



## POPULATION STUDY ARTICLE

## Awareness of abusive head trauma in a German population-based sample: implications for prevention

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**BACKGROUND:** Despite efforts to reduce the incidence of abusive head trauma (AHT), incidence rates remain high. One cause is that prevention programs mostly aim to educate mothers of newborns on AHT and infant crying. However, mothers commonly have already a high knowledge and constitute only a minority among identified AHT perpetrators. The hypothesis was that there are great differences in AHT awareness in different subgroups. To assess awareness of AHT, a population-based study was performed.

**METHODS:** A population-based representative sample of the German population aged >14 years ( $N = 2510$ ) was assessed in a cross-sectional observational survey. The sample was selected in a random route approach between November 2017 and February 2018.

**RESULTS:** Overall knowledge of AHT was higher in women (67.9%) than in men (48.8%,  $p < 0.001$ ). Female gender, having children, higher age, and level of education were predictors for the awareness of AHT. A majority of participants reported to have heard about AHT from the media.

**CONCLUSIONS:** Awareness of AHT differs significantly within the population. In groups at higher risk to perpetrate AHT, including men, young caregivers, and those with low educational level, awareness of AHT was low. These subgroups should be targeted by tailored education programs for prevention.

*Pediatric Research* (2019) 86:537–541; <https://doi.org/10.1038/s41390-019-0467-8>

## INTRODUCTION

In spite of a number of different preventive programs in the past decade,<sup>1–7</sup> incidence rates of abusive head trauma (AHT) remain high.<sup>8,9</sup> Incidence rates estimated in two studies by Boop and Dias vary between 22.0/100,000 live births and 47.4/100,000 live births. Data from Switzerland suggest a lower incidence (14/100,000 live births, ref. <sup>10</sup>), whereas the German Society of Pediatric Surgery estimates that there might be 100–200 cases per year in Germany.<sup>11</sup> Given the birth rate of 784,901 in 2017,<sup>12</sup> this estimate translates into an incidence rate of 12.7–25.5/100,000 live births. Most campaigns prove effective in educating mothers about AHT. However, there are only few studies looking at an actual decrease in local AHT incidence rates—with heterogeneous results.<sup>13–16</sup> Some studies revealed no effect at all,<sup>15,16</sup> whereas Dias et al. found a decrease of 47% in AHT incidence.<sup>14</sup> Furthermore, Altman et al. showed a 76% decrease in AHT incidence rates after targeted education programs for parents shortly after birth of their child.<sup>13</sup> In a recent study from Canada, Barr was able to reproduce a decrease of AHT incidence with a similar prevention program.<sup>17</sup> Interestingly, all three positive studies systematically had targeted both mothers and fathers and reported percentages of at least 40.5% male participants,<sup>13,14,17</sup> while the studies without effect focused mainly on mothers.<sup>15,16</sup> However, analyses of perpetrator characteristics consistently reported that only a minority of AHT

had been committed by the child's mother.<sup>18–21</sup> More frequently, fathers or men biologically unrelated to the child and unmarried to the child's mother ("mother's boyfriend") had been identified as perpetrators. Data on risk factors of AHT are rather scarce in Europe, but perpetrator characteristics seem to be rather consistent in Europe and the U.S., as studies from France, Belgium, and the U.S. suggest.<sup>18–22</sup> The mean age of male perpetrators was 27 years and thus lower than the mean age of female perpetrators (34 years).<sup>18</sup> This indicates that (young) men are a highly relevant group for targeted prevention strategies. Leventhal et al. emphasized this fact in a recent editorial to *JAMA Pediatrics*.<sup>23</sup> Other risk factors for AHT include low socioeconomic status, low education, young or single mother, and previous involvement of welfare services.<sup>24–27</sup> Another important risk group for AHT are female babysitters, accounting for up to 17.3% of cases.<sup>20</sup> Finkelhor and Ormrod reported that female babysitters being charged with physically harming the children in their care were usually in their teens.<sup>28</sup>

Whereas these data suggest the relevance of specific subgroups for targeted preventive strategies, there is an evident lack of research that assesses AHT awareness in these groups. With one exception, existing studies examined the awareness of AHT primarily in parent samples or only in mothers of young children.<sup>1,4,6,14,29–31</sup> Therefore, a representative population-based

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Received: 30 January 2019 Revised: 4 June 2019 Accepted: 8 June 2019

Published online: 18 June 2019

survey was conducted to assess the awareness of AHT in the German population stratified for gender, age groups, existence of children, and education level. The hypothesis was that there might be great differences in AHT knowledge in different subgroups, rendering them crucial target groups for tailored educational campaigns to prevent AHT.

## METHODS

### Survey

The survey was conducted by a social research institute (USUMA, Berlin, Germany) between November 2017 and February 2018. A representative sample of the German population of  $\geq 14$  years was examined. To assure representativeness, a random route approach was chosen to select participants: Germany was first geographically grouped into 258 areas; in each area, one sample point was stochastically defined. Starting from the sampling points, the interviewers had to contact every third household until 20 households have been contacted. Using a Kish-Selection-Grid, a pre-assigned table of random numbers,<sup>32</sup> participants were selected randomly in multi-person households. The interviewers made appointments to meet with the selected household member to maximize inclusion of working subjects. Inclusion criteria were sufficient German language skills and age  $\geq 14$  years. Of the 5160 initially contacted households, 2531 persons completed the survey. Main reasons for non-participation were refusal by the selected household to identify the person of target (16.5%), refusal to participate (15.8%), and failure to contact anyone in the residence after four attempts (14.4%). Participants were informed about the study and informed consent was obtained. In the case of minors, participants gave informed assent with informed consent being provided by their caregivers. Participants agreed to take part without compensation. Responses were anonymized. Socio-demographic data was obtained by interview. Participants then completed a questionnaire with 124 questions, comprising questions from various areas of research (the questions on AHT are provided in English as an online supplement). The questionnaires were then sealed in an envelope. The questionnaire was linked to the socio-demographic data but did not contain any data to identify the participant.

The study was conducted in accordance with the Declaration of Helsinki and fulfilled the ethical guidelines of the International Code of Marketing and Social Research Practice of the International Chamber of Commerce and of the European Society of Opinion and Marketing Research. Approval by the Ethics Committee of the Medical Department of the University of Leipzig was obtained.

### Measures

Socio-demographic questions covered among others: age, gender, educational level, occupation, marital status, number of persons aged  $< 18$  years in the household, and the number of one's own children. School graduation was defined as any graduation after 9 years of school, which is the compulsory minimal level of education in Germany. Attending school means any school below higher education.

Awareness of AHT was assessed by asking "Have you ever heard of shaken baby syndrome"? The common term in Germany is still "Schütteltrauma", ("shaking trauma"), so in the questionnaire AHT was referred to by "Schütteltraumasyndrom" ("shaken baby syndrome"). To assess the awareness of the potential fatality of AHT, only participants who have heard about AHT before were asked "Do you think death can result from Shaken Baby Syndrome?"

Sources of information were assessed in those participants who reported being aware of AHT by asking "How did you learn about Shaken Baby Syndrome?" Finally, participants were asked "What

do you consider as the best method of information about Shaken Baby Syndrome?"

### Participants

To test the hypothesis that AHT awareness might be different in different subgroups, a subgroup of young men and women aged  $< 25$  years was defined. This cutoff was chosen as this age group includes female adolescents who are likely to qualify as babysitters. Also, the mean age of male perpetrators from previous studies has been reported to be 27 years.<sup>18</sup> Consequently, it was important to analyze the awareness of young men before that age.

To analyze the preferred means of information, two potential target groups were defined. First, a "high-risk group" with participants without graduation and without children, and second, a "low-risk group" of participants with academic degree and children.

### Statistical analyses

All analyses were conducted using SPSS version 21. Descriptive analyses were performed for prevalence rates. Comparisons were conducted using Chi<sup>2</sup> tests. From the literature on perpetrator characteristics (male, young age, biological vs. non-biological relation), the following predictors for the knowledge on AHT were chosen and tested in a binary logistic regression analysis: age as a continuous variable; gender, the existence of one's own children, and educational achievement as potential predictors.

## RESULTS

Two thousand five hundred and thirty-one participants completed the questionnaire; 55.4% ( $n = 1401$ ) were female. Mean age was 48.6 years (14–93 years). The sample was representative of the German population in regard to age and gender. Relevant sample characteristics are presented in Table 1.

### Awareness of AHT

Overall, 59.4% ( $N = 1503$ ) reported that they had heard of AHT before. Awareness was higher in women compared to that in men. Awareness was lowest among those aged  $< 25$  years (37%). Awareness was  $> 60\%$  in all other age categories. Participants with children reported a higher awareness compared to those without children. Awareness increased with the level of education (Table 2A).

Female gender, having children, and higher level of education were shown to be predictors for the awareness of AHT. In sum, the predictors included in the binary logistic regression explained 10% of the variance (Nagelkerke's  $R^2 = 0.1$ ). The odds to be aware were double for women compared to men and for participants who had children compared to those without. Odds were three-fold higher for participants who had achieved any school graduation and four-fold higher for those with an academic degree compared to participants who were still attending school (Table 2B).

### Awareness of dangers of AHT

Of those who affirmed knowledge on AHT ( $n = 1503$ ), 90.8% ( $n = 1365$ ) reported that they thought AHT could potentially result in death. No differences were seen for gender while participants aged  $< 25$  years considered death as a consequence of AHT less frequently (Table 3).

### Sources of information about AHT

Of those who had heard of AHT before, the vast majority reported to have heard about AHT in the media and news (83.8%). Healthcare professionals (physicians, midwives, and others) represent the second largest source of information, but only for participants with children (16.3, 15.2, and 14.4%,

**Table 1.** Characteristics of the population representative sample, presented as mean (M) and standard deviation (SD) for age and number of subjects (%) for other characteristics

	Total (n = 2531)	Female (n = 1401, 55.4%)	Male (n = 1130, 44.6%)
Age, M (SD)	48.6 (18.0)	48.7 (18.0)	48.4 (18.1)
Living with a partner	1351 (53.4%)	734 (52.4%)	617 (54.6%)
Subjects with own children	1586 (62.7%)	949 (67.7%)	637 (56.4%)
German citizenship	2429 (96.0%)	1359 (97.0%)	1070 (94.7%)
Educational level			
Left school before graduation	56 (2.2%)	40 (2.9%)	16 (1.4%)
School graduation	2169 (85.7%)	1222 (87.2%)	947 (83.8%)
Academic degree	233 (9.2%)	103 (7.4%)	130 (11.5%)
Attending school	65 (2.6%)	33 (2.4%)	32 (2.8%)
Occupational status			
Full-time	1067 (42.4%)	429 (30.8%)	638 (56.8%)
Part-time	285 (11.3%)	260 (18.7%)	25 (2.2%)
<15 h/week	83 (3.3%)	71 (5.1%)	12 (1.1%)
Federal volunteer service/parental leave	26 (1.0%)	23 (1.7%)	3 (0.3%)
Unemployed	125 (5.0%)	68 (4.9%)	57 (5.1%)
Retiree	640 (25.4%)	350 (25.1%)	290 (25.8%)
Homemaker	79 (3.1%)	76 (5.5%)	3 (0.3%)
In training	62 (2.5%)	36 (2.6%)	26 (2.3%)
Student	149 (5.9%)	80 (5.7%)	69 (6.1%)

**Table 2A.** Participants who answered the question "Have you ever heard of shaken baby syndrome" with yes, presented as percentage (N = 2531)

	Total	Female	Male
	59.4% (1503)	67.9% (951)	48.8% (552)
<i>p</i>			<0.001
Age in years			
<25	37.0% (107)	46.2% (73)	26.0% (34)
25–40	63.5% (385)	76.7% (254)	47.6% (131)
41–55	63.4% (425)	71.1% (270)	53.4% (155)
>55	60.7% (586)	66.5% (354)	53.5% (232)
<i>p</i>	<0.001	<0.001	<0.001
Children			
Yes	66.3% (1052)	72.7% (690)	56.8% (362)
No	47.7% (448)	57.8% (260)	38.4% (188)
<i>p</i>	<0.001	<0.001	<0.001
Educational level			
Left school before graduation	41.1% (23)	50% (20)	18.8% (3)
School graduation	60.3% (1307)	68.3% (835)	49.8% (472)
Academic degree	64.4% (150)	75.7% (78)	55.4% (72)
Attending school	26.6% (17)	45.5% (15)	6.3% (2)
<i>p</i>	<0.001	0.02	<0.001

**Table 2B.** Binary logistic regression showing predictors for the awareness of AHT

Awareness of AHT	OR (95% CI)	<i>p</i>
Gender (female)	2.16 (1.8–2.55)	<0.001
Age	0.996 (0.99–1.00)	0.10
Children	2.07 (1.70–2.52)	<0.001
Left school before graduation	1.22 (0.55–2.74)	0.62
Any school graduation	3.24 (1.79–5.86)	<0.001
Academic degree	4.61 (2.41–8.81)	<0.001
Attending school	Ref.	

AHT abusive head trauma, CI confidence interval, OR odds ratio

**Table 3.** Participants who considered "death" as a possible consequence of AHT, presented as percentage (N)

	Total	Female	Male
	90.8% (1365)	90.9% (864)	90.8% (501)
<i>p</i>		>0.05	
Age in years			
<25	82.2% (88)	86.3% (63)	73.5% (25)
25–40	90.1% (347)	90.6% (230)	89.3% (117)
41–55	93.9% (399)	93.7% (253)	94.2% (147)
>55	90.6% (531)	89.8% (318)	91.8% (213)
<i>p</i>	0.03	0.25	0.06
Children			
Yes	92.2% (971)	91.9% (634)	92.8% (337)
No	87.5% (392)	88.1% (229)	86.7% (163)
<i>p</i>	0.002	0.07	<0.01

Answered only by participants who answered the question "Have you ever heard about shaken Baby Syndrome?" with yes (n = 1503)

**Means of information about AHT**

The majority of participants were in favor of written material or TV campaigns as the best method of information, followed by courses. Only two thirds considered online sources as their method of choice, and only almost half radio broadcasts. While 83.1% of the low-risk group favored written material to be informed about AHT, in the high-risk group only 42.9% favored this method (Table 5, online only).

**DISCUSSION**

Education is the most commonly used measure to prevent AHT, but despite many educational programs worldwide, the incidence remains high.<sup>8,9,17</sup> Almost all campaigns that are being reported in the literature approach mothers in maternity wards or shortly after discharge, offering information on the nature of infant crying, safe possibilities to react if an infant is crying inconsolably, and the dangers of shaking an infant.<sup>1–4,6,7,13,14,16,31</sup> Only a few studies systematically had included fathers or other relevant groups like babysitters.<sup>9,13,14,33</sup> Importantly, those non-related potential caregivers are mostly not present when information is offered. However, previous research showed that, among all perpetrators of AHT, mothers of the affected children were a minority.<sup>18–20,22</sup> While incidence rates vary even between Western countries, perpetrator characteristics seem to be rather consistent. This raises concern that we might be missing important groups for intervention.

respectively). For participants aged <25 and >55 years, health-care professionals were a less important source as in other age groups. For the young, friends seemed to be a more important source (30.8%, Table 4).

**Table 4.** Answers to the question “How did you hear about Shaken Baby Syndrome?,” multiple selections possible

	Physician	Midwife	Other medical staff	Media/news	Friends	Colleagues	Other	No response
Sources of information about AHT?	14.5% (218)	11.5% (173)	12.8% (192)	83.8% (1,252)	24.2% (363)	8.3% (124)	5.9% (88)	0.6% (9)
Gender								
Female	15.6% (148)	14.8% (141)	13.2% (126)	83.8% (797)	23.7% (225)	8.0% (76)	6.4% (61)	0.5% (5)
Male	12.7% (70)	5.8% (32)	12.0% (66)	83.9% (463)	25% (138)	8.7% (48)	4.9% (27)	0.7% (4)
<i>p</i>	0.13	<0.001	0.47	0.97	0.56	0.63	0.23	0.2
Children								
Yes	16.3% (172)	15.2% (160)	14.4% (125)	84.3% (887)	24% (253)	8.3% (87)	5.2% (55)	0.8% (8)
No	10.3% (147)	2.9% (13)	0.9% (40)	82.8% (371)	24.1% (108)	8% (36)	7.4% (33)	0.2% (1)
<i>p</i>	<0.01	<0.001	0.01	0.56	0.23	0.28	0.25	>0.05
Age in years								
<25	14.0% (15)	10.3% (11)	9.3% (10)	74.8% (80)	30.8% (33)	7.5% (8)	14.0% (15)	0% (0)
25–40	20.5% (79)	16.1% (62)	14.5% (56)	82.1% (316)	27.8% (107)	9.4% (36)	5.7% (22)	0.8% (3)
41–55	15.5% (66)	12.9% (55)	15.8% (67)	86.1% (366)	24.9% (106)	8.9% (38)	4.9% (21)	0.2% (1)
>55	9.9% (58)	7.7% (45)	10.1% (59)	85.0% (498)	20% (117)	7.2% (42)	5.1% (30)	0.9% (5)
<i>p</i>	<0.001	0.001	0.02	0.02	0.01	0.60	<0.01	>0.05

Presented as percentage of participants (*N*). Answered only by participants who answered the question “Have you ever heard about shaken Baby Syndrome?” with yes (*n* = 1503)

**Table 5.** Answers to “What do you consider as the best method to inform about Shaken Baby Syndrome?,” multiple selections possible

	Written material	TV campaign	Online webpage	Courses	Radio	Others
Favored methods to inform about AHT?	82.4% (916)	79.0% (879)	56.3% (626)	71.9% (799)	47.3% (526)	12.5% (139)
High-risk group	42.9% (9)	85.7% (18)	38.1% (8)	71.4% (15)	38.1% (8)	14.3% (3)
Low-risk group	83.1% (907)	78.9% (861)	56.6% (618)	71.9% (784)	47.5% (518)	12.5% (136)
<i>p</i>	<0.001	0.58	0.23	0.91	0.51	0.55

Presented as percentage (*N*). Answered only by participants who answered “Have you ever heard about shaken Baby Syndrome?” with yes. Risk groups were defined by the results of the regression analyses

In the present study, the overall knowledge of AHT was higher in women (67.9%) than in men (48.8%). These rates were somewhat lower than reported from Connecticut and France and considerably lower in comparison to Dias et al.<sup>1,6,14</sup> This can be explained by the different samples that had been targeted, as these previous studies focused primarily on mothers shortly after giving birth. This is in line with results of the present study with the highest awareness of AHT (72.7%) in women with children.

The exceptionally high AHT awareness in the cohort of Dias et al. could have been caused by two effects as the authors themselves discussed: the study was conducted 1 year after a famous case of AHT had been covered extensively in the media and two prevention programs had started in the region.<sup>14</sup>

An important finding of the present study was the low level of awareness of AHT in young men and women with low levels of education. Low educational and socioeconomic status has been identified as important risk factors for any type of child maltreatment.<sup>24–27</sup> The lack of knowledge about AHT is yet an additional risk factor—resulting in a potentially dangerous accumulation of risks. It is thus paramount to include this group into comprehensive preventive efforts.

Regarding the dangers of shaking, similar tendencies were observed: overall, a majority of 90% of the participants knew of potentially fatal consequences of shaking a baby. As only those who were aware of AHT per se were asked this, the high figure is not surprising. Lower rates can be assumed for participants who have not heard about AHT before. However, in the group of those aged <25 years this rate declines to 82.2%. This means that one fifth of young persons who know about AHT are not aware that

shaking a baby is life-threatening. This indicates that key messages of past information campaigns do not succeed to reach this group sufficiently.

Even among participants with children, only about 50% remembered being informed about AHT by a healthcare professional. In all groups, media was consistently the main source of information. In the high-risk group of young participants without children, TV campaigns were the most favorable way of education. Only a minority favored written material. Given that most campaigns offer leaflets or brochures as a form of education,<sup>1–4,6,7,13,14,16,31</sup> this method might not be effective for high-risk groups.

**Limitations**

This survey examined AHT awareness in a representative sample of the German population. As sufficient German language skills to complete the questionnaire were necessary, the study systematically excluded the non-German speaking population. In addition, people without German citizenship were under-represented in the sample. Because of the lack of language skills, this group might also be missed by education programs on AHT. Therefore, awareness on AHT might be lower than in the general public. Further studies are needed to investigate awareness of AHT in this specific population.

Although German data are reported, AHT awareness in women with children is comparable to AHT awareness of mothers in previous studies from the U.S.<sup>1</sup> Furthermore, as in the U.S. and other western countries, AHT prevention in Germany primarily targets parents shortly after birth. As we would show, perpetrator characteristics are similar throughout Europe and the U.S. We thus

believe that our findings are highly relevant for any western country that tries to prevent AHT by education programs.

As in all surveys, social desirability bias is an issue. To minimize this bias, the survey was designed to administer anonymous questionnaires rather than interviewing the subjects. The answers were dependent on the participant's memories. This could have blurred results, especially underestimated the role of healthcare professionals as source of information on AHT.

In summary, the results indicate that men, young people without children, and those with low educational level—e.g., fathers, new boyfriends of mothers, and babysitters—have very low knowledge about AHT. Considering that these groups are known to be at higher risk to perpetrate AHT, preventive effort should target these groups. As media campaigns seem to be the most favored method, further research is needed as to how an effective design of such a media campaign could look like. Then broad media campaigns, e.g., in proximity to popular sports events or TV shows popular to young adults and adolescents, should be meticulously planned and funded—and regularly repeated. Furthermore, the inclusion of AHT into school-based teenage pregnancy prevention programs should be discussed. Evaluations will show whether this can be a way to better reach the subgroups at particular risk to perpetrate AHT.

## AUTHOR CONTRIBUTIONS

O.B., A.W., and V.C. conceptualized and designed the study, carried out the initial analyses, drafted the initial manuscript, and reviewed and revised the manuscript. E.B., P.L.P., and J.M.F. conceptualized and designed the study, designed the data collection instruments, coordinated and supervised data collection, and critically reviewed the manuscript for important intellectual content. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

## ADDITIONAL INFORMATION

The online version of this article (<https://doi.org/10.1038/s41390-019-0467-8>) contains supplementary material, which is available to authorized users.

**Competing interests:** P.L.P. has received research funding from the Bundesinstitut für Arzneimittel und Medizinprodukte, BMBF (Federal Ministry of Education and Research), VW-Foundation, Baden-Württemberg Stiftung, Lundbeck, and Servier. P.L. holds no stocks of pharmaceutical companies. Within the past five years, J.M.F. received research funding from the European Union (EU), German Research Foundation (DFG), the German Federal Ministry of Health (BMG), the German Federal Ministry of Education and Research (BMBF), the German Federal Ministry of Family Affairs, Senior Citizens, Women and Youth (BMFSFJ), several state ministries of social affairs, State Foundation Baden-Württemberg, Volkswagen Foundation, European Academy, Pontifical Gregorian University, RAZ, CJD, Caritas, and Diocese of Rottenburg-Stuttgart. He has received travel grants, honoraria and sponsoring for conferences and medical educational purposes from the German Research Foundation (DFG), the American Academy of Child and Adolescent Psychiatry (AACAP), the National Institute of (Mental) Health (NIMH/NIH), the European Union (EU), Pro Helvetica, Janssen-Cilag (J&J), Shire, several universities, professional associations, and German federal and state ministries. He has conducted clinical trials for Janssen-Cilag, Lundbeck, the German Federal Ministry of Education and Research (BMBF) and Servier. He is in steering committees and DSMB for Lundbeck, Servier. Every grant and honorarium has to be declared to the law office of the University hospital Ulm. Potential conflicts of interests have to be declared to German Society for Child and Adolescent Psychiatry and Psychotherapy (DGKJP) and American Academy of Child and Adolescent Psychiatry (AACAP) annually, because of commission membership. He has no stocks, no interests in pharmaceutical companies, and is a majority owner of the 3Li institute. The other authors declare no competing interests.

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