

Box 1 Search Criteria

1 child.mp.	16 (dat: adj3 bruise:).mp.
2 child abuse.mp.	17 (bruise: adj3 child:).mp.
3 child protection.mp.	18 (pattern: adj3 bruise:).mp.
4 1 or 2 or 3	19 (ag: adj3 bruise:).mp.
5 bruise:.mp.	20 (hemorrhage: adj3 bruise:).mp.
6 contusion.mp.	21 (petechiae adj3 child abuse).mp.
7 physical abuse.mp.	22 (ecchymoses adj3 child abuse:).mp.
8 serial abuse.mp.	23 ((petechiae or ecchymoses) and child abuse:).mp.
9 non-accidental injury.mp.	24 ((petechiae or ecchymoses) and child protection:).mp.
10 non-accidental trauma.mp.	25 or/15-24
11 (nonaccidental:and injur:).mp.	26 4 and 14
12 (hematoma or haematoma).mp.	27 25 or 26
13 physical punishment.mp.	
14 or/5-13	
15 (battered child or shaken baby or battered baby).mp.	

Fig 1 Ranking used for study type and abuse definitions.

Study type	Criteria used to define abuse	Ranking
Case control	Abuse confirmed at case conference or civil or criminal court proceedings or admitted by perpetrator.	1
Cross sectional	Abuse confirmed by stated criteria including multidisciplinary assessment	2
Qualitative	Abuse defined by stated criteria	3
Case series	Abuse stated but no supporting detail or evidence given	4
	Suspected abuse	5

Table A Summary of papers detailing bruising in non-abused children

Author/ date/ location	Study population	Study type and ranking	Outcome	Excluded			Critical appraisal
				Abuse	Neuro- disability	predispo- sition to bruising	
Sugar et al 1999, Seattle	973 children attending well child clinic at 7 sites. Age: under 3 years. M:F=1:1 (ethnically and racially representative population included).	Cross sectional (2) prospective	Prevalence and distribution of bruises related to age and motor development	Yes	Yes	Yes	Study focused on bruising. Large population representative of young age group studied and exposure effects. Recall bias: possible as development based on parent reporting and not validated. Observer bias: unlikely due to standard bruise recording method used. Statistical analysis to eliminate chance effect.
Carpenter 1998 Darlington UK	177 babies, seen in HV hearing and child surveillance clinics in two centres. Age: 6-12 months M:F=1:1	Cross sectional (2) prospective	Demography. Size and colour of bruises. Prevalence and distribution related to motor development	No	No	No	Study focused on bruises. Limited age range. Matching with census data revealed under representation of upper social class. Recall bias: possible as development based on parent reporting and not validated. Observer bias: unlikely due to standard bruise recording method used. Statistical analysis to eliminate chance effect. Possible confounding effect of abuse as it was not excluded.
Tush 1982 Pennsylvania USA	30, 3 year old children attending urban day care centre. M:F=17:13	Case series (4) prospective	Prevalence of bruises related to demography. Distribution of bruises,.	No	Yes	Yes	Study focused on bruising. Representativeness limited by small case series. Observer bias: unlikely due to standardised and validated recording method. Recall bias: minimised by validation of parent reporting of demographic and development details and researcher observation. Statistical analysis to eliminate chance effect. Possible confounding effect of abuse as it was not excluded
Wedgwood 1990 Derbyshire UK	56 children under 4 years, admitted or referred to children's hospital admission unit	Case series (4) prospective	Distribution, of bruising related to developmental level. Number colour and size of bruises	Yes	No	Yes	Study focused on bruising. Small case series limits the representativeness of study. Recall bias on development assessment by parents possible. Observer bias: unlikely due to standard bruise recording method used but single researcher may introduce bias. Data presented in a way that makes

							prevalence data difficult to extract. Error on figure labelling.
Mortimer 1983 Camden and Islington UK	620 infants under 1 year attending child health clinic or hospital follow up clinic	Case series (4) prospective	Prevalence and description of size, number and distribution of bruises in 6 cases	No	No	No	Study focused on bruising. Study detail limited as results are presented in a letter. Population limited to infants, no age break down or detail given to determine how representative the study is. However clear description of the 6 infants with bruising given. Results possibly confounded by one of the cases where abuse not adequately excluded. Methodology of bruise recording not given.
Lyons et al 1993. Sydney Australia	Immediate assessment of 207 children under 6 years old who fell from hospital beds or cribs	Cross sectional (2)	Distribution of injuries seen after falls from hospital beds; including contusions (bruises)	Yes	No	No	Selected group of children, examined after known documented injury. Useful study looking at injury after fall from a known height. Descriptive study focussed on forces and mechanism of injury related to clinical findings collected in systematic manner. Limited bruising data
Labbe et al 2001, Quebec Canada	2040 examinations of 1476 children under 17yrs old seen in medical centre over a year for reasons other than trauma. (Girls 1109)	Cross Sectional (2) prospective	Prevalence, number, distribution and type of skin injury related to age. Including some data on bruising	Yes	Yes	Yes	Bruising not the main focus, only paper to address older children. Bruising data limited to age group prevalence figures. Most of the data applied to all injury types. Observer bias: standard recording method described but single observer may introduce bias.

Table B Papers comparing bruising patterns in abused and non abused children.

Author, date and place of study	Study population	Study type and ranking	Definition of abuse and ranking	Study Outcome	Critical appraisal
Dunstan et al 2002 Cardiff UK	Age:1-13 years . M: F= 66:34 <i>Cases:</i> 133 abused children examined for physical child abuse (1992-6) <i>Controls:</i> 189 children from ambulatory outpatients (1998-9)	Case control (1)	diagnosed at case conference (1) controls children attending for reasons other than abuse	Distribution, size and number of bruises in abused and non-abused children. A scoring system for probability of abuse	Bruising prime focus of paper. Retrospective data collection from cases from standardised case notes. Prospective data collection from controls according to study protocol. Population not representative for infants under 1 year. Selection bias: possible, controls (a) not matched (b) not from same time period (c) not victims of accident (d) male predominance. Measurement bias: unlikely but possible observer bias in absence of blinding to exposure. Statistical analysis: eliminates chance effect No obvious confounders.
Worlock et al Nottingham UK	Age: under 5years old Sex ratio for cases and controls not significantly different <i>Cases:</i> 35 children non accidental fractures <i>controls:</i> 116 children with accidental fractures	Case control (1)	On child protection register for confirmed physical abuse. (1) Abuse excluded from controls but not stated how	Pattern of fractures in abused and non-abused children with a description of the prevalence and distribution of significant associated bruises	Bruising not the main focus of the paper. Population only representative of bruising in selected group of young children with non-accidental fractures. Selection bias: possible, controls not age matched or from same time period. Measurement bias: possible as “significant” bruises recorded Statistical analysis eliminates chance effect. No obvious confounder.

Table C Summary of papers detailing bruising in abused children

Author/date/location	population	Study type and ranking	Definition of abuse and ranking	outcome	Critical appraisal
Johnson Showers 1985 Ohio USA	616 children examined for suspected physical abuse. 1980-82 Age under 17 years 56% boys	Case series (4)	Suspected physical abuse (5)	Demographics, injury type, cause and location. Some data on bruising included	Bruising not main focus. One of largest population studies of physical child abuse. Retrospective notes based. Data from standardised data collection at assessment. Bruising data limited to prevalence figures, most statistically significant causes and sites of bruising.
Galleno et al 1981, Los Angeles USA	66 child abuse cases seen by child abuse team Age under 17 years	Case series (4)	child abuse confirmed on stated clinical and presenting criteria (3)	Demography of cases Pattern and distribution of soft tissue injury	Bruising not the main focus. Population includes age group of the review but small series limits the applicability of findings to the general population. Abuse criteria used raise the possibility of reverse causality
de Silva S 1993 Camperdown Australia	Hospital records of 17 cases of fatal child abuse, (homicide) Age 1-3 years. 10 boys	Case series (4)	Cause of death homicide. Excluded if there was only suspicion of abuse (3)	Autopsy findings including prevalence and site of bruising	Bruising not the main focus of the paper. Small case series of highly selected severe child abuse; deaths from head injury or strangulation in young children. Bruising data limited to short description of the prevalence, nature and site of bruising in these cases.
Naidoo 2000 Cape Metropole S. Africa	Hospital records of 300, children with NAI (1992-6) with oral-facial trauma Age:under 14 years old (mean age 4.75 years) M:F=1:1. no data on ethnicity	Case series (4)	Cases of "proven physical abuse" criteria not stated. (excluded neglect, emotional or sexual abuse) (4)	Injury type, prevalence, site on the head. Site of the crime and limited characteristics of perpetrator and disclosure of abuse.	Highly selected cases. Bruising not main focus. Retrospective notes based methodology. Single data collector, method validated by test-retest procedure. Bruising data limited to prevalence figures for bruising to head and neck and qualitative observations as to their cause.
McMahon et al 1995 Pittsburgh USA	371 children with suspected NAI seen in children's hospital 1987-90. Age 0-18 yrs	Case series (4)	Suspected physical abuse (5) (sexual, mental abuse and neglect excluded)	Prevalence type and site of soft tissue injuries including data on prevalence and numbers of bruising	Retrospective descriptive study based on review of hospital records and photographs. Bruising not the main focus. Bruising data included prevalence figures. Age related data given on prevalence and site of soft tissue injury but bruise specific data could not be extracted
Atwel et al 1998 Sheffield UK	Pathology records of 24 cases fatal NAHI all under 5 years	Case series (4)	Fatal NAHI Diagnosed at autopsy included 5 cases where abuse admitted) 19	Prevalence, distribution and pathological association of external bruising in NAHI	Focused on bruising patterns. Descriptive study of detailed autopsy findings. Population: study not representative of total age group under review. Bias: to young age group, fatal cases of abuse

			ranked (4) 5 ranked (1)		Measurement bias: highly unlikely due to meticulous recording. with specific injury mechanism . Reverse causality unlikely due to multiple criteria of injury and presentation to define abuse in all cases.
Brinkman et al 1979. Hamburg Germany	93 cases of child abuse. Clinical detail presented for 45 cases Age 0-16	Case series (4)	Investigatory child abuse police files in Germany (3)	Characteristics site of skin injuries and mechanism of injury	Bruising not the main focus. Population: series too small to be generally representative of whole of age range chosen. Measurement bias: unlikely photographic backup. Paper contains 9 photographs of bruising after clear injury description.
Sussman. 1968 San Fransisco. USA	11 “battered Children” no age range	Case series (4)	Child battered by care taker/sibling (4)	Characteristics of skin lesions described and photographs. Some reference to bruising	Early paper giving qualitative description of skin lesions in small series of physically abused children. Evidence augmented by Photographs of bruises in children with physical abuse of a known cause.
Johnson et al 1990. Ohio USA	94 of 944 physically abused children with hand injury 1980-82 seen by children’s hospital child abuse team. Age under 19.5 years	Case series (4)	Physical abuse diagnosed by child abuse programme teams (2)	Prevalence of hand injury in NAI children, related to demography. Type of injury, description of bruising of hand.	Bruising not the main focus of paper which is specific to hand injuries. Retrospective notes based study from standardised data collection. Population demographics not defined for children with bruises. Evidential value limited to description of bruises, prevalence and description of mechanism of injury in 5 cases and photograph in one.
Feldman 1992.. Seattle USA	13 children 9:cases of vertical gluteal cleft injury 4 of bruising to pinna Age: under 10 years	Small case series (4)	physical abuse confirmed on clinical and presenting features (including 4 cases of witnessed or admitted abuse) 9 ranked (3) 4 ranked (1)	Description and mechanism of two specific types of bruising injury	Two specific bruising patterns form the main focus of the paper. Not a population study. Photographs and detailed case scenarios lend evidential weight to paper.
Leavitt et al. 1992 New York . USA	85 children admitted to hospital with diagnosis of abuse /neglect. 1987-89.	Case series (4)	Children admitted to hosp with suspected abuse/neglect/sexual abuse (5)	Abnormalities in head and neck	Retrospective notes based study. Highly selected data about head and neck injury in NAI. Bruising data limited to prevalence figures with comment on location of bruise to head and neck.

	Age: under 16 years (mean age 3.75 years) M:F=1:1				
Ellerstein 1979 Buffalo USA	3 children case history and photograph Age: two 4 year olds and one 8 years.	Review article including 3 case reports (4+)	Abuse of known cause (1)	Photographs of cutaneous injury and cause	Not a population based study, bruises not the main focus of paper. Strong photographic evidence of bruises in 3 case scenarios with NAI of known cause.
Lynch A 1975 Pennsylvania USA	275 cases of abuse in Metropolitan school pupil population of 202,000 surveyed in 1970	Cross sectional (2)	Suspected abuse and neglect documented by 5 of 8 child abuse committees (5)	Epidemiology of abuse in school population. Injury type and cause	Bruising not the main focus or part of case control analysis. Prospective study to identify the prevalence and characteristics of abuse in school aged population. Study methodology subject to observer and recall bias. Bruising data limited to prevalence figure
Smith SM, Hanson R 1974 UK	134 children admitted to hospital as “battered “ children and 53 controls, children admitted with other conditions. Age; under 5 years	Case control study that included a case series (4) with data on injuries in abused children	Cases: Abuse diagnosed in hospital (4) Controls Children admitted to hospital for cause other than trauma.	Description of injury type and severity in abused group. Case control comparison of related psycho social risk factors and developmental status.	Bruising not the main focus of the paper. Population preschool children. A prospective control study but no matched data presented regarding bruising. Bruising data limited to description of prevalence and commonest site.

