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Use of the scale-up methods in injury prevention research: An empirical assessment to the case of choking in children

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Abstract

The scale-up method estimates the size of hard to count subpopulations. This method is based on the idea that the proportion of subjects in a subpopulation E known to each member of the general population T is the same as the proportion of members of E belonging to general population T.

The aim of this study is to assess if this method is suitable for estimating the number of foreign body injuries and for setting up an algorithm in order to choose the most suitable subpopulations to use in estimates.

The scale-up estimator is robust and precise and the selection of subpopulations of known size is improved by our algorithm.

Keywords: Scale-up method; Non-probabilistic sampling; Small prevalence; Foreign body injuries; Population size estimation

1. Introduction

Suffocation due to foreign bodies (FB) is a leading cause of death in children aged 0–3 and it is common also in older children up to 14 although it is a rare event (Altmann and Nolan, 1995).

Recent data (Zigon and Gregori, 2006) indicate that the estimated number of choking accidents per year in children aged 0–14 in the 25 countries of the European Union is about 50,000, 10% of which are fatal. These estimates are based on hospital discharge records and death certificates, which are known to be sometimes not very accurate and to have high cost of analysis (Scheidt and Brenner, 2000). The latter situation is quite common particularly in developing economies,

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where, however, the need for data on injuries is somewhat more urgent (Rahman and Andersson, 2000). One of the most effective method in such situations is to conduct surveys in clinics or hospitals. This approach is quite accurate but at greater costs and with difficulties in making such investigations a routine assessment. Additionally, common methods of probabilistic sampling are quite inadequate in this respect and better results are commonly obtained from non-probabilistic sampling schemes (Morrison and Stone, 2000; Guard and Gallagher, 2005).

Our proposal is to apply the scale-up estimator to this issue. The scale-up approach is a methodology targeted at estimating the size of subpopulations of unknown size with the benefits of smaller samples and perhaps lower costs (Snidero and Corradetti, 2004).

Our study is an empirically driven assessment of the correctness and efficiency of the scale-up estimator in injury research, applied to the estimation of hospitalizations for choking injuries. All the otorhinolaryngologists of the Piemonte region – a Northwest Italian region – were asked to answer a questionnaire about the number of injuries they have observed having hospitalization as a consequence. The estimates obtained were then compared with those derived from the official discharge records of the Piemonte region referring to the same period of time.

The next section introduces the scale-up method and the social network size estimator, the third section describes the study design, the fourth section presents the estimates and describes the results.

2. The scale-up method estimator

The estimator belonging to the scale-up method is a novel estimator born from an idea of Bernard and his collaborators in the 90s (Bernard and Johnsen, 1989, 1991; Johnsen and Bernard, 1995; Killworth and McCarty, 1998; Bernard and Killworth, 2001), aimed at estimating the size of hidden or hard-to-count populations. This method is based on the concept of social network, which consists in the set of people and ties a person has; obviously the width of the network is strictly dependent from the definition used for “knowing” someone. Besides the difficulties in defining exactly this concept, this estimator has two main advantages: (i) people are asked indirectly about problems; (ii) and consequently the samples used are smaller compared to those obtained using common estimators for events with small prevalence (Killworth and McCarty, 1998; Snidero and Corradetti, 2004).This method assumes a total population T of size t and a subpopulation E of T with size e; the basic assumption underlying the scale-up method is

$$\frac{m}{c} = \frac{e}{t} \tag{1}$$

where m is the mean number of persons known in E and c is the mean social network size of the members of T. Hence, the proportion of subjects in E known to each member of T is the same as the proportion of members of E belonging to general population T, i.e. e/t (Bernard and Johnsen, 1989, 1991; Shelley and Bernard, 1995; Killworth and McCarty, 1998).

In order to estimate the size e of the target population we also need to know the size e of the social network of each person in the sample. Several estimators for the social network size were proposed. Some of these proposed to estimate c using the number of persons known by each respondent in several subpopulations of known size (Bernard and Johnsen, 1989, 1990, 1991; Freeman and Thompson, 1989; Bernard and Killworth, 1990; Killworth and McCarty, 1998; McCarty and Killworth, 2000). Thus, the basic idea is to ask respondents how many people they know in the target subpopulation of unknown size and how many people they know in a certain number of subpopulations of known size. For example, the respondent could be asked: “How many people do you know who are seropositive?" (the unknown size subpopulation) and "How many people do you know owing a swimming pool?" (the known size group).

The scale-up method also has several strong assumptions which can lead to several problems in estimations: (i) each subject T has the same probability to know a person in subgroup E, (ii) everyone in T knows all about his/her acquaintance and (iii) the difficulty to recall in short time people known in certain subpopulation is negligible (Bernard and Johnsen, 1989, 1991; Johnsen and Bernard, 1995; Killworth and McCarty, 1998).

The violation of these assumptions can lead to some problems called barrier, transmission and estimation effect. The barrier effect is due to some social and geographical characteristics that create a barrier in knowing some specific groups of people. The transmission effect faces us when the information about a person is not transmitted with the same probability to his/her social network and finally the difficulty in recalling people belonging to a subpopulation can lead to the estimation effect (Bernard and Johnsen, 1989, 1991; Johnsen and Bernard, 1995; Killworth and McCarty, 1998).

Assuming that E is a subpopulation of T of unknown size e, then the scale-up estimator (Killworth and McCarty, 1998) of e is the maximum likelihood estimator

$$\hat{e} = t\frac{\sum_i m_{i0}}{\sum_i c_i} \tag{2}$$

It is demonstrated that this estimator is unbiased, i.e.: with $E(\hat{e}) = e$ and standard error given by

$$\text{S.E.}(\hat{e}) = \sqrt{\frac{t\hat{e}}{\sum_i c_i}}. \tag{3}$$

The scale-up estimator requires simply computing the ratio of the sum of m_{i0} over all respondents and the sum of c_i social networks size over all respondents.

2.1. Estimation of social network size

The only unknown element in the scale-up estimator is the social network size of each respondent: we have therefore to substitute c_i with a good estimate of it.

In order to estimate the social network sizes there are two estimators that use subpopulations of known sizes (Killworth and McCarty, 1998). The network size estimator adopted in this paper is the *proportional estimator*

$$\hat{c}_i = t\frac{\sum_{j=1}^{L} m_{ij}}{\sum_{j=1}^{L} e_j} \tag{4}$$

with standard error

$$\text{S.E.}(\hat{c}_i) = \sqrt{\frac{tc_i}{\sum_{j=1}^{L} e_j}}. \tag{5}$$

Killworth et al. (Killworth and McCarty, 1998) proved that for small values of m_{ij}/c and p_j, the estimate of c_i is almost the same as that obtained by the *subgroup estimate*, the result being also corroborated by simulations (Snidero and Corradetti, 2004).

Each estimate of c_i has an error that is transmitted to the unknown subpopulation size estimate. It is proven (Killworth and McCarty, 1998) that the effect of this error on estimation is negligible if $\sum_{ij} m_{ij}$ is sufficiently large.

3. The study design

The study is designed to estimate the number of foreign body (FB) injuries which required an hospitalization in children aged 0–14 in Piemonte – a Northwest Italian region – in the years 1999–2000–2001 using the scale-up estimator and then to compare the results with the official discharge records.

Therefore we contacted all the heads of the ORL departments in the Piemonte region asking them to demand to the otorhinolaryngologists to fill in a questionnaire about:

- the number of people they know in 25 subpopulations of known size;
- the number of children they remember were hospitalized in their institutions for choking injuries in the years 1999–2000–2001.

Seventy-two questionnaires were then collected. The question about the target subpopulation was: "How many hospitalizations were made in your institution for foreign bodies in the upper aero-digestive ways in the years 1999, 2000 and 2001?". The definition of social network used in this survey is the so called *active network*, i.e.: "mutually recognize each other by sight or name, can be contacted, and have had contact within the last 2 years, either in person, by phone or mail" (Bernard and Johnsen, 1990; Killworth and McCarty, 1998).

The 25 subpopulations of known size were formed by 12 subpopulations of names and 13 subpopulations chosen from the Census. In order to choose the subpopulations more suitable for the target sample of physicians, we selected 13 pairs of subpopulations from those available in the Census Report, all having similar size (see Table 1). A psychologist carried out a pilot study by interviewing 10 physicians with the aim of selecting one subpopulation from each pair. The psychologist eliminated the subpopulation for which it turned out to be more difficult for

Table 1
Subpopulations from the census that were used for the pre-test

Id	Relative size—eliminated populations	Relative size—chosen populations
1	People with a bachelor in political sciences	Graduates in physical education
2	People with a bachelor degree	Women with one child
3	Families formed by one person	Houses with more than six inhabitants
4	Houses with centralized heating	People living in a rented house
5	Widows	Self employed
6	Clerks	Families with seven or more components
7	Bricklayers	Women with three or more children
8	People living in charitable institutions	Graduated at school of arts
9	People with a bachelor in dentistry	Sport trainers
10	Commuters by train, tram and underground	Farmers
11	Engineers	Architects
12	Engine drivers	People living in assistance institute
13	Artisans and people working in building	Unlettered

Table 2
Subpopulations of known size used for estimating the social network of respondents

	Subpopulations	Absolute size
1	Maria	29326
2	Anna	13489
3	Rosa	8184
4	Giuseppina	8108
5	Angela	8033
6	Giovanna	7654
7	Giuseppe	59865
8	Antonio	40996
9	Giovanni	37738
10	Francesco	32433
11	Mario	27508
12	Luigi	27356
13	Graduates in physical education	3715
14	Women with one child	180870
15	Houses with more than six inhabitants	137671
16	People living in rented houses	1305153
17	Self employed	325040
18	Families with seven or more components	40019
19	Women with three or more children	32897
20	Graduated at school of arts	3544
21	Sport trainers	558
22	Farmers	73177
23	Architects	3415
24	People living in assistance institute	24240
25	Unlettered	37253

respondents to answer and for which more time was needed to recall the number of people known in the subpopulation. Table 2 shows the 25 subpopulations on which the otorhinolaryngologists were interviewed.

4. Results

In June 2004, 72 questionnaires were collected. Nine items were not completed in the 72 forms (out of a total number of 1872 items, 0.48%), so they have been replaced with the median value of the same questions.

Interviewed ORLs had a median age of 47 (40, 51 I and III quartile) and 86.1% of them were male. The median number of years at work was 18, the median number of years worked in the current Institution was 9 and in the current Department 8. To avoid the possible multiple counting of each injury occurred in the same Department, responses for all cases in the same department were weighted for the number of ORLs working in the same department.

4.1. Estimation of the unreported injuries

The total number of injuries recalled by the ORLs was 174. Table 3 shows the number of ORLs working in each Institution and the mean number of children having a hospitalization for a foreign body injury as recalled by physicians in each Department. In three centers no cases of

Table 3
Institutions, number of otorhinolaryngologists working in each institution and mean number of observed cases in each institution

Institution	Number of otorhinolaryngologists	Mean number of cases
Gradenigo	3	0.0
Molinette 2	4	3.5
Molinette 3	10	1.9
Alba	5	2.4
Asl 19	6	0.7
Ivrea	1	0.0
Ciriè	5	1.8
Maria Vittoria	6	3.0
Mauriziano	9	2.0
S. Croce Cuneo	5	0.4
S. Giovanni Bosco	6	0.0
SS. Annunziata	4	1.0
Tortona	4	17.5
Vercelli	4	1.0

hospitalization for foreign body injuries in children were observed, whereas the maximum number of children hospitalized was observed in the hospital of Tortona (17.5 weighted cases). According to ISTAT (Sistema statistico nazionale–Istituto nazionale di statistica 1992–1997), Piemonte has a population of 4,303,000 people, 546,000 of which are children under 15.

4.2. The choice of subpopulation of known size

The choice of the suitable subpopulations to use in the estimates of the social network sizes is the most important and sensitive operation to carry out in this methodology.

The basic idea of the scale-up method is that the mean number of people known in a subpopulation is linearly proportional to the size of the same subpopulation (Killworth and McCarty, 2003). Sometimes this linearity is not hold, which could be due to problems of barrier and transmission effect (Johnsen and Bernard, 1995; McCarty and Killworth, 2000; Killworth and McCarty, 2003). Therefore, we decided to choose the final subgroups to be used in the estimation by assessing the linear relation between the subpopulation sizes and the mean number of people recalled by respondents for each subgroup. We tested first if the linearity between the mean number of people known in each subpopulation and the relative subpopulation size holds. For this evaluation we set up a regression model with the mean number known in each subpopulation as dependent variable and the relative size of the subpopulations as independent. The regression model with all the 25 subgroups accounted only for the 32% of the variability (adjusted $R^2 = 0.32$), showing that some subpopulations were not in linear relation. Therefore, using a graphical analysis of residuals we eliminated five subpopulations, the resulting adjusted R^2 being 0.79. The eliminated subpopulations were: (i) ‘people living in rented houses’, (ii) ‘self employed’, (iii) ‘families with seven or more components’, (iv) ‘farmers’ and (v) ‘unlettered’. The residuals for all the 25 subpopulations were represented in Fig. 1. Three out of the five eliminated subpopulations – ‘people living in a rented house’, ‘families with seven or more components’ and ‘unlettered’ – overestimated the size of the subpopulation and in particular the population ‘people living in a rented house’ is highly overestimated. The subpopulations ‘self employed’ and ‘farmers’ were underestimated.

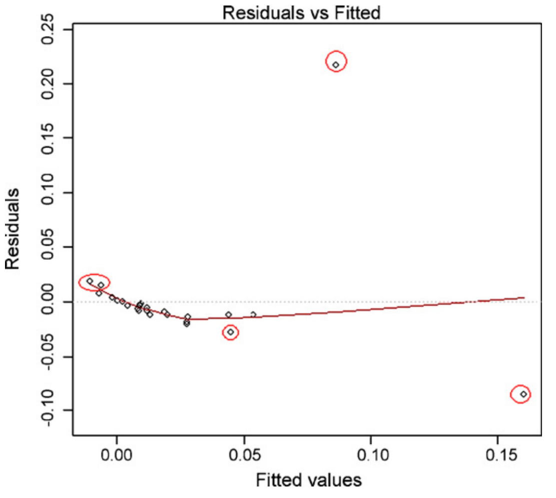

Fig. 1. Residuals vs. fitted values. In the circle the eliminated subpopulations.

Moreover, Fig. 2 shows the predicted estimated subpopulation sizes versus the actual sizes.

With the chosen 20 subgroups we estimated the social network size of each ORL involved in the study ($\hat{c}_i$); the mean network size of the otorhinolaryngologists was 947.3 (95% C.I. 810.7–1083.9) people. A previous estimate of the mean social network size of an American study was of 286 people (Killworth and McCarty, 1998).

4.3. The estimated number of foreign body injuries

The estimated social network sizes were then used for estimating the number of children younger than 15 hospitalized for an injury due to a foreign body in the years 1999–2000–2001

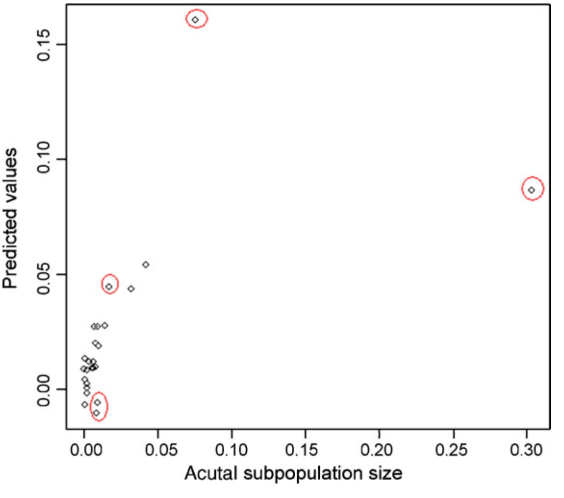

Fig. 2. Predicted subpopulation size vs. Actual size of the subpopulations. In the circle the eliminated subpopulations.

Table 4
Results of bootstrap: social network size bootstrap estimates, target subpopulation bootstrap estimates and respective standard errors

Percentiles (‰)	Bootstrap estimate of social network size	S.E. of social network size	Bootstrap estimate of target subpopulation	S.E. of target subpopulation
10	897.4	74.9	299.1	50.3
20	913.8	75.6	293.7	49.4
30	922.8	76.0	290.8	48.9
40	935.3	76.5	287.0	48.2
50	948.5	77.0	283.0	47.6
60	959.8	77.5	279.6	47.0
70	969.5	77.9	276.8	46.5
80	974.8	78.1	275.3	46.3
90	980.4	78.3	273.7	46.0

Each decile of the social network size bootstrap estimate was used for the target subpopulation bootstrap estimate.

($\hat{e}$). The resultant estimate was of 281 (95% C.I. 188.5–374.6) hospitalizations due to foreign body injuries.

Official data indicates that the number of foreign body injuries in children, as recorded in the Hospital official discharge database, was for the years 1999–2000–2001 equal to 218 injuries (Ministero della Salute, 2004).

4.4. Robustness to distributional assumptions

In order to evaluate the robustness of the estimated standard error with respect to the asymptotic normality, a nonparametric bootstrap estimate was performed, both on social network and target subpopulation size.

For the bootstrap estimate of the social network size of each respondent we replicated 1000 independent samples with replacement by re-sampling the answers given by respondents about the known subpopulation.

Then we get the 0.1, 0.2, . . ., 0.8 and 0.9 quantiles of the bootstrap estimate of social network sizes. For each quantile we performed a bootstrap estimate of the target subpopulation size by replicating 1000 independent samples with replacement, re-sampling the answers of respondents about the number of people known in the target subpopulation.

The results are presented in Table 4 and are divided by quantiles. No differences emerge comparing the re-sampled estimates with the standard estimates. The mean bootstrap estimate for the social network sizes was 943.4 people (bootstrap S.E.: 1097.3) and this result is almost the same of the mean of estimates (947.3). Finally, also the estimate of the target subpopulation size is almost similar to the bootstrap estimate (282.7 versus 281.1 injured children, bootstrap S.E.: 79.0).

4.5. The choice of subpopulations

A sensitivity analysis was carried out to understand how estimates depend on the specific set of subpopulations used in the analysis. Therefore, a cross-validation was performed, excluding one of the subpopulations of known size at a time, and estimating e and c in each occasion. For each subpopulation, Table 5 shows the mean estimates of social network sizes and the target subpopulation size omitting the subgroup and presents also the total size obtained excluding

Table 5
Results of the sensitivity analysis for each subpopulation excluded from the analysis: total size of known subpopulations without the excluded subgroup, social network size estimate, target subpopulation estimate and respective standard errors

	Excluded subpopulation	Total size without the excluded subgroup	Estimate of social network size	S.E. of social network size	Estimate of the target subpopulation	S.E. of target subpopulation
1	Maria	658274	917.8	68.5	290.6	49.0
2	Anna	674111	923.2	68.6	288.9	48.7
3	Rosa	679416	939.7	69.4	283.8	47.9
4	Giuseppina	679492	932.7	69.1	285.9	48.2
5	Angela	679567	935.7	69.2	285.0	48.1
6	Giovanna	679946	921.8	68.7	289.3	48.8
7	Giuseppe	627735	961.4	70.3	277.4	46.8
8	Antonio	646604	950.1	69.9	280.7	47.3
9	Giovanni	649862	929.5	69.0	286.9	48.4
10	Francesco	655167	935.5	69.2	285.1	48.1
11	Mario	660092	942.8	69.5	282.9	47.7
12	Luigi	660244	947.7	69.7	281.4	47.5
13	Graduates in physical education	683885	923.4	68.8	288.8	48.7
14	Women with one child	506730	1130.2	75.8	236.0	39.8
15	Houses with more than six inhabitants	549929	1063.4	75.0	250.8	42.3
16	Women with three or more children	654703	955.2	69.7	279.2	47.1
17	Graduated at school of arts	684056	942.3	69.5	283.0	47.7
18	Sport trainers	687042	911.5	68.1	292.6	49.3
19	Architects	684185	907.4	67.9	293.9	49.6
20	People living in assistance institute	663360	943.4	69.9	282.7	47.7

Table 6
Center choice

	Excluded center	Number of physicians working	Mean estimate of social network size	S.E. of social network size	Estimate of target subpopulation	S.E. of target subpopulation estimate
1	Ciriè	5	859.3	67.3	316.4	54.8
2	Mauriziano	9	999.8	71.4	287.5	50.0
3	Ivrea	1	946.3	69.6	285.8	48.2
4	Tortona	4	966.2	70.2	146.8	34.9
5	S.G. Bosco	6	992	71.2	293.3	49.5
6	Cuneo	5	897.5	68.4	315.7	53.5
7	Asl 19	6	956.9	69.5	298.3	50.8
8	SS. Annunziata	4	975.8	70.8	281.1	48.1
9	Molinette 2	4	973.0	70.6	261.3	46.4
10	Molinette 3	10	976.0	70.8	300.2	52.0
11	Maria Vittoria	6	994.4	71.4	267.6	47.2
12	Vercelli	4	903.9	67.8	303.5	51.9
13	Alba	5	866.1	67.1	308.3	53.9
14	Gradenigo	3	961.0	70.0	289.6	48.8

Sensitivity analysis estimate: number of otorhinolaryngologists working in each center excluded from the analysis, mean social network size estimate, target subpopulation estimates and respective standard errors.

that subpopulation. This analysis shows that excluding one subpopulation at a time we obtained almost the same results than using all the subgroups, except in two cases ("Women with one child" and "Houses with more than six inhabitants"). As expected, the estimates, excluding the two subpopulations with the largest sizes, have the biggest differences from the estimates obtained employing all the subpopulations.

4.6. Center choice (sample selection)

In order to study how estimates are related to a specific observed sample and in particular with reference to the set of centers used in the analysis, we set up a sensitivity analysis. Therefore, a cross-validation was performed, excluding one of the centers at a time, and estimating e and c in each occasion.

Results are contained in Table 6, where it is shown that for each omitted department the estimates are almost the same both for the social network size (range: 859.3–999.8) and for the target subpopulation size (range: 146.8–316.4).

5. Discussion

The scale-up method proved to be able to provide valid information on the number of injuries treated in a given region. Indeed, the estimated number of injuries matches the estimate based on the discharge records, the latter being within the 95% confidence bounds. The estimate of the social network size for the otorhinolaryngologists is bigger than the one of other studies (286 persons) and this is probably due to the big amount of people that a physician usually knows and meets.

The cross-validation and bootstrap analysis suggest that this estimator is robust and the sensitivity analysis shows that in the scale-up method the choice of the appropriate subpopulation is of paramount importance. A Monte Carlo simulation study might be helpful in understanding the effect of coverage (i.e. the sum of the sizes of known size subpopulation on the general population size) on the correctness of the estimates. The center choice does not seem to affect estimates.

In order to choose the subpopulations of known size we used an algorithm based on the regression model that is simply to be implemented and seems useful for our purposes. Clearly, this kind of selection algorithms has to be specified before the analysis is started.

However, both the method and the study are characterized by several limitations. It is reasonable to think that the number of people belonging to the eliminated subpopulations was difficult to count for a physician due his/her particular social position, which makes it very difficult for him/her to meet certain categories of people (e.g. ‘farmers’). Unfortunately the problems due to the barrier and transmission effects are only reduced by the selection algorithm adopted in the present work but not solved by it. Therefore the best solution is to choose the subpopulations suitable for the selected sample, e.g. subgroups that we suppose are known by our sample with a higher or lower probability than the general population.

The barrier and transmission effects could affect also the estimates of the number of injuries. Obviously some kinds of accidents are more common in some regions and countries than in others (Mullins and Diggs, 2006) but if we focus the studies on specific geographical areas these types of injuries could be nevertheless estimated with a sufficient degree of accuracy. Moreover the barrier and the transmission effect are also due to the social characteristics of the people interviewed, but probably information about all kinds of injuries (omitting the violence) is well transmitted to the acquaintance. The major problem is to recall the injuries of minor severity: some studies show that even parents tend to forget less serious accidents occurred to their children (Scheidt and Brenner, 2000; Cummings and Rivara, 2005). Moreover, physicians recall more accurately the injuries they treat than those they are just aware of, within their working social network.

In conclusion, our results show that the scale-up method estimates are an efficient and precise way to estimate the size of unknown subpopulations in the context of injury research with very selected populations (like the one represented by the otorhinolaryngologists). Our study also shows that the choice of subpopulation is a crucial aspect, which can be improved with the selection algorithm proposed in the paper, but which still remains also a matter of adequacy to the specific substantive problem. In this particular regard, the paper also suggests a series of sensitivity analyses, which should be used in the concrete application of the scale-up methods.

References

Altmann, A., Nolan, T., 1995. Non-intentional asphyxiation deaths due to upper airway interference in children 0–14 years. Injury Prevention 1 (2), 76–80.

Bernard, H.R., Johnsen, E., et al., 1989. Estimating the size of an average personal network and of an event population. In: Kochen, M. (Ed.), The Small World. Ablex Publishing, Norwood, NJ.

Bernard, H.R., Johnsen, E.C., et al., 1990. Comparing four different methods for measuring personal social networks. Social Networks 12, 179–215.

Bernard, H.R., Johnsen, E.C., et al., 1991. Estimating the size of an average personal network and of an event subpopulation: some empirical results. Social Science Research 20, 109–121.

Bernard, H.R., Killworth, P.D., et al., 2001. Estimating the ripple effect of a disaster. Connections 24 (2), 18–22.

Bernard, H.R., Killworth, P.D., et al., 1990. Estimating the size of personal networks. Social Networks 23, 289–312.

Cummings, P., Rivara, F.P., et al., 2005. Ability of parents to recall the injuries of their young children. Injury Prevention 11, 43–47.

Freeman, L.C., Thompson, C.R., 1989. Estimating acquaintanceship volume. In: Kochen, M. (Ed.), The Small World. Norwood, NJ, Ablex Publishing, pp. 147–158.

Guard, A., Gallagher, S.S., 2005. Heat related deaths to young children in parked cars: an analysis of 171 fatalities in the United States, 1995–2002. Injury Prevention 11 (1), 33–37.

Johnsen, E.C., Bernard, H.R., et al., 1995. A social network approach to corroborating the number of AIDS/HIV victims in the US. Social Networks 17, 167–187.

Killworth, P.D., McCarty, C., et al., 2003. Two interpretations of reports of knowledge of subpopulation sizes. Social Networks 25, 141–160.

Killworth, P.D., McCarty, C., et al., 1998. Estimation of seroprevalence, rape and homelessness in the U.S. using a social network approach. Evaluation Review 22, 289–308.

McCarty, C., Killworth, P.D., et al., 2000. Comparing two methods for estimating network sizes. Human Organization 60, 28–39.

Ministero della Salute, 2004. Dati di ricovero—classificazione ICD-9 CM. 2005, from www.ministerosalute.it.

Morrison, A., Stone, D.H., 2000. Capture-recapture: a useful methodological tool for counting traffic related injuries? Injury Prevention 6 (4), 299–304.

Mullins, R.J., Diggs, B.S., et al., 2006. Regional differences in outcomes for hospitalized injured patients. Journal of Trauma 60 (4), 691–698, discussion 699–700.

Rahman, F., Andersson, R., et al., 2000. Potential of using existing injury information for injury surveillance at the local level in developing countries: experiences from Bangladesh. Public Health 114 (2), 133–136.

Scheidt, P.C., Brenner, R.A., et al., 2000. Parental attitudes regarding interviews about injuries to their children. Injury Prevention 6, 51–55.

Shelley, G.A., Bernard, H.R., et al., 1995. Who knows your HIV status? What HIV+ patients and their network members know about each other. Social Networks 17, 189–217.

Sistema statistico nazionale—Istituto nazionale di statistica (1992–1997). 13. Censimento generale della popolazione e delle abitazioni: 20 ottobre 1991, ISTAT.

Snidero, S., Corradetti, R., et al., 2004. The network scale-up method: a simulation study in case of overlapping sub-popualtions. Metodoloski Zvezki 1 (2), 395–405.

Zigon, G., Gregori, D., et al., 2006. Child mortality due to suffocation in Europe (1980–1995): a review of official data. ACTA Otorhinolaryngologica Italica 26 (3), 154–161.