) extracted data from all included studies. A second reviewer (AMS) independently checked a 10% sample of the extracted data. The reviewers compared outputs and discussed the applicability of the extraction form; no changes were required. Consistent with scoping review methodology, no formal risk of bias or quality appraisal was undertaken. Extracted data were charted and presented in tabular form to summarise study characteristics, methods, skin tone classification approaches, and bruise identification methods. A narrative summary accompanied the tables to map the extent, range, and nature of the evidence and to identify patterns, gaps, and emerging themes.

Patient and Public Involvement

Patient and public involvement was integral to the development of this review. Survivors with lived and living experience of violence from Black and minoritised ethnic communities, including contributors affiliated with specialist violence against women and girls services, contributed from the initial conception of the project through to analysis and synthesis. Their input highlighted recurring challenges in being believed, accessing support for injuries and welfare, and obtaining justice, particularly where bruising and other injuries were not recognised or documented. These insights shaped the review questions and underscored the need to examine how bruising is recognised and documented across skin tones.

Results

The search strategy identified 21 studies meeting the inclusion criteria. Data extraction and study characteristics are provided in Supplementals 3 and 4.

Study Characteristics

Studies were published between 1995 and 2024; 12 (57%) were published since 2020 and seven of those 12 (58%) since 2021. Ten studies were primary research studies and six

involved secondary analysis of primary datasets. Two studies were systematic reviews, and three were guidance documents, descriptive texts, or symposium papers. Five studies were based on the same primary dataset (Scafide et al., 2020b). Studies spanned four countries: the United States ($n=13$), the United Kingdom ($n=5$), a combined United States and China study ($n=1$), China ($n=1$), and Sweden ($n=1$). Ten of the 21 included studies specifically addressed bruising from violent injury in individuals with darker skin tones; the remaining 11 contained findings relevant to this question but were not primarily concerned with it.

Diversity

Skin Tone and Ethnicity. Both ethnicity and skin tone were used to characterise study participants, and in some studies ethnicity was used as a proxy for skin tone. Because skin tone varies within ethnic groups, this practice introduces uncertainty into findings and limits the extent to which results can be attributed specifically to skin pigmentation.

Skin tone, rather than ethnicity, was used as the primary characterisation variable in 11 (52%) studies. The Commission Internationale de l'Éclairage (CIE) $L^*a^*b^*$ colour space method was used to measure skin tone in several of these, describing colours on a three-dimensional structure where L^* represents lightness, a^* the red–green axis, and b^* the blue–yellow axis (Scafide et al., 2013, 2021a, 2021b; Thavarajah et al., 2012). In one study, six skin tone categories were used: very light, light, intermediate, tan, brown, and dark (Scafide et al., 2020b); and this same six-category dataset was used in four further studies (Aminfar et al., 2024; Downing et al., 2024; Scafide et al., 2021b, 2022). One study collapsed these six categories into three: light, medium, and dark (Scafide et al., 2013). Other studies relied on subjective ratings: in one, skin tone was estimated using three categories comprising pale skin, tanned Caucasian or fair Asian skin, and dark Asian or Black skin (Baker et al., 2013); in another, skin tone was assessed through comparison with reference photographs depicting five categories of fair, light, midtone, brown, or dark (Pierce et al., 2021). Of the 18 studies that involved human participants, two did not report on participant ethnicity. Five had predominantly White or Caucasian populations, six reported approximately equal representation across skin tone categories, and the remaining five featured predominantly non-White populations.

Sample Population

Twelve studies focused exclusively on adult participants aged 18 years or older. Four focused exclusively on children aged 10 years or under. Thirteen studies included both female and male participants. One large study had a sample of 2,161 participants (Pierce et al., 2021); otherwise sample sizes ranged from a single participant case study (Li et al., 2015) to 172 participants (Holbrook & Jackson, 2013).

Bruise Causation. Bruises were experimentally induced in participants in nine studies, using a controlled paintball pellet (Scafide et al., 2013), a dropped weight applied to the arm (Scafide et al., 2020a), or both methods (Aminfar et al., 2024; Downing et al., 2024; Scafide et al., 2020b, 2022). In one study a vacuum pump applied suction to the arm for 25 min (Thavarajah et al., 2012). In another, participants sustained bruising through recreational paintballing (Baker et al., 2013). One study recruited participants with existing accidental bruising (Scafide et al., 2021a). Eight studies included bruising attributable to real-world violence, with four of these also including accidental bruising.

Study Topics

Study topics, including skin tone classification approach and bruise induction method, are summarised in Supplemental 5.

Photographic Techniques and Light Sources. Eight studies examined the applicability of photographic techniques and varied light sources to the identification of bruising. Five considered the use of white light and alternate light sources (ALS), including ultraviolet and visible wavelengths from 350 nm to 555 nm, with coloured filters including yellow, orange, and red.

Four of these five studies originated from the same research laboratory. One involved eight healthy adult participants, three with lighter skin tones described as White or Caucasian, and five with darker skin tones originating from Southern India or Africa (Scafide et al., 2020a). Three subsequent studies refined these findings using the same primary dataset of 157 adult participants representing six skin tone categories, each comprising between 13.4% and 20.4% of the total sample (Downing et al., 2024; Scafide et al., 2021b, 2022). Across these studies, ALS wavelengths of 415 nm and 450 nm viewed through a yellow filter consistently increased the likelihood of bruise detection compared to white light, and this improvement was observed across all skin tone categories. One study reported specifically that these two ALS wavelength and filter combinations increased the likelihood of detecting bruises across all categories of skin pigmentation following a history of physical trauma (Scafide et al., 2022). A subsequent analysis using the same dataset found that 415 nm wavelength light with a yellow filter produced the highest bruise visibility ratings across skin tones (Downing et al., 2024). These findings were subsequently incorporated into a systematic review, which reported that ALS detection and visualisation of bruising outperform conventional white-light approaches in medico-legal contexts (Tyr et al., 2024). Studies further reported that faint bruises were more likely to be detected using shorter visible wavelengths during the first three days post injury, and that detection ability diminished generally with time regardless of light source (Scafide et al., 2020a, 2020b).

One study examined the use of ALS in a sample of 172 patients presenting following strangulation, of whom 118 (69%) were African American, 47 (27%) were Caucasian, and seven (4%) were Hispanic or Asian (Holbrook & Jackson, 2013). Physical examination found no visible evidence of external injury in 93% of patients. ALS examination, however, revealed positive findings of intradermal injury in 98% of that group. The study found that because bruising caused by strangulation occurs at multiple intradermal levels, no single wavelength or filter colour was effective across all cases, and the authors recommended that practitioners use varied wavelengths and coloured filters during strangulation assessments (Holbrook & Jackson, 2013).

One study involving eight Caucasian and one African American participant investigated whether black and white infrared (IR) photography could improve the imaging and documentation of cutaneous haemorrhage in blunt force injuries compared to standard colour photography (Bernstein et al., 2013). The study found that IR photography was of particular benefit where confounding surface interferences, including darker skin pigmentation, impeded visualisation of the bruise. When used alongside colour photography, IR added to the interpretation and analysis of traumatic injuries, providing a three-dimensional appreciation of injury morphology. The authors concluded that IR photography is appropriately used where it is necessary to verify questionable bruising, to assist in determining bruise extent, or to identify bruise patterning indicative of blunt force injury (Bernstein et al., 2013).

A study comparing four photographic techniques, namely visible white light, cross-polarised white light, reflected IR light, and reflected ultraviolet (UV) light, found that cross-polarised white light was the most effective technique for photographing bruises on human skin (Baker et al., 2013). Cross-polarisation enhanced bruise colour and shape and produced high contrast between bruised and surrounding skin, including on faded, ageing, and darker-skinned bruises. Reflected IR photography performed better on darker skin than on lighter skin but remained less effective than white light or cross-polarised white light overall. Given the small sample size of 16 participants, the authors noted that reflected IR may offer additional benefit in some darker skin cases (Baker et al., 2013). In this study, skin tone adjacent to 32 paintballing bruises was subjectively rated across three categories: pale ($n=15$), tanned Caucasian or fair Asian skin ($n=9$), and dark Asian or Black ($n=8$).

Across these studies, several factors that may influence bruise identification were identified. Localised subcutaneous fat, participant age, injury mechanism, and bruise age were formally modelled and each contributed to whether a bruise was detected (Scafide et al., 2020b). Other factors, including bruise depth, volume of bleeding, and rate of healing, were identified as potentially influential but not investigated (Baker et al., 2013; Scafide et al., 2020b). Topical cosmetic

products, hyperpigmented areas such as skin folds, age spots, prior wounds and scar tissue, tattoos, moles, and freckles may also affect identification (Holbrook & Jackson, 2013; Scafide et al., 2020b; Tyr et al., 2024). It should also be noted that these studies predominantly examined bruising under conditions where its presence was already known or had been experimentally induced. Identifying bruising in those exposed to violence introduces additional challenges including survivor distrust of services, stigma, and fear, each of which can affect both ascertainment and documentation.

Development and Assessment of Tools. Six studies examined the assessment or development of tools for detecting and documenting bruising across diverse skin tones. Five studies evaluated existing or newly developed scales and clinical decision rules designed to improve bruise visibility and detection; one study assessed the identification of signs of NFS, which can include bruising. Collectively, these studies reveal both the promise and limitations of technical tools in addressing disparities in injury documentation. While some tools demonstrate good reliability and validity, critical gaps remain. Bruises are systematically less visible on darker skin, detection accuracy varies by practitioner factors, and technological solutions require careful evaluation across diverse populations before implementation. The following section examines each tool's design, validation, and implications for equitable documentation of injuries.

A Bruise Visibility Scale (BVS) for bruises documented under standard white light and an Absorption Visibility Scale (AVS) for bruises visualised using ALS were evaluated for reliability and validity and their potential application in clinical forensic practice (Scafide et al., 2021b). Both scales had been adapted by Scafide and colleagues. Where injury was detected, raters applied the appropriate scale using reference images corresponding to the light source used; bruise length and width were measured, and in the case of the BVS, participant skin tone and bruise colour were measured using a spectrophotometer. The scales were tested across the six identified skin tone categories. Sixteen of the 69 participants (23%) had dark skin tone, and 31 of the 120 interrater assessments (26%) were conducted on very light skin tone. Both scales demonstrated good reliability and validity in measuring bruise visibility, and greater bruise size was associated with higher visibility on either scale. Greater contrast in colour or lightness was additionally associated with higher visibility on the BVS (Scafide et al., 2021b).

The BVS was further evaluated in a more diverse clinical sample of 30 patients with existing bruising: five (16.7%) were Asian, three (10%) Black, 16 (53.3%) Caucasian or White, four (13.3%) Middle Eastern, and two (6.7%) multi-racial (Scafide et al., 2021a). Criterion validity was assessed by comparing BVS values against spectrophotometrically measured colour contrast between bruised and surrounding skin. The study concluded that, with further research and development, the BVS has the potential to be a reliable and

valid tool for documenting the degree of clarity in bruise appearance (Scafide et al., 2021a).

A previously developed Bruising Clinical Decision Rule, the TEN-4, subsequently renamed TEN-4-FACESp, was refined and validated in a study designed to identify young children at risk of physical abuse on the basis of bruise characteristics (Pierce et al., 2021). TEN-4 refers to bruising on the torso, ears or neck, and to bruising anywhere on infants aged 4.99 months or younger; FACES adds the frenulum, angle of the jaw, cheeks, eyelids and subconjunctivae; and p refers to patterned bruising. The refined tool was found to be 96% sensitive and 87% specific for distinguishing abusive from non-abusive trauma in young children. The tool was evaluated on data from 2,161 patients who were predominantly White (83%), and skin tone was assessed by the researchers during clinical examination and categorised as fair, light, midtone, brown, or dark. Patients with fair skin had higher bruise counts than those with the four darker categories. Among children with non-abusive injury, those with darker skin tones had significantly lower total bruise counts than children with the lightest skin tone. The authors interpreted this as suggesting that bruise visibility may have been affected by skin tone, since non-abusive injuries tend to produce bruising in predictable numbers (Hibberd et al., 2017; Kemp et al., 2014; Sugar et al., 1999). Importantly, the accuracy of the tool did not substantially vary across skin tones, though the authors acknowledged that bruises may be more difficult to detect in those with darker skin (Pierce et al., 2021).

A further study examined indicators of NFS as identified by police officers completing a standardised strangulation assessment in family violence complaints, in most cases within hours of the reported assault (Brady et al., 2023). The sample of 133 cases was ethnically diverse, with survivors who were Hispanic (41.4%), Black (30.1%), and Non-Hispanic White or Asian (28.6%), providing an opportunity to examine whether ethnic disparities existed in officers' identification of injury. Officers who had received specialised NFS training identified approximately twice as many signs compared to those who had not. After controlling for whether officers had received NFS training and for co-occurring violence in the same incident, the study estimated a 49% to 54% reduction in the number of injuries identified by officers on the neck and overall when the victim was Black, compared to cases with White survivors (Brady et al., 2023). The most overlooked signs included redness and bruising on Black survivors' necks, torsos, and under the chin. The study noted that the mechanisms underlying this disparity, whether attributable to skin tone, practitioner factors, or their interaction, were not formally modelled, and it is not clear whether the training improved bruise ascertainment specifically. The standardised assessment was found to have multiple positive operational benefits, including saving time and resources, enabling triaging for high-risk cases, supporting officer decision-making, and facilitating trauma-informed care. Its use

also assisted first responders in challenging incorrect assumptions that obvious visible signs of trauma will always be present in strangulation survivors regardless of ethnicity (Brady et al., 2023).

One study described the design and development of a handheld multispectral imager with the objective of creating a point-of-care technology capable of detecting erythema and bruising in individuals with darker skin pigmentation (Kong et al., 2008). The device incorporated two significant hardware components: a colour filter array targeting four defined wavelengths and an illumination system based on LEDs targeting the same wavelengths. The colour filter array was realised in a CMOS sensor using a multilayer film fabrication process. Together these components formed a compact handheld device. No information on subsequent implementation, evaluation, or further development was included in the paper, though multispectral imaging of this kind has since been adopted in forensic contexts (Kong et al., 2008).

One study explored the feasibility of adapting methods from structural health monitoring (SHM) for damage detection to medical forensics, using computer vision to support the identification of bruising in survivors of violence (Aminfar et al., 2024). SHM uses visual indicators to identify structural defects; the methodology was adapted here by modifying algorithms originally developed for engineered system diagnostics to detect bruises under varying conditions of lighting, colour, and skin tone in human skin. Using the primary dataset from Scafide et al. (2013), the adapted model demonstrated a capability to detect bruises under conditions of distinct contrast and, in more challenging images, outperformed human expert analysis. The model was also found to be suitable for deployment on mobile phone devices (Aminfar et al., 2024).

Complications From Alternative Bruising and Mimics. One study examined complications arising from non-violent bruising mechanisms and medical conditions that may mimic bruising, which poses challenges to clinicians conducting examinations in cases of suspected abuse. This study reported that in children with darker skin tones, bruises may be confused with café-au-lait spots and pigmented birthmarks (Stephenson, 1995). The author recommended that to differentiate between bruising and café-au-lait spots, a series of examinations should be scheduled, since bruising will change in colour and fade over time whereas café-au-lait spots will not (Stephenson, 1995). A single case study suggests that traditional Chinese massage therapies may result in bruising that may be interpreted as consistent with abuse and therefore forensic practice should consider the cultural background of those where such injuries arise (Li et al., 2015).

Characteristics of Bruising. One study considered the effects of bruise size, skin tone, gender, and levels of subcutaneous fat on changes in bruise colorimetry over time (Scafide et al.,

2013). Skin tone was classified into three categories: light, medium, and dark. Change in bruise colorimetry over time was statistically significant, and skin tone was a significant predictor of that change. On average, bruises on individuals with medium skin tone were significantly more red and yellow compared to those with light or dark skin tone. Individuals with dark skin tone had significantly darker bruises overall (Scafide et al., 2013).

One study assessed changes in bruise appearance over time in individuals with darker skin tones of South Indian or Sri Lankan ethnicity, using tristimulus colorimetry for forensic analysis (Thavarajah et al., 2012). $L^*a^*b^*$ readings were recorded daily until the bruise was no longer visible to the naked eye. The study found that colorimetry could be used to measure and analyse bruises on darker skin, even where bruises were not clearly visible to visual inspection. The yellowing of a bruise was found to be undetectable visually or by tristimulus colorimeter in individuals with darker skin tones due to the masking effect of skin pigmentation. The study concluded that tristimulus colorimetry can analyse the colour changes of bruises in individuals with Asian skin tones, and that the $L^*a^*b^*$ measuring technique offers a reliable approach for this purpose, though colorimetric models derived from lighter-skinned populations require recalibration before application to those with darker skin tones can be assumed equitable (Thavarajah et al., 2012).

Guidance. The Mind the Gap handbook of clinical signs in Black and Brown skin provides practitioners with guidance on the identification and clinical presentation of multiple conditions, including bruising, across skin tones (Mukwende et al., 2020). The handbook provides images of clinical presentations on Black and Brown skin, which are frequently absent from standard textbooks and reference materials where language and descriptors typically assume a White patient. With respect to bruising, the handbook states that bruising in darker skin may present as a purple or dark brown discolouration. “Due to the increased melanin pigmentation, it might be difficult to see immediate bruising (which often appears red in light skin). It might only become obvious as the colour of the bruises develops into a dark purple, brown or black which is darker than the surrounding skin. Similarly, the yellow discolouration of older bruises may be more subtle in darker skin types. Close inspection with comparison of both sides is recommended” (Mukwende et al., 2020, p. 21). To enable accurate diagnosis, the handbook recommends close inspection with bilateral comparison, alongside thorough history taking, and notes that careful assessment is necessary to avoid misdiagnosis of dermal melanocytosis, also referred to as Mongolian blue spots, as non-accidental bruising, and to avoid the inverse error of attributing genuine bruising to this condition (Mukwende et al., 2020).

Survivor and Provider Experiences. One study examined the experiences of interpersonal violence (IPV) survivors and

IPV service providers in relation to injury and bruise documentation, and their perceptions of the impact of race on legal outcomes (Deutsch et al., 2017). The study identified a range of social, logistical, and systemic constraints associated with injury documentation and with survivors' decisions about seeking legal support. Participants described bruises as barely visible or invisible in those with darker skin tones and emphasised that the degree of visible bruising was not reflective of the survivor's pain or injury severity (Deutsch et al., 2017). Survivors reported distrust of the legal system, including a perception that those within it did not take their bruising or their legal situation seriously. Prosecutors reported that, in their experience, survivors with darker skin tones were less likely to cooperate with law enforcement, a finding that should be understood in the context of the well-documented and historically grounded mistrust of institutional systems within Black and other racially and ethnically minoritised communities rather than attributed to individual disposition. Documentation quality was also identified as a systemic concern: photographic images were typically of poor quality, and there was a mistaken and widespread belief among both survivors and some providers that photographs taken by survivors themselves could not be used in legal proceedings (Deutsch et al., 2017).

Time constraints presented a further structural challenge, with a limited window available for documenting injuries before they fade. The study reported that the legal system largely relies on judges and juries to assess whether an injury justifies legal protection; however, assessing the presence or absence of a bruise is inherently inaccurate under standard conditions, and this works to the structural disadvantage of survivors with darker skin tones whose bruising is less visible and less directly reflective of injury severity (Deutsch et al., 2017). The study identified several areas in which improvement is needed: better coordinated responses across physicians, advocates, and legal providers; improved photographic documentation practices; improved education for service providers, including training on photographic documentation and on what constitutes admissible evidence; promotion of survivors taking their own photographic records; the importance of early contact with survivors to capture perishable evidence; and the collection of evidence in a trauma-informed, culturally sensitive way. The study also called for better use of current and emerging technology, including the digital cameras available on smartphones, to document bruising and its evolution over time in ways that are accessible to both courts and medical providers offering follow-up care. A reduced legal focus on the visual appearance of bruising as the primary indicator of harm was recommended, alongside education for judges and juries about why bruising may be less visible in those with darker skin tones (Deutsch et al., 2017). Finally, the study highlighted the need to build trust between police and African American women given their high rates of victimisation and the institutional barriers they face in accessing justice (Deutsch et al., 2017).

Discussion

This scoping review synthesised evidence from forensic medicine, clinical nursing, imaging science, social and behavioural sciences, and law to examine how bruising is ascertained and documented in people with darker skin tones who have been exposed to violence. Studies varied considerably in design, setting, population, and methodological approach, reflecting the interdisciplinary nature of the field (Table 1). The review addressed three objectives: to map the methods and technologies used to detect and document bruising across skin tones; to identify practitioner-level and organisational barriers to equitable documentation; and to characterise gaps in the evidence base that limit progress towards equitable injury assessment in survivors from racially and ethnically minoritised communities. The findings have direct implications for practice, policy, and research across the disciplines represented among professionals who work with survivors of violence.

The literature consistently demonstrates that melanin attenuates light transmission, reducing the chromatic contrast associated with subdermal haemorrhage and making bruises less visible at the skin surface (Santiago et al., 2022; Tyr et al., 2024). Standard white-light examination and photography, which remain the dominant methods for injury documentation across emergency, forensic, and investigative settings, are therefore systematically less sensitive in people with darker skin tones. This is potentially exacerbated by variations in the admissibility of images across jurisdictions, and the fidelity with which guidance is followed (Anderson, 2024; Evans, 2024; Payne-James et al., 2012). The reduced visibility of bruising in darker skin is not a novel observation. It has been present in the literature since at least the mid-1990s (Stephenson, 1995). What the present review demonstrates is that despite over three decades of recognition, this has not been translated into consistent changes in documentation practice across the settings where survivors seek help.

The reviewed literature identifies a range of technological and procedural approaches to improving bruise detection and documentation across skin tones, including ALS imaging, cross-polarised photography, infrared imaging, spectrophotometry, and structured assessment tools (Table 2). ALS imaging at wavelengths of 415 nm and 450 nm with yellow filtration substantially improves bruise detection across skin tones and represents the most consistently supported technological advance in the reviewed literature (Downing et al., 2024; Scafide et al., 2022). The degree of alternate light absorption in areas of trauma varies by wavelength and is not uniform across skin pigmentation levels, meaning that protocol design and not simply equipment availability determines whether imaging is effective (Scafide et al., 2022). Cross-polarised white light reduces surface reflection that further obscures injury under standard illumination (Baker et al., 2013). Black and white infrared photography has utility in specific documentation contexts (Bernstein et al., 2013).

Table 1. Summary of Critical Findings.**Visibility and detection**

- Bruises are less visible in darker skin tones because increased melanin reduces the chromatic contrast between injured and uninjured tissue. Standard white-light examination is therefore less sensitive in individuals with darker skin tones and may contribute to under-detection of injury.
- Absence of visible bruising does not necessarily indicate absence of injury, pain, or assault severity and may reflect limitations of the detection method used.

Photographic and imaging technology

- Alternate light sources (ALS), particularly wavelengths of 415 nm and 450 nm used with yellow filters, together with cross-polarised white-light and infrared photography, improve bruise detection and visualisation compared with standard white-light photography. However, these technologies have rarely been evaluated in routine clinical, forensic, or investigative settings involving survivors of violence.

Emerging technology

- Emerging approaches, including handheld multispectral imaging devices and computer vision algorithms, show potential for improving bruise detection across a range of skin tones. However, evidence remains limited and further validation is required before routine implementation.

Assessment tools

- Validated tools, including the Bruise Visibility Scale, Absorption Visibility Scale, TEN-4-FACESp, and structured non-fatal strangulation assessments, demonstrate some utility across diverse skin tones and support more systematic injury identification and documentation.

Practitioner knowledge and training

- Existing education and training resources remain disproportionately focused on lighter skin presentations. Practitioners across health care, forensic, investigative, and legal settings report limited confidence and training in recognising and documenting injuries in darker skin tones.

Structural and systemic barriers

- There is no consistent cross-sector approach to bruise ascertainment and documentation in people with darker skin tones. Fragmented protocols and information systems may impede effective communication and use of injury evidence across health, social care, forensic, and criminal justice settings.

Survivor impact and equity

- Racially and ethnically minoritised survivors face additional barriers to disclosure, help-seeking, injury assessment, and documentation. These barriers include institutional mistrust, discrimination, adultification bias, and cultural or social factors that influence engagement with services. Documentation failures may contribute to existing inequalities in health care, protection, and access to justice.

Legal and justice outcomes

- Inadequate injury documentation has implications for police investigation, charging decisions, prosecution outcomes, and access to legal remedies. Studies identified disparities in injury identification and documentation involving Black survivors, alongside evidence that photographic injury evidence can influence legal decision-making.

Research gaps

- The evidence base remains limited by small samples, controlled study conditions, inconsistent skin-tone classification systems, and limited inclusion of survivors from real-world practice settings. Evidence evaluating interventions in clinical and investigative environments is particularly sparse.

Reflectance spectrophotometry provides an objective, skin-tone-independent measure of subdermal chromatic change that does not depend on the practitioner's unaided visual judgement (Thavarajah et al., 2012). Early work in computer vision has further demonstrated the feasibility of automated detection algorithms adapted from engineering and materials science (Aminfar et al., 2024). Each of these approaches is technically available. We found no evidence to suggest that they are in routine use across the full range of settings where survivors present.

The consequences of that gap are most sharply illustrated in the NFS literature. Holbrook and Jackson (2013) found that 93% of patients presenting following strangulation had no visible injury detectable under standard examination conditions, yet 98% showed intradermal injury when assessed using ALS. NFS carries significant risk of neuropsychological harm

(Bichard et al., 2022) and presents challenges to documentation across emergency, forensic, and investigative settings (Donaldson et al., 2023). The ability of any practitioner to document, communicate, and act on injury evidence in these cases partially depends on whether that injury is detectable in the first instance. Where standard methods are used and no visible injury is found, the clinical record, the police report, and the advocate's case notes can all reflect an absence that does not represent the physical reality of what occurred (Victoire et al., 2022).

Detection of injury and recognition of injury are related but distinct problems. Brady et al. (2023) examined injury recognition by police officers following assault and found that officers were between 49% and 54% less likely to identify injuries in Black survivors compared to White survivors. Specialist training partially attenuated but did not eliminate

Table 2. Summary of Implications for Practice, Policy, and Research.

Practice and policy
• Incorporate skin-tone-inclusive injury recognition and documentation into undergraduate, postgraduate, and continuing professional education across health care, social care, policing, and forensic practice. • Improve access to alternate light source imaging, enhanced photographic techniques, and validated assessment tools in services that routinely assess survivors of violence. • Develop standardised protocols for bruise assessment and documentation that explicitly address challenges associated with darker skin tones. • Revise professional guidance, regulatory standards, and evidence-management systems to support equitable injury documentation, including the storage and transfer of high-quality forensic images. • Promote cross-sector collaboration among health, social care, forensic, legal, and law-enforcement services to improve continuity and usability of injury evidence. • Increase awareness among legal professionals and decision-makers of the limitations of visual injury assessment across different skin tones.
Research
• Evaluate the effectiveness, acceptability, and feasibility of combining imaging technologies, alternate light sources, and structured assessment tools in routine practice. • Investigate the utility of accessible technologies, including smartphone-based imaging and computer-assisted detection systems, for equitable bruise documentation. • Develop and evaluate complex interventions integrating technology, practitioner training, organisational change, and survivor-informed approaches.
Practice, policy, and research
• Ensure that survivors and communities with lived experience are actively involved in the design, implementation, and evaluation of future guidance, services, and research initiatives.

this disparity. This finding extends beyond law enforcement. Any practitioner whose role involves identifying injury operates within a system where the legibility of injury on darker skin tones has not been adequately supported by training, tools, or organisational protocol. A technology that exists in a setting but is not reliably deployed, or whose output is not understood by the practitioner receiving it, does not close the evidential gap for the survivor.

The recognition problem is compounded by the clinical complexity of bruise mimics in racially and ethnically diverse populations (Li et al., 2015; Stephenson, 1995). In paediatric and elder care contexts, the capacity to distinguish traumatic bruising from non-traumatic skin presentations has direct child protection and safeguarding consequences (Kemp et al., 2014; Pierce et al., 2021; Ziminski et al., 2013). The consequence of misidentification operates in both directions: a mimic documented as traumatic injury constitutes an evidential error with potential legal consequences, while a genuine injury dismissed as a mimic represents a failure of documentation with potential safety consequences for the survivor. The absence of skin of colour images in widely used clinical atlases and training resources limits the development of this competence across training programmes (Ji-Xu et al., 2023; Long et al., 2023; Mukwende et al., 2020).

Validated tools including the TEN-4 (Pierce et al., 2021), the Bruise Visibility Scale (Scafide et al., 2021a), and the Absorption Visibility Scale (Scafide et al., 2021b) offer a basis for more standardised practice. However, their

performance across the full range of skin tones represented in clinical and community populations has not been comprehensively established, and this limits their generalisability. Colorimetric bruise ageing models present a further unresolved challenge: available models were developed predominantly using lighter skin tone populations (Thavarajah et al., 2012). Their application to survivors with darker skin tones in legal and clinical contexts cannot be assumed to be valid without recalibration. Where ageing models are used without validation across skin tones, there is a risk of systematic error in the estimation of injury timing that may affect case outcomes.

The classification of skin tone itself presents a methodological constraint that cuts across the entire evidence base. The Fitzpatrick Scale, one of the most widely used classification system in the included studies, was designed to predict ultraviolet reactivity and its application as a forensic measurement tool has documented limitations that constrain comparability of findings across studies. A classification approach appropriate for forensic and documentation purposes requires development and validation as a methodological priority.

Beyond the technical literature, the reviewed social and behavioural science evidence identifies several practitioner-level and structural barriers to equitable documentation. Racially and ethnically minoritised survivors face compound barriers to help-seeking that affect whether they present for injury assessment at all. These include prior experiences of

discrimination, modesty norms that affect willingness to undergo physical examination, language barriers that affect communication with practitioners, and structural mistrust of state institutions (Lipsky et al., 2006; Thiara & Roy, 2020; Widanaralalage et al., 2024). Black African children are disproportionately represented in child protection referrals while simultaneously being less likely to receive adequate clinical assessment (Bernard & Gupta, 2008), and adultification bias further compounds the risk of harm going unrecognised in Black girls and young women (Brissett et al., 2025; Davis, 2022). Black male survivors of violence report significant barriers to care engagement, including experiences of being treated as perpetrators rather than survivors within the health and justice systems they approach for help (Liebschutz et al., 2010).

Practitioners across health and social care settings report their own barriers to responding effectively to disclosures of violence, including uncertainty about professional roles and responsibilities and lack of confidence in documentation (Keeling & Fisher, 2014; Peckover, 2003; Robinson & Spilsbury, 2008). These practitioner-level barriers interact with organisational conditions. Evidence management and case recording systems in use across health care, social care, and justice settings may impose format and capacity constraints that render high-resolution forensic images unusable in practice. The interval between assault and clinical presentation frequently exceeds the window of optimal bruise detectability, particularly where access to specialist services is limited by geography, language, or immigration status (Sorenson et al., 2014). Fragmented record systems further risk information loss at transfer points between services, including among emergency departments, specialist forensic units, police, social care, and legal advocates. These are structural conditions whose investigation is warranted in future research. Nurse-led violence intervention programmes in emergency department settings offer one model through which identification and documentation of violence-related presentations can be systematically improved at the point of care (Hamilton et al., 2025).

Disparities in bruise documentation do not remain contained within clinical settings. Where injury evidence is absent, incomplete, or inadequate, the downstream consequences for survivors extend through legal proceedings, sentencing outcomes, and access to protection. Racial and ethnic disparities in sentencing have been documented (Sanchez et al., 2024), and the absence of documented injury in cases involving darker-skinned survivors may compound existing inequalities within the criminal justice system (Walby et al., 2010). Deutsch et al. (2017) found that inadequate bruise documentation constituted a barrier to survivors of intimate partner violence seeking legal relief, and that this barrier operated differently by race. The photographic evidence base used in legal proceedings has its own dynamics: high-quality photographic evidence influences juror decision-making (Douglas et al., 1997; Grady et al., 2018), and its absence is

therefore not evidentiary neutral. Linking police and health data offers a means of making these cross-system patterns visible at scale (Kennedy et al., 2023).

The evidence assembled in this review points towards action at multiple levels. At the level of individual practice, practitioners across clinical, investigative, social care, and legal contexts require training in injury recognition and documentation that reflects the full range of skin tones encountered in practice, that includes competence in distinguishing bruise mimics from traumatic injury, and that develops the capacity to communicate clearly about what the absence of visible injury does and does not mean. The existing evidence does not support strong conclusions about which training content or delivery approaches are most effective in improving practice across these diverse professional contexts, and this is itself a research priority.

At the level of organisations and services, the availability of ALS equipment and trained practitioners should be a standard expectation in settings where survivors of violence present. Services should have formal protocols for imaging across skin tones, and for the transfer and usability of imaging evidence across agency boundaries. Where such infrastructure does not exist, community-based specialist services with appropriate capacity should be accessible and adequately funded (Thiara & Roy, 2020).

At the level of policy and professional standards, regulatory bodies and policymakers have a responsibility to act on the evidence that now exists rather than to defer reform until a larger or more definitive evidence base is available. The evidence is sufficient to establish that standard documentation methods are less sensitive in people with darker skin tones, that this disparity is not addressed by current practice across most of the settings captured in this review, and that technical and organisational means of reducing that disparity exist and are not being implemented at scale. Incorporating skin-tone-inclusive injury recognition into postgraduate curricula, revising evidence system specifications to accommodate forensic imaging, and funding research into complex interventions that address the full range of practitioner, organisational, and contextual barriers are all actions warranted by what the evidence already shows.

Future research should prioritise prospective studies conducted in real-world settings with adequately powered and representative samples across the full range of skin tones. Survivor perspectives are largely absent from the quantitative and experimental literature included in this review, and patient and survivor involvement in the design, conduct, and interpretation of future studies is necessary to ensure that documentation practices are developed in ways that are acceptable to, and appropriate for, the people they concern. Interdisciplinary collaboration will be necessary to address a problem whose causes and consequences span the full range of systems that survivors encounter.

The central finding of this review is that people with darker skin tones who have been exposed to violence face a

structurally higher risk that the injuries they sustain will not be detected, recorded, or communicated in ways that reflect the severity of harm they have experienced. That risk is not attributable to any single practitioner failure or technological deficit. It is the cumulative product of inadequate training, absent or underused technology, organisational systems that do not support equitable practice, and a research literature that remains too narrow in its methods, populations, and disciplines to yet provide a comprehensive basis for intervention. Addressing it is a responsibility distributed across every professional field that encounters survivors of violence.

Limitations

Although a systematic search strategy was applied across multiple databases, the review was conducted in English only, which may have excluded relevant international literature. Grey literature inclusion was limited, and unpublished studies or institutional reports not indexed in searched databases may have been missed. Included studies varied considerably in design, population, setting, outcome measures, and skin tone classification systems used, limiting direct comparison across findings. No single study addressed the full pathway from bruise ascertainment through to justice or protection outcomes. The majority of included studies used small sample sizes, often in controlled or simulated rather than clinical settings, with limited representation of the full range of skin tones, body sites, bruise causes, and injury presentations, limiting opportunities to generalise to real-world practice. Studies used a range of skin tone classification systems, including the Fitzpatrick Scale, Individual Typology Angle, and von Luschan scale, without consensus on which is most appropriate for research or clinical use. This inconsistency further limits comparability across studies and complicates translation into practice guidance. Many studies used volunteer participants, rather than survivors of violence presenting in clinical or forensic settings. The applicability of laboratory findings to real-world conditions cannot be assumed. Few studies examined how skin tone interacts with other characteristics such as age, gender, disability, and socioeconomic position. The evidence base therefore cannot account for intersectional vulnerabilities of multiply marginalised survivors. This review focused specifically on bruising as a physical injury marker. Other forms of physical injury, psychological harm, and the broader consequences of violence for health and wellbeing are outside its scope, though they are relevant to the overall picture of survivor need. Evidence on practitioner experiences, and on survivor perspectives on documentation and help-seeking, was drawn largely from studies not specifically designed to examine skin tone as a variable. This limits the depth of insight available into how skin tone shapes the practitioner-survivor encounter in practice.

Conclusion

Irrespective of skin colour, the absence of visible harm does not necessarily mean the absence of harm. However, despite a growing body of research on bruising in general clinical and forensic contexts, the bruising arising from violence in people with darker skin tones has not received adequate attention relative to its prevalence and consequences, and the existing evidence base is insufficiently developed to support the adoption of standardised protocols. This scoping review has demonstrated that progress has been made in photographic techniques and ALS methods for improving bruise identification across skin tones, and in assessment tools that support the identification and documentation of bruising associated with violence. Notable gaps remain.

The potential to build meaningfully on what exists is real. Combining imaging technologies, including ALS at 415 nm and 450 nm with yellow filtration, cross-polarised photography, and reflectance spectrophotometry, with structured assessment tools has the potential to produce a more complete and more equitable documentary record, one that does not rest on visible surface injury alone, and one that can link imaging findings to a violent event in combination with survivor testimony. Realising that potential will require larger and more diverse study populations, comparative evaluation of different technologies and approaches, and research conducted in real-world settings with survivors of violence rather than under controlled experimental conditions. It will also require research conducted by and with more diverse research teams, and with the meaningful participation of survivors whose voices have been largely absent from the literature to date.

Future research should focus on the development and rigorous evaluation of complex interventions that combine evidence-based tools to improve bruise ascertainment and documentation, accompanied by guidance and training for practitioners, and informed throughout by survivor and stakeholder need. This kind of rigorous and pragmatic real-world research can support improved responses that help survivors access appropriate services and contribute to meaningful reductions in the disparities in health, protection from harm, and access to justice that the current evidence demonstrates are real, measurable, and preventable.

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Ethical Considerations

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Data Availability Statement

This scoping review did not generate or analyse any primary datasets. All data supporting the findings of this study are derived from previously published literature, which is cited throughout the manuscript. A full list of included sources and the data extraction table are available in the Supplemental materials.

Supplemental Material

Supplemental material for this article is available online.

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