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## FINAL TECHNICAL REPORT

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**TITLE OF PROJECT:** Bruising as a Forensic Marker of Physical Elder Abuse  
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### ABSTRACT

**OBJECTIVE:** To describe bruising as a marker of physical elder abuse.

**DESIGN:** Consenting older adults were examined to document location and size of bruises and assess whether they were inflicted during physical abuse. An expert panel confirmed physical abuse. Findings were compared with results of an earlier study of accidental bruising in older adults.

**SETTING:** Residences of participants

**PARTICIPANTS:** 67 adults aged 65 and older reported to Adult Protective Services for suspected physical elder abuse

**MEASUREMENTS:** Age, sex, ethnicity, functional status, medical conditions, cognitive status, history of falls, bruise size, location, and recall of cause, responses to Revised Conflicts Tactics Scale items and Elder Abuse Inventory.

**RESULTS:** Seventy-two percent (n=48) of older adults who had been physically abused within 30 days prior to examination had bruises. They reported that 89 of 155 (60%) bruises were inflicted, 26 (14.2%) were accidental, and 40 (25.8%) were of unknown cause. When the study population was compared to a group of elders in an earlier study who had not been abused, the physically abused elders were found to have significantly larger bruises, and more of them knew

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the cause of their bruises (41 or 91% vs. 14 or 28.6% of the comparison group) after excluding participants with surrogates. The physically abused older adults were significantly more likely to have bruises on the neck and head, especially the face, the lateral aspect of the right arm, and the posterior torso.

**CONCLUSION:** Bruises that occur as a result of physical elder mistreatment are often large (>5 cm.) and on the face, the lateral right arm or the posterior torso. Older adults with bruises should be asked about the cause of the bruises to help ascertain if physical abuse occurred. Claims of bruising inflicted by others should be reported to APS, law enforcement or another investigating agency.

**Keywords:** Physical elder abuse, forensic marker, bruising

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### INTRODUCTION

A recent summary of international elder abuse prevalence data reported that from 0.5 to 4.3% of older adults (equivalent to 186 thousand to 1.6 million older Americans) are physically abused annually and even higher rates are reported for dependent elders with caregivers (Cooper, Selwood, & Livingston, 2008). Prosecution rates for these crimes are low, and research is needed on forensic markers of physical elder mistreatment. Although elders tend to be frequent visitors to the doctor's office, less than 2% of reports of abuse to Adult Protective Services (APS) come from physicians (Taylor, Bachuwa, Evans, & Jackson-Johnson, 2006). One reason may be that normal and common age-related changes mask or mimic markers of abuse. Bruising is one such example. Bruising is common in the general geriatric population, and distinguishing when a bruise is accidental versus inflicted is clinically challenging. Although clinicians and APS workers have learned to be suspicious of excessive or unusual bruising when they report or investigate abuse, no systematic research has explored the nature of bruising associated with physical elder abuse. In the United States, APS is responsible for investigating reports of abuse, neglect, and exploitation of older adults. APS is administered by a local or state social services agency, and its primary mission is to help victims of elder abuse.

There is very little research into bruising of older adults although age-related changes, such as thinning epidermis, increased capillary fragility and decreased subcutaneous fat (Webster, 2001), indicate that bruising will present differently than in younger people. Only one study, published in 2005, specifically addressed characteristics of bruising in older adults. It found that accidental bruises in a geriatric population (n=101) were not found on the neck, ears, genitalia, buttocks or soles of the feet and almost 90% of accidental bruises were on the extremities. The

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older adults frequently did not know the cause of accidental bruises. Once a bruise appeared, it was visible from 4-41 days. On average, bruises were gone after  $11.73 \pm 7.13$  days with half resolved by day 6 (Mosqueda, Burnight, & Liao, 2005). Although there is no known research addressing the duration of inflicted vs. accidental bruises, a Norwegian study using an animal model determined that velocity and mass of the injury affected the presentation of bruises and there was a clear relationship between the impact and degree of damage (Randeberg et al., 2007). The 2005 study also found that the color of bruises was not an indicator of their ages in older adults (Mosqueda et al., 2005). This finding is consistent with a recent summary of pediatric research on the dating of bruises by their color (Maguire, Mann, Sibert, & Kemp, 2005b). The geriatric bruising study measured factors that may influence bruising including mobility, gait instability, falls and frequently prescribed pharmaceutical agents that interfere with coagulation pathways. The only significant finding associating these hypothetical predictors of bruising and bruising characteristics in older adults was that people who took medications that interfere with coagulation pathways were more likely to have multiple bruises (Mosqueda et al., 2005).

Because there are few studies that examine bruising in elders, it is helpful to turn to the pediatric and intimate partner violence literature for comparison purposes. A meta analysis of 23 studies of bruising in children compared bruises in non-abuse to abuse situations (Maguire, Mann, Sibert, & Kemp, 2005a). Bruises from abuse are most commonly on the head and neck, particularly the face, followed by the buttocks, trunk, and arms. Bruises due to abuse are large, and they usually occur with other injuries (Maguire et al., 2005a). A study directly comparing patterns of bruising in children who had been abused (n=133) and controls (n=189) found differences between groups were most pronounced for head and neck, chest, abdomen, back and

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buttocks rather than for the arms, and there were no statistically significant differences between the two groups in amount of bruising on the legs (Dunstan, Guildea, & Kontos, 2002). Head and especially facial injuries also figured prominently in medical records of adults who encounter intimate partner violence (312 women and 39 men from records of over 100,000 injured adults (Petridou et al., 2002).

The research questions addressed by this study are as follows.

- (1) In cases of confirmed physical elder abuse reported to APS, what percentage of the victims have bruises?
- (2) In cases of confirmed physical elder abuse, what is the location, color, number and victim-stated cause of bruises?
- (3) Are there differences between bruises in older adults who have not been abused (Data from NIJ Grant #2001-IJ-CX-KO14) (Mosqueda et al., 2005) as compared to bruises in those who have been physically abused?

## **METHODS**

### **Study Population**

When a participating APS worker received a report alleging physical abuse of an older adult, they asked the client for permission to have a research nurse (RN) contact them. Those who agreed were approached by a RN who explained the project and solicited participation.

Inclusion criteria were (1) age 65 or greater, (2) an allegation of physical elder abuse occurring within the last six weeks, (3) alleged perpetrator was someone in a position of trust to the older adult (i.e., not a stranger). The six-week criterion was based on the time duration that a bruise

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could be visible as determined in the earlier study of accidental bruising in a geriatric sample population. APS clients who met criteria and agreed to participate were formally consented. Consent forms contained assurances of confidentiality, except as specifically required by law. Consistent with mandatory reporting requirements, when the researchers suspected that participants were experiencing additional abuse other than what had been reported (for example, financial abuse as well as physical abuse), they made an additional report to the assigned APS worker. If APS Clients were assessed as lacking decision-making capacity (with a widely used assessment tool modeled after the MacArthur Competence Assessment Tool for Clinical Research (Applebaum & Grisso, 2001)), a qualified surrogate was identified to consent for them. Study sites included the participant's home (60), a neutral site where the participant felt safe such as a relative's house (5) or an inpatient setting (2). Both English and Spanish-speaking older adults participated. During home visits, privacy of participants was carefully guarded, and assessments were discontinued when there was a risk that privacy might be compromised by the presence of others.

### **Data Collection**

A prior study of accidental bruising in older adults (Mosqueda et al., 2005), served as a model for the methods for this study, especially measurements of bruises and assessment of characteristics of the participant. The same principle investigator oversaw both studies and the lead researcher for the first study consulted and provided training for the research team for this study. Data from that earlier study provided a baseline for comparison with the data collected in the current study. The study protocol was approved by the Institutional Review Board of the University of California, Irvine.

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The same RN conducted all of the study assessments. Participants removed their clothing and she examined all of their skin to document any bruising. Location, width and length (using a clear pliable circular measurement tool), and colors present were recorded along with the participant's or surrogate's recollection of the cause of the bruise and the time elapsed since the alleged abuse incident. Participants answered questions about their medical conditions and use of prescription and over-the-counter (OTC) medications and use of assistive devices. Functional status was measured using the Katz ADL (Katz, Downs, & Cash, 1970) and Lawton IADL (Lawton & Brody, 1969) scales. Mobility was measured with the Tinetti Gait and Balance scales (Tinetti, 1986; Tinetti & Gliner, 1988). Participants or surrogates were asked to report falls over the last week, month, 6 months and year. To collect evidence of physical abuse, participants or surrogates responded to the twelve item Revised Conflict Tactics Scales (CTS2) Physical Assault Scale (Straus, Hamby, Boney-McCoy, & Sugarman, 1996). The CTS2 is widely used in studies of domestic violence to measure conflict by direct questioning. Responses indicate whether specific tactics (e.g., slapping, choking) were used against the respondent, as well as the frequency of the events over the prior year. The RN also used the Elder Abuse Inventory (EAI; (Fulmer, Street, & Carr, 1984) to rate 12 Possible Abuse Indicators, including other types of injuries. Each participant was also asked to describe the abusive incident.

Longitudinal Experts, All Data (LEAD) methodology was applied as a criterion standard to assess whether the study participants had experienced physical elder abuse (National Research Council, 2003). This involves convening a panel of experts, who consider all available evidence in determining whether a research participant was abused or not. The panel of elder abuse

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experts included four board certified geriatricians with a combined experience of 37 years working in the field of elder mistreatment. The panel adopted the following conceptual definition: physical elder abuse is the non-accidental use of physical force by someone in a trust relationship that may result in bodily injury, physical pain or impairment of an older adult (age 65 or greater). In addition, an operational definition clarified specific issues, as follows:

- Does not include sexual abuse (because it presents differently and has low prevalence compared to other physical abuse)
- Does not consider the perpetrator's intent
- Does include improper physical restraint, however there is a concern about defining physical restraint too narrowly when restraint can also be used to enhance the elder's safety.
- Does not include physical neglect or deprivation by others; these are categorized as neglect not physical abuse.
- Does not include threats with a weapon, but does include use of a weapon that may result in bodily injury, physical pain or impairment.
- Does not include chemical restraint
- Does not require evidence of harm. Evidence of risk of harm is sufficient.

The LEAD panel met monthly to review oral and written information for each participant assessed since the last meeting. The APS worker related the findings of the physical abuse investigation (confirmed, inconclusive, unfounded), and panel members were allowed to ask questions of the RN and APS workers. (Sample questions are available on the research group's web site (<http://www.centeronelderabuse.org/>.) The panel was not allowed to hear any information related to the presence/absence or characteristics of bruises. Written information

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included demographics, medical histories and responses to CTS2 and EAI items. Questioning focused on other injuries (i.e., not bruises), the participant's statements, witnesses, police involvement and prior APS reports. A unanimous decision among members of the LEAD panel was required to declare that physical abuse had occurred.

A methodological difference in collection of bruising data from the two studies precludes any analyses of differences in numbers of bruises between the two groups. The comparison bruises (from the prior study) were not collected as a cross sectional sample. The focus and the objective of the first study was to follow bruises from their first appearance until their resolution. All bruises that were present on the first visit were excluded from the study data. So the comparison group data consists of bruises that were detected as new bruises over a two-week period from a 68-person, sample, while the case group data was collected in one time visits to participants from this study who presented with bruises. The resulting number of bruises for comparison is similar in the two groups.

### **Analysis**

Data were analyzed with SPSS version 16.0 (SPSS inc., Chicago, IL). Frequencies of continuous assessment variables (e.g., falls, Tinetti scores) were examined and non-normal distributions were tested non-parametrically. Because many participants had multiple bruises, bruising data per se did not meet criteria as independent samples. To address this, participants were categorized by characteristics of bruises (e.g., having a bruise on the head or not; knowing the cause of bruises or not) and Pearson Chi Square tests of comparison of the abused and non-abused elders were executed to assess significant differences in the nature of bruising between

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groups. Other tests of comparison used were T-tests for two independent samples and Mann Whitney U non-parametric tests.

### **RESULTS**

#### **Sampling**

Between July 2006 and May 2008, participating APS social workers approached 407 individuals alleged to have been physically abused to assess their interest in being in the study. Of these, 234 were categorized as ‘failed attempts’ (e.g., unable to locate the client, client refuses APS contact, client was moved to a skilled nursing facility that is not participating in the study, client appears psychotic or is too anxious or agitated to assess interest in the research, client lacks decision-making capacity and no surrogate is available). Another 93 were initially interested in participating but ultimately refused to participate. Demographic data were available on 78 of these people. The remaining 80 APS clients were enrolled in the study. Of these, 13 were excluded from the analyses for the following reasons: refused to allow a full body inspection (1), the alleged perpetrator was found not to be a person in a position of trust (2), suspected date for abuse incident more than 6 weeks prior to assessment (2) no allegation of physical abuse (1), a LEAD finding of no abuse (6), and the LEAD was unable to reach consensus (1). There were no significant differences (age and sex) between the 69 participants in the study and the 78 older adults who refused to participate. Of the 67, three lacked decision-making capacity and a surrogate was consented for participation in the study. The RN, who had geropsychiatric experience, observed that none of the participants with dementia, or whose performance on the MMSE (<24) indicated cognitive impairment, evinced signs of delusions or hallucinations during the home visit.

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Of the 67 abused cases, 57(85.1%) endorsed items on the CTS2 physical assault scale. The EAI indicated evidence of physical abuse other than bruising (e.g., lacerations, fractures, repeated hospital admissions) for 42(62.7%) of the abused sample. There was consistency between LEAD decisions and APS findings for the abused sample. APS found that physical abuse was confirmed for 56 participants (83.6%), inconclusive for 10(14.9%) and unfounded for 1(1.5%).

Of the 67 abuse victims, 48 had bruises. Four subjects with bruises from the initial study were dropped because of missing data for four or more variables used in the comparative analyses.

### **Findings for physically abused older adults**

The age (mean±SD) of the 67 abused elders was 76.7±8.2 years, 48 (71.6%) were female, 62 (94%) were Caucasian and 11 (16.4%) were Hispanic (9 of these were assessed in Spanish rather than English). Assessment data for the physically abused elders were as follows: 15 (22.4%) scored 24 or below on the MMSE (The nurse was unable to assess 2 participants.), 53 (79.1%) did not need assistance with ADL's and 34 (50.7%) were competent on IADL'S. Twenty-nine (43.3%) required a cane or walker to move around the home and one was bedbound. Medications that interfere with coagulation pathways were being taken by 17 (25.4%). Abuse perpetrators were predominantly family members (86.6%) and 32.8% of them were suspected substance abusers or had a mental health diagnosis.

Bruises were found on 71.6% (48 of 67) of participants. All participants were seen within 30 days of an incident of physical abuse (10.3±6.5 days). Twenty-two participants had 1-2 bruises,

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26 had 3-9 bruises. Table 1 is organized by participant-stated cause of bruise. Although there appear to be trends in the data, direct statistical comparison of bruising data in Table 1 would not meet requirements for independence of samples, since individual participants frequently had multiple bruises, and cell sizes are too small for comparison of grouped individuals.

Participants were asked to state the cause of any bruises. Bruises were categorized as inflicted, accidental or unknown based on the participant's response. One surrogate (the alleged abuser) categorized four bruises as "accidental" although the person stated that the bruises were incurred during the alleged abuse incident.

Data on all 67 abused elders was analyzed to see if the reported time interval since the abuse differed when abused elders were grouped based on whether they reported inflicted bruises or not. There was a difference of mean elapsed time between elders with at least one inflicted bruise (N=32; mean = 7.7(4.3) days; range = 1-15 days) compared to those who reported no inflicted bruises (N=35: 16 with accidental or unknown bruises only and 19 without any bruises; mean=12.7(7.3); range=3-30 days) (Independent samples T-Test  $p=.001$ ). This result suggests that some abuse victims were not seen early enough to collect data on bruises that had already healed. It is also possible that a longer elapsed time is associated with failure to accurately recall the cause of bruises.

People who used an assistive device for mobility were more likely to have a bruise (Pearson's Chi-Square,  $p=.021$ ). No other characteristics of the abused older adults (as listed in Table 2) predicted bruising or major characteristics of bruising.

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### **Comparison of bruising in the two samples**

Table 2 reports characteristics of the 48 physically abused older adults with bruises and the comparison group of 68 older adults with bruises acquired accidentally. There are significant differences in age, use of over-the-counter medications (OTC), home mobility (being bedbound and needing assistive devices), balance and numbers of falls between the groups. Disabilities differ across groups; for example, more people in the comparison group were bedbound and those who were not had worse balance scores, while more people who were abused and ambulatory required assistive devices for mobility. Also, although the MMSE scores did not differ across groups, 11 people in the comparison group were unable to perform the MMSE tasks, compared to two abused elders. When cognitively impaired participants were defined as those who required use of a surrogate as well as those with MMSE scores  $<24$ , 23% of the abuse group were impaired, while 26% of the comparison group were impaired. The groups do not differ in this respect (Pearson's Chi Square,  $p=.35$ ). The earlier study required that the participants be available daily for an extended length of time so that newly formed bruises could be detected and followed until they healed. For this reason, participants who were residents of skilled nursing (16 or 23.5%) or independent living (52 or 76.5%) facilities were recruited for the earlier study, while the recruitment sample for this study was community dwelling APS clients.

Table 3 shows significant differences between groups in the size of their largest bruise. The abused elders with bruises all had at least one bruise greater than 1 cm and the majority (56%) had at least one large bruise ( $\geq 5$ cm). Only 5 (7%) subjects who were not abused had any bruises in the largest bruise category.

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Since none of the surrogates for the comparison group knew the cause of any bruises, this data from all surrogates were excluded from the comparative analysis. In the abuse group, 41 of 45 (91%) knew the cause of at least one bruise, while only 14 of 49 (28.6%) in the comparison group knew the cause of any bruise (Pearson's Chi-Square,  $p < .001$ ). Eight participants in the abuse group who had bruises and were not represented by surrogates had an MMSE score less than 24 (range 16-23). They all stated they knew the cause of their bruises with six reporting inflicted bruises and two reporting accidental falls. Credible statements by mildly to moderately cognitively-impaired older adults that they recalled the abusive event were consistent with the clinical experience of the LEAD geriatricians, however other evidence contributed to their finding of physical abuse of these elders. Further research is needed on preservation of memory for emotional events despite mild to moderate cognitive impairment (Ikeda et al., 1998).

Forty percent of abused elders (19 of 48) had bruises on head, neck or torso, while only 13% (9 of 68) of the comparison group had bruises in those regions. Table 4 contains analysis for group differences in location of bruises on body regions. Abused older adults were significantly more likely to have bruises on head and neck (bruises on the head were exclusively on the face except for one bruise on the ear), lateral right arm and posterior torso. Twenty-five percent (12 of 48) of abused, bruised subjects had a bruise on their lateral right arm while only 7% (5 of 68) of the comparison group had bruises on the lateral right arm.

Comparison group participants with bruises only on the trunk or head were significantly more likely to remember their cause than others in the group with bruises on the extremities only

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(Pearson's Chi-Square,  $p < .001$ , Holm's sequential Bonferroni method). This finding did not pertain to the abused group.

### DISCUSSION

Research on bruising or other injuries associated with physical child abuse has been conducted for a number of years and there are systematic reviews of these studies (Maguire et al., 2005a, 2005b). Less is known about injuries associated with intimate partner violence, but there are published, systematic research projects involving large numbers of abused adults (Fanslow, Norton, & Spinola, 1998; Petridou et al., 2002). The literature on injuries due to elder abuse is limited to case studies and non-statistical samples except for one study of accidental bruising in elders (Mosqueda et al., 2005). The current study is the first to address the characteristics of bruising associated with elder abuse, and it builds on the prior study by incorporating its data set for purposes of comparison.

It was difficult to recruit a sample of older adults who are recent victims of trauma to participate in research. Others who study elder mistreatment victims have also encountered low participation rates (Fulmer, Paveza, Vandeweerd, Fairchild et al., 2005; Fulmer, Paveza, Vandeweerd, Guadagno et al., 2005). Yet, despite the limited sample size, significant findings are reported.

The poor understanding of aging of bruises places limits on what can be learned from the color of bruises (Bariciak, Plint, & Gaboury, 2003; Maguire et al., 2005b). Recent research has explored new methods of addressing questions about aging of bruises, and there is potential to

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shed light on these questions in future (Randeberg et al., 2007). When that happens, the color data collected in this study may provide additional insights to the forensics of bruising associated with elder abuse. The data on dominant color for this study (Table 1) suggest that bruise color may be affected by either method of delivery (accidental or inflicted) or age of the bruise.

The significant findings that can be derived from this study involve comparison of size of bruises, participant-stated cause of bruises, and location of bruises on the body.

Inflicted bruises are larger, with a mean size of five cm or greater. Bruises one cm. in size or less are not associated with physical abuse in the study sample.

When a bruise is inflicted rather than accidental, older adults are likely to remember the circumstances that caused the bruise.

Bruises on the head, neck, lateral right arm or posterior torso should arouse suspicion of physical elder mistreatment. Findings that bruises associated with elder mistreatment are large and occur on the face and posterior trunk are consistent with the literature on bruising associated with child abuse. Bruising specific to the lateral aspect of right arm found on physically abused older adults is not documented in the pediatric abuse literature.

Mandated reporters who see elders with bruises that are large (>5cm.) or in suspicious locations should ask about the cause. If the older adult does not mention abuse they should be gently questioned in a reassuring manner about the cause of the bruise. This may allow them to feel safe

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in disclosing a previously unrecognized abusive situation. Many elders who are in an abusive situation endure it for years before having it discovered or dying. We now have an opportunity, using these data, to recognize abuse at an earlier stage and to assist with appropriate intervention strategies. In addition, first responders who investigate alleged elder abuse can make use of these suspicious characteristics as they collect evidence and attempt to determine whether criminal elder abuse has occurred. Prosecutors trying physical elder abuse cases may want to bring in expert witnesses, especially physicians with elder abuse expertise, to explain any bruising evidence in light of the findings of this study.

Because this was a cross-sectional study it is unclear if the higher level of need for assistive devices and greater number of falls in the physically abused subjects reflects their vulnerability to abuse or it may also reflect the consequences of abuse. It seems unlikely that the discrepancy in falls is entirely due to mobility differences since use of assistive devices is not associated with falls in the earlier study of accidental bruising ( $n=101$ , Pearson's chi square,  $p>.05$ ). Three abused elders reported bruises caused by an accidental fall, while two elders in the comparison group reported fall-related bruises. On the other hand, 11 abused elders reported falls in the last week and 21 reported falls in the last month, compared to 2 and 4 elders in the comparison group, respectively. In narratives of abuse incidents, eight participants specifically mention falling as a result of the abuse.

In the study sample, bruising emerges as the most prevalent medical marker of physical abuse, found on 71.6% of abused elders who are APS clients, seen within 30 days of the abusive event. The RN assessed all participants while unclothed and documented one or more other physical

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indicators, (i.e., lacerations, fractures, burns, skin tears, scratches, abrasions, swelling) in only 41.8% of those who had been abused.

### **Limitations and future research**

Research on forensics of elder abuse is dependent on the cooperation of highly vulnerable, recently traumatized older adults. The convenience sample of abused older adults for this study excludes the bulk of abused older adults - those not reported to APS - as well as those who were reported, but declined to participate in research. Among those who did participate were elders who denied that abuse occurred, were unable to provide information due to cognitive impairment, or provided information despite cognitive impairment. In addition, conducting assessments soon after an abuse incident was not always possible, and bruising data were lost when bruises resolved before the participant could be assessed. When participants were seen too soon, bruising caused by the abuse may have not emerged yet. The true proportion of physically abused elders reported to APS with bruising for the study is almost certainly higher than the 72% reported here, and this is borne out by the analysis of the elapsed time since the bruises were inflicted. It is also consistent with data from the prior study (Mosqueda et al., 2005) showing that 50% of accidental bruises disappear within 6 days of injury. Further, some participants (surrogates and elders) provided questionable data about the cause of bruises, perhaps due to fear. However since bruising itself may arouse suspicion of abuse and trigger reports to APS, the percentage of all physically abused people with bruises may be lower than 72%.

The two study samples differed in a number of respects, largely due to the recruitment strategies employed to ensure enrollment and assessment of the needed samples. Despite the fact that

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vulnerability is associated with abuse, the comparison group was more frail and disabled in several respects. They were significantly older, had poorer balance, took more OTC medications, and included people who were living in institutional environments (i.e., assisted living, skilled nursing facilities). A subset of those who were not abused were bedbound (15 in the comparison group, and only 1 in the abuse group). On the other hand, when the ambulatory members of both groups are compared, the abuse group had a greater need for assistive devices and experienced more falls. In a cross-sectional study, it is unclear whether these attributes were pre-existing in the abused population or a result of a pattern of abuse. Although the proportion of people in the two groups who were demented did not differ, there were more severely demented people who were unable to perform on the MMSE in the comparison group. Dementia is a risk factor for abuse (Cooney, Howard, & Lawlor, 2006; Dyer, Pavlik, Murphy, & Hyman, 2000), and so the abuse sample should logically include a larger proportion of people with that diagnosis. Any of these factors, age, institutionalization status, medications, dementia, mobility, or balance could theoretically alter bruising in a research sample. However, none of them predict statistically significant bruising characteristics when they are analyzed in the sample of elders with accidental bruising alone (Mosqueda et al., 2005).

Data collection strategies also differed in the two studies, especially the opportunity to collect data longitudinally, over the full life cycle of bruises in the comparison group, while the abuse group was seen only once in a cross-sectional study, and at variable time periods since the abuse incident. As a result some variables are collected in different circumstances: for example, those in the comparison group were asked about the cause of a bruise on the first day it appeared, while the abused elders were asked about the cause regardless of how long ago the bruise was

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incurred. On the other hand, the comparison group had their skin examined many times while the abuse victims had their skin examined only once, and the data from repeated examinations may be more reliable. A true control group study is needed, with better matching of methods and populations, and we encourage others to improve upon the strategies reported here, while cautioning them about the difficulties both of locating and recruiting physically abused elders and identifying an unbiased, comparable sample of older adults. Indeed, group matching issues are complex at best and since some types of vulnerability in the abuse group could be either a cause or effect, a prospective study is needed, but difficult to achieve. Nevertheless, studies that attempt to replicate and extend the findings of this study to other samples of older adults are clearly needed.

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GRAPHICS

Table 1. Bruises and their characteristics for the physically abused elders by reported mechanism of injury

|  | <b>Mechanism of Injury</b> |            |            |
|--|----------------------------|------------|------------|
|  | Inflicted                  | Accidental | Unknown    |
| Number of participants reporting bruises (%)*          | 32 (66.5)                  | 15 (31.3)  | 18 (37.5)  |
| Count of bruises (%)                                   | 89 (57.4)                  | 26 (16.8)  | 40 (25.8)  |
| <b>Characteristics of bruises</b>                      |                            |            |            |
| <i>Number bruises by body location</i>                 |                            |            |            |
| <i>(% of all bruises for that mechanism of injury)</i> |                            |            |            |
| head, neck & torso (%)                                 | 38 (42.7)                  | 1 (3.8)    | 6 (15)     |
| extremities (%)  | 51 (57.3)                  | 25 (96.2)  | 34 (85)    |
| <i>Longest dimension of bruises in centimeters</i>     |                            |            |            |
| mean ± standard deviation                              | 5.4 ± 3.1                  | 3.4 ± 2.3  | 3.2 ± 2.1  |
| range  | 0.8-21.4                   | 1.0-10.4   | 0.8-10.2   |
| <i>Dominant color/bruise</i>                           |                            |            |            |
| <i>(% of all bruises for that mechanism of injury)</i> |                            |            |            |
| purple   | 39 (43.8%)                 | 12 (46.2%) | 24 (60.0%) |
| black  | 20 (22.5%)                 | 6 (23.1%)  | 4 (10.0%)  |
| yellow   | 17 (19.1%)                 | 1 (3.8%)   | 3 (7.5%)   |
| red  | 10 (11.2%)                 | 7 (26.9%)  | 8 (20.0%)  |
| blue   | 3 (3.4%)                   | 0 (0.0%)   | 1 (2.5%)   |
| <i>Time elapsed since reported abuse in days</i>       |                            |            |            |
| mean ± standard deviation                              | 7.5 ± 4.3                  | 14.0 ± 6.6 | 8.2 ± 6.6  |
| range  | 1-19                       | 1-30       | 2-30       |

\*Participants with multiple bruises may report more than one mechanism of injury (n=48).

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Table 2. Groups with Bruising: Comparison of Characteristics

|  | Physical Abuse<br>(n=48)                         | No Physical Abuse*<br>(n=68) | P-value |
|--|--|------------------------------|---------|
|  | Number (Percentage) or Mean ± Standard Deviation |                              |         |
| Age  | 77.5 ± 8.1                                       | 88.5 ± 5.7                   | <.001†  |
| Female Sex   | 33 (68.8)  | 49(72.1)                     | .427‡   |
| Caucasian Race                                       | 44 (91.7)  | 68 (100)                     | .053‡   |
| Number prescription medications                      | 5.6 ± 4.5  | 6.6 ± 4.0§                   | .199†   |
| Number over-the-counter medications                  | 0.85 ± 2.0                                       | 3.2 ± 2.7§                   | <.001¶  |
| Medications interfere with coagulation               | 14 (29.2)  | 28 (41.2)#                   | .120†   |
| Needs assistance on Activities of Daily Living (ADL) | 24(50.0)   | 29 (42.6)                    | .276†   |
| Unable to maintain self on Instrumental ADLs         | 14 (29.2)  | 25 (36.8)                    | .213†   |
| MMSE   | 26.2 ± 3.9**                                     | 27.4 ± 3.8††                 | .114    |
| Bedbound   | 1 (2.1)  | 14 (20.6)                    | .002‡   |
| Need assistive devices (not bedbound)                | 24 (51.1)  | 11 (20.4)                    | .001‡   |
| Tinetti gait score                                   | 8.7 ± 2.8 ††                                     | 9.2 ± 2.2 §§                 | .365†   |
| Tinetti balance score                                | 10.3 ± 4.0 ††                                    | 11.9 ± 3.2§§                 | .028†   |
| Fell in last month                                   | 20 (41.7)  | 4(6.0)‡                      | <.001‡  |
| Fell in last year                                    | 27 (56.2)  | 8 (11.9)‡                    | <.001‡  |

\* Participants in an earlier study of accidental bruising in the geriatric population.(Mosqueda et al., 2005)

Only participants with bruises are included here.

† Independent samples t-test

‡ Pearson's Chi-Square

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§ Missing data for 1 participant

¶ Mann Whitney U

# Missing data for 2 participants

\*\* Missing data for 2 participants unable to perform the task

†† Missing data for 14 participants, 11 unable to perform the task

‡‡ Missing data for 1 participant, not ambulatory

§§ Missing data for 15 participants, 14 not ambulatory, all unable to perform the task

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Table 3. Number of Persons by the Size of Their Largest Bruise

|                           | Physical Abuse<br>(n=48) | No Abuse*<br>(n=68) |
|---------------------------|--------------------------|---------------------|
| Bruise size (centimeters) |                          |                     |
| Small (0.1-1.0) (%)       | 0                        | 24 (35)             |
| Medium (1.1-4.9) (%)      | 21 (44)                  | 39 (57)             |
| Large (5.0-25.0) (%)      | 27 (56)                  | 5 (7)               |

Pearson Chi-Square,  $p < .001$

\* Participants in an earlier study of accidental bruising in the geriatric population. (Mosqueda et al., 2005) Only participants with bruises are included here.

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Table 4. Older Adults with Bruising: Comparison of Location between Abused and Not Abused

| Region                 | Older Adults        |                         | P-value† |
|------------------------|---------------------|-------------------------|----------|
|                        | Abuse<br>n = 48 (%) | No Abuse*<br>n = 68 (%) |          |
| Head and neck          | 10 (21)             | 3 (4)                   | .006     |
| Anterior torso         | 4 (8)               | 5 (7)                   | .846     |
| Posterior torso        | 7 (15)              | 2 (3)                   | .021     |
| Lateral right arm      | 12 (25)             | 5 (7)                   | .008     |
| Right arm, not lateral | 13 (27)             | 25 (37)                 | .274     |
| Left arm               | 25 (52)             | 25 (37)                 | .101     |
| Right leg              | 7 (15)              | 5 (7)                   | .208     |
| Left leg               | 8 (17)              | 9 (13)                  | .607     |

\*\* Participants in an earlier study of accidental bruising in the geriatric population.(Mosqueda et al., 2005) Only participants with bruises are included here.

†Calculated using two-way contingency table analysis Pearson chi-square statistics comparing older adults who had at least one bruise on the stated region..