Prevalence and Prognostic Factors of Disability After Childhood Injury

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ABSTRACT. ***Objective.*** **To assess the prevalence and the prognostic factors of disabilities after minor and major childhood injuries and to analyze which sociodemographic and injury-related factors are predictive for suboptimal functioning in the long term.**

Method. **We conducted a patient follow-up study in a stratified sample of 1221 injured children who were aged 5 to 14 years and had visited an emergency department in the Netherlands. Our study sample was stratified so that severe, less common injuries were overrepresented. Postal questionnaires were sent 2.5, 5, and 9 months after the injury. We gathered injury and external cause data, sociodemographic information, and data on functional outcome with a generic health status measure EuroQol (EQ-5D) with an additional cognitive dimension. A nonresponse analysis was performed by multivariate logistic regression, and the data were adjusted for nonresponse and the sample stratification. We performed bootstrap analysis to estimate the prevalence of disability in terms of the EQ-5D summary score and the occurrence of limitations in separate health domains: mobility, self-care, usual activities, pain/discomfort, anxiety/depression, and cognition. Respondents also rated their own health state on a visual analog scale, between 0 (worst imaginable health state) and 100 (best imaginable health state). We analyzed the relationship between functional outcome and sociodemographic (age and gender) and injury-related determinants (type of injury, external cause, multiple injury, admission to hospital, and length of stay) by logistic regression analysis.**

Results. **Response rates with respect to the original sample were 43%, 31%, and 30%, respectively. A total of 37% of the children were admitted to the hospital. The mean age of the children was 9.6 years. In two thirds (65%) of the cases, the injury was attributed to a home and/or leisure injury. The health status of injured children improved from 0.92 (EQ-5D summary score) at 2.5 months to 0.96 at 5 months and 0.98 at 9 months. Of all injured children, 26% had at least 1 functional limitation after 2.5 months, 18% after 5 months, and 8% still experienced functional limitations after 9 months. After 2.5 months, lower extremity fractures and other injuries (eg, spinal cord injury, injury of the nerves) demonstrated the worst functional outcome. Independent of the type of injury, our sample of injured children generally showed good recovery between 2.5 and 9 months. The highest prevalence of dysfunction after 9 months existed for pain/discomfort (7%) and usual activities (5%). Hospital admission (odds ratio: 3.6–5.8) and female gender (odds ratio: 3.0) were predictive for long-term disability. Girls reported more problems for all health domains (except self-care) compared with boys after 9 months, which was also confirmed by the visual analog scale score for self-related health (89 for girls vs 95 for boys). Almost one fifth of injured children with a hospital stay of >3 days still had pain and problems with usual activities 9 months after the injury. Three quarters of all residual problems were caused by nonhospitalized injuries.**

Conclusion. **Most children show quick and full recovery after injury, but a small subgroup of patients (8%) have residual disabilities after 9 months. Girls have a 3-fold risk compared with boys for long-term disability after childhood injury. Prognosis in the long-term is also negatively influenced by hospitalization, but in absolute terms, residual disabilities are frequently caused by injuries that are treated fully in the emergency department. The group of injured children with persistent health problems as identified in this study indicates the importance of health monitoring over a longer period in trauma care, whereas trauma care should be targeted at early identification and management of the particular needs of these patients.** ***Pediatrics*** **2005;116:e810–e817. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2005-1035;** ***injury, prevalence, prognostic factors, pediatrics.***

ABBREVIATIONS. ED, emergency departments; VAS, visual analog scale; CI, confidence intervals; OR, odds ratio; EQ-5D, EuroQol.

Injury has been widely recognized as a major public health problem and is the leading cause of death and morbidity among children in high-income countries.[1,2] Information on both short- and long-term functional outcome of injury and its major determinants demonstrates specific health consequences of different injuries and helps to identify patients who are at risk for severe or permanent disability. It therefore contributes to the evaluation and further improvement of preventive interventions and trauma care for children. Because of the considerable variety in functional consequences and recovery patterns of injuries, a uniform measurement of disability is a necessary and challenging task. Generic instruments thereby enable a uniform comparison of injuries among each other and with other health problems.

Several studies on the health consequences of injuries have been done before.[3–6] However, functional outcome in children has received little or no attention.[7] Assessment of patient outcome after injury for

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children so far has focused mainly on the psychological effects,[8–10] or only on the most severely injured trauma patients, including children with traumatic brain injury.[11–15] Few studies have described the impact of injuries on the health status of children with both minor and major injuries over time with a generic quality-of-life measure.[7,16]

This article describes a large follow-up study in injured children who were aged 5 to 14 years and had visited an emergency department in the Netherlands. This study is an extension of an earlier follow-up study on functional outcome of injured people who were aged 15 years and older with a similar design.[17] It provides uniform data on the levels of functioning and disability at 3 points in time until 9 months after injury, which gives information about the recovery pattern of children. We aimed to answer the following questions: (1) What is the functional outcome in children 2, 5, and 9 months after injury? (2) Which sociodemographic and injury-related factors are predictive for suboptimal functioning in the long term?

METHODS

Study Population and Follow-up

We conducted a patient follow-up study among 1221 injured children who were aged 5 to 14 years and had visited 1 of the emergency departments (EDs) of the Dutch Injury Surveillance System (LIS) between October 8, 2001, and December 31, 2002. LIS has been implemented in 17 hospitals in the Netherlands (15% coverage), in which all unintentional and intentional injuries are recorded. These hospitals are geographically spread across the country and are regarded to be representative of the total population. Our study sample was stratified so that severe, less common injuries were overrepresented.

Postal questionnaires were sent 2.5, 5, and 9 months after the injury. When the child was younger than 13 years, the parents were asked to complete the questionnaire, when possible together with the child.

All hospitals gave permission for the study before the questionnaires were fielded. For privacy reasons, the first questionnaire was made anonymous. For the second and third questionnaires, the patients and their parents needed to give permission by an informed consent form. Nonresponders on the second and third questionnaires received a reminder to increase response rates. The questionnaire was designed to collect information on functional outcome, sociodemographic and injury-related characteristics, and health care use.

Functional Outcome

In this study the generic EuroQol (EQ-5D) classification of health[18] was used to measure health status because it is simple and takes only 2 minutes to complete; this could allow routine collection of these data in the future.[19] We selected the EQ-5D because it covers the main health domains that are affected by injury. It is well able to describe a heterogeneous injury population and to discriminate among specific injuries.[17] Moreover, the EQ-5D has been recommended for (economic) evaluation of trauma care at a consensus conference.[20] Earlier research has established the feasibility and the validity of the EQ-5D for children in the age of 5 to 15 years.[21,22] In this classification, health is defined along 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has 3 levels: no problem, moderate problem, or severe problem. In the second part of the EuroQol instrument, respondents rate their own health state on a visual analog scale (VAS), between 0 (worst imaginable health state) and 100 (best imaginable health state). In addition, a scoring algorithm based on empiric valuations from the UK general population and subsequent statistical modeling is available by which each health state description can be expressed into a summary score.[23] This summary score ranges from 1 for full health to 0 for death and can be interpreted as a judgment on the relative desirability of a health status compared with perfect health. Because the EQ-5D classification does not inform memory patterns and/or ability to concentrate, an item was added on cognitive ability.[24]

Sociodemographic and Injury-Related Characteristics

Potential determinants of health status can be grouped into sociodemographic (age and gender) and injury-related characteristics (type of injury, external cause, multiple injury, admission to hospital, and length of stay). Injury-related factors could be regarded as proxy indicators of injury severity. The type of injury was picked from the LIS, in which up to 3 injuries can be recorded by type and body region. In case of multiple injuries, an algorithm derived from the literature determined the most severe injury.[25] This algorithm gave priority to spinal cord injury over skull/brain injury (except concussions), hip fracture, and other lower extremity fractures, respectively. Injuries were classified by location and type into 8 groups, which represent the main injury groups in children. For admitted patients, the diagnosis was verified at the individual level with information from the hospital discharge register (HDR) (*International Classification of Diseases, Ninth Revision*). In discordant cases (8%), the hospital discharge diagnosis replaced the diagnosis from the ED (LIS). The relatively high percentage of discordant cases can be explained, because additional diagnostic information becomes available between admission (LIS) and discharge (HDR). The first-line nature of the ED can result in a "most likely diagnosis" that has to be changed after thorough clinical evaluation. Demographic information was drawn from LIS and was verified by the questionnaire. The prevalence of comorbidity was very low (5%). Therefore, this variable was not addressed specifically in our study.

Statistical Analysis

A nonresponse analysis was performed by multivariate logistic regression. We tested age, gender, type of injury, external cause, hospitalization and length of stay, health status (EQ-5D summary score), and ambulance transport as possible determinants of nonresponse. Because response differed between the first, second, and third questionnaires, separate nonresponse analyses were conducted for each measurement. All significant variables were used to adjust for response bias. Subsequently, the respondents were weighted with the inverse probability of response resulting from the final model. In addition to the nonresponse correction, the data were adjusted for the sample stratification. The resulting weighted data can be considered representative of a population of children who visited 1 of the EDs in the Netherlands. Additional statistical analyses were performed on the weighted data.

A number of respondents (2.5 months: 13%) did not report on 1 or more health domains of the EQ-5D. Because the summary score can be computed only in case of complete information on all health domains, the missing values were estimated by hot-deck imputations, using the reported values of people with similar scores in the health domains that were reported.[26]

Sociodemographic and injury-related characteristics were tested as predictors of suboptimal functioning after 9 months in univariate and multivariate logistic regression analyses. They all were entered as categorical variables. Suboptimal functioning was defined as having limitations for at least 1 of the 5 EQ-5D dimensions. The extreme unequal weighting of the data as a result of adjustment for nonresponse stratification could influence the confidence intervals (CIs) of the estimates.[27] To take this problem into consideration, we used bootstrap analysis. This is a resampling technique by which a specified number of population samples are drawn from the data, given the distribution of the population across the variables that are tested. The distribution of the bootstrap replica across the variables gives information about the significance of each variable. We did 500 iterations to test the significance levels of the independent variables. We calculated overall P values using the regression coefficients and covariance matrix resulting from the bootstrap replicas. The results were regarded as significant when the outcomes yielded $P < .05$. Logistic regression analysis was used to estimate the relative risk of the predictors of suboptimal functioning. These relative risks were estimated by odds ratios (ORs) with 95% CIs. The 95% CIs were determined by using the 2.5% lowest and highest percentiles of 500 replicas. An OR of 1 indicates no association. When OR is <1, the risk is lower than the reference category, and when it is >1, the risk is higher. The departure from 1 (no association) is statistically significant at the 5% level if the 95% CI does not include 1.

RESULTS

Study Population

The questionnaires were sent to 1221 injured children and their parents. We obtained completed first questionnaires on 527 (43%) children, 383 (73% of the responders of the first questionnaire) on the second questionnaire, and 365 (95% of the responders of the second questionnaires) on the third questionnaire. Therefore, response rates with respect to the original sample were 43%, 31%, and 30%, respectively. A small percentage (10%) of children who were younger than 12 years completed the questionnaire themselves; in 75% of the cases, their parents completed the questionnaire, and 15% of the children completed it together with their parents. On the first questionnaire, 297 boys and 230 girls (both 43% response rate) responded, 37% of which were admitted to the hospital. The mean age of the children was 9.6 years. In more than half (65%) of the cases, the injury was attributed to a home and/or leisure injury.

There were minor differences between respondents and nonrespondents (Table 1). Younger patients, hospitalized patients, and patients with upper extremity fractures had a somewhat higher response to the first questionnaire ($P < .05$). For the second and third questionnaires, children with a relatively good health state (EQ-5D summary score at 2.5 months) were less likely to respond ($P < .05$).

Functional Outcome

The health status of injured children improved from 0.92 (EQ-5D summary score) at 2.5 months to 0.96 at 5 months and 0.98 at 9 months (Table 2). Hospital admission and the length of hospitalization were negatively related to functioning in both the short term and the longer term, with children who stayed in the hospital for >3 days having a relatively worse health state at all measurements. After 2.5 months, lower extremity fractures and other injuries (eg, spinal cord injury, injury to nerves, whiplash) demonstrated the worst functional outcome. The relatively high score of head injuries partly reflects that the EQ-5D insufficiently discriminates between injuries with and without cognitive sequelae. Only 5% of children with head injury reported cognitive limitations after 2.5 months. Independent of the type of injury, our sample of injured children generally showed good recovery between 2.5 and 9 months. There were no differences found in health state for

TABLE 1. Study Population by Age, Gender, Admission and Length of Stay, External Cause, and Type of Injury for the Total Study Sample and Responders (2.5 Months)

	Total (n = 1221)	%	Respondents, % (n = 527)	P Value
Age				$P < .05$
5–8	437	35.8	38.1	
9–11	342	28.1	30.0	
12–14	442	36.2	31.9	
Gender				NS
Boys	696	57.0	56.4	
Girls	525	43.0	43.6	
Hospitalization				<.05
Not admitted	784	64.2	62.6	
1–3 d	342	28.0	32.2	
≥4 d	54	4.4	4.8	
Unknown	40	3.3	0.6	
Transport				NS
Ambulance transport	215	17.6	18.4	
No ambulance	1002	82.1	80.9	
Unknown	4	0.3	0.7	
External cause				NS
Home and leisure	794	65.0	61.4	
Traffic	177	14.5	15.4	
Sport	233	19.1	21.7	
Intentional	6	0.5	0.7	
Unknown	11	0.9	0.7	
Type of injury				
Head injury	228	18.5	17.5	<.05
Facial injury (including eye)	60	4.9	4.0	
Upper extremity fractures	404	33.1	40.0	
Lower extremity fractures	156	12.8	14.0	
Dislocation upper and lower extremity	79	6.5	6.8	
Internal organ injury	34	2.8	2.3	
Minor external injuries (incl. burns)	152	12.5	8.5	
Other and unspecified injury*	108	8.9	6.8	
Multiple injury				NS
1	1070	87.6	88.8	
2	125	10.3	9.3	
≥3	26	2.1	1.9	

NS indicates not significant (significance level .05).
* Consists of spinal cord injury, injury of nerves, whiplash, open wounds, and poisoning.

TABLE 2. EQ-5D Summary Score (95% CI) 2.5, 5, and 9 Months After Injury by Sociodemographic and Injury-Related Characteristics

	2.5 Months	5 Months	9 Months
Total	0.92	0.96	0.98
Gender	NS	NS	$P < .05$
Boys	0.92 (0.88–0.95)	0.97 (0.95–0.98)	0.99 (0.99–1.00)
Girls	0.92 (0.89–0.94)	0.94 (0.91–0.96)	0.95 (0.92–0.98)
Age	NS	NS	NS
5–8	0.93 (0.88–0.96)	0.95 (0.92–0.98)	0.99 (0.98–1.00)
9–11	0.91 (0.84–0.97)	0.96 (0.93–0.98)	0.98 (0.96–1.00)
12–14	0.91 (0.87–0.95)	0.97 (0.94–0.99)	0.97 (0.95–0.99)
Hospitalization	$P < .05$	$P < .05$	$P < .05$
Not admitted	0.92 (0.89–0.95)	0.96 (0.94–0.98)	0.98 (0.97–0.99)
1–3 d	0.86 (0.83–0.89)	0.92 (0.88–0.95)	0.96 (0.92–0.98)
≥4 d	0.79 (0.71–0.85)	0.91 (0.87–0.98)	0.95 (0.91–1.00)
Accident category	NS	$P < .05$	$P < .05$
Home and leisure	0.91 (0.86–0.95)	0.95 (0.93–0.97)	0.98 (0.97–0.99)
Traffic	0.91 (0.86–0.95)	0.95 (0.91–0.97)	0.95 (0.91–0.98)
Sport	0.94 (0.91–0.97)	0.97 (0.94–0.99)	0.98 (0.96–1.00)
Type of injury	NS	$P < .05$	NS
Head injury	0.93 (0.86–0.97)	0.96 (0.89–0.99)	0.97 (0.92–0.99)
Facial injury	0.98 (0.92–1.00)	0.93 (0.86–0.99)	1.00 (0.99–1.00)
Upper extremity fractures	0.92 (0.87–0.96)	0.97 (0.94–0.98)	0.99 (0.97–1.00)
Lower extremity fractures	0.87 (0.82–0.92)	0.95 (0.92–0.98)	0.96 (0.92–0.98)
Dislocation extremity injury	0.91 (0.80–0.98)	0.96 (0.85–0.99)	0.98 (0.92–1.00)
Internal organ injury	0.87 (0.72–0.98)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Minor external injuries	0.93 (0.83–0.97)	0.97 (0.94–1.00)	0.99 (0.96–1.00)
Other injury*	0.80 (0.61–0.95)	0.94 (0.88–0.99)	0.97 (0.92–1.00)
Multiple injury	NS	NS	NS
1	0.92 (0.89–0.94)	0.96 (0.94–0.99)	0.98 (0.96–0.99)
2	0.91 (0.84–0.97)	0.98 (0.91–0.98)	0.98 (0.93–0.99)
>3	0.79 (0.60–0.93)	0.89 (0.71–0.94)	0.95 (0.86–0.96)

Data are corrected for nonresponse and stratification and are representative of a population of injured children who visited an ED in the Netherlands.

* Consists of spinal cord injury, injury of nerves, whiplash, open wounds, and poisoning.

boys and girls after 2.5 months (24% of boys and 26% of girls reported suboptimal functioning), but in the long run, girls (in particular from the age of 10–11 years onward; data not shown) had a significantly worse health state than boys, with an EQ-5D summary score after 9 months of 0.95 for girls compared with 0.99 for boys. Furthermore, parents valued their children's health better than children themselves (0.93 vs 0.91 after 2.5 months). However, no significant association was found between parent proxy report and gender (data not shown).

Of all injured children, 26% had at least 1 functional limitation after 2.5 months, 18% after 5 months, and 8% of children still reported functional limitations after 9 months. After 2.5 months, most limitations were reported for pain/discomfort (22%) and performing usual activities (15%), but also the largest improvements between 2.5 and 5 months were reported in these domains (Fig 1). After 2.5 months, almost 10% of the children reported limitations in mobility and self-care, but after 5 months, none of the children had problems with their usual activity and only a very small group (2%) still reported limitations in mobility. The prevalence of limitations for all health domains decreased in time, except for anxiety/depression, for which higher numbers of limitations were reported after 5 than after 2.5 months.

After 9 months, most children had recovered from their injury. In Table 3, the prevalences of limitations

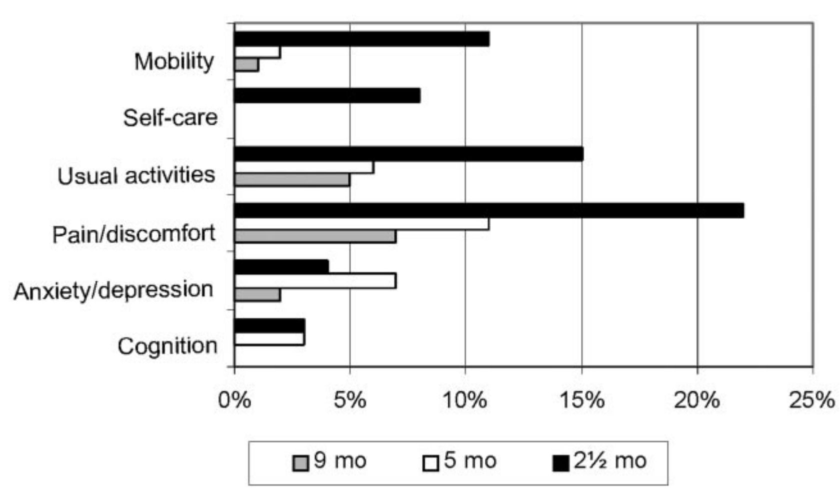

Fig 1. Prevalence of limitations (moderate or severe) of the EQ-5D health domains by time interval (%). Data are corrected for nonresponse and stratification and are representative of a population of injured children who visited an ED in the Netherlands.

TABLE 3. Prevalence of Moderate or Severe Problems in the EQ-5D Health Domains and Cognitive Ability (in %) and Mean EQ-5D Summary Measure and VAS by Sociodemographic and Injury-Related Characteristics (9 Months)

	Mobility	Self-Care	Usual Activities	Pain, Discomfort	Anxiety, Depression	Cognition	EQ-5D Summary Score	VAS
Total	1.4	0.0	4.6	6.8	2.2	0.4	0.98	93
Gender								
Boys	0.1	0.0	1.0	2.5	0.7	0.3	0.99	95
Girls	4.1	0.0	12.2	15.7	5.4	0.7	0.95	89
Age								
5–8	1.0	0.0	1.6	2.7	1.1	0.9	0.99	92
9–11	0.5	0.2	5.3	6.0	4.8	0.5	0.98	96
12–14	2.3	0.0	6.9	11.0	1.7	0.2	0.97	92
Hospitalization								
Not admitted	1.4	0.0	4.3	6.4	2.0	0.2	0.98	93
1–3 d	6.7	0.3	6.5	16.1	3.4	4.1	0.96	92
≥4 d	7.1	2.6	15.0	16.6	13.5	10.6	0.94	88
Accident category								
Home and leisure	0.7	0.1	2.6	5.4	2.4	0.4	0.98	94
Traffic	4.6	0.0	7.9	15.1	3.7	1.7	0.95	92
Sport	1.0	0.0	7.1	7.0	0.7	0.1	0.98	93
Intentional	15.6	0.0	15.6	15.6	15.6	0.0	0.94	93
Type of injury								
Head injury	5.3	0.4	6.6	7.3	7.8	1.4	0.97	92
Facial injury	0.0	0.0	0.2	0.2	0.4	0.0	1.00	99
Upper extremity fractures	0.0	0.0	3.8	3.9	3.4	0.1	0.99	95
Lower extremity fractures	9.9	0.0	5.9	11.8	1.6	0.5	0.95	91
Dislocation extremity injury	2.6	0.0	5.3	8.0	0.9	0.5	0.98	94
Internal organ injury	0.0	0.0	0.0	0.0	0.0	0.0	1.00	96
Minor external injury	0.0	0.0	4.8	5.0	0.0	0.0	0.99	87
Other injury*	0.0	0.0	9.6	28.0	3.1	2.9	0.94	94
Multiple injury								
1	1.6	0.1	4.9	7.4	0.1	0.4	0.98	93
2	0.5	0.0	6.4	7.8	0.0	0.0	0.98	88
≥3	0.0	0.0	20.0	0.0	0.0	25.8	0.95	85

* Consists of spinal cord injury, injury of nerves, whiplash, open wounds, and poisoning.

on each EuroQol health domain after 9 months are presented by sociodemographic and injury-related characteristics. The highest prevalences of disability existed for pain/discomfort (7%) and usual activities (5%). Girls reported more problems for all health domains (except self-care) compared with boys, which was also confirmed by the VAS score for self-related health (89 compared with 95). Furthermore, we found an increase in levels of pain/discomfort and in limitations of usual activities by age. Almost one fifth of the children who had been admitted to the hospital for >3 days still reported problems with usual activities and pain/discomfort after 9 months. Children with head injury reported relatively high prevalences of limitations on usual activities, pain/discomfort, and anxiety/depression. Children with lower extremity fractures reported relatively high prevalences of limitations on mobility and pain/discomfort, and children with other injury reported a very high prevalence for pain. A high percentage of children with multiple injuries reported problems with usual activities and cognition 9 months after injury.

Nine months after the injury, 8% of the children still had functional limitations for at least 1 EQ-5D dimension. Hospitalization was a significant and independent predictor for long-term disability (Table 4). Girls had a 3 times higher chance for suboptimal functioning in the long term than boys, which reached significance after adjustment for hospitalization (adjusted OR: 3.0). The other variables did not show significant associations with functional outcome in the long term. Because of their 3-fold risk of suboptimal functioning, girls (54%) outnumber boys (46%) in the group with residual disabilities at 9 months. Despite the increased risk for a bad functional outcome among injury patients who were admitted to the hospital, 74% of children with residual disabilities had not been hospitalized.

DISCUSSION

The vast majority of injured children reported a good health status already within 3 to 5 months after the injury, and almost every child has fully recovered after 9 months. Of all injured children, 26% had at least 1 functional limitation after 2.5 months, 18% after 5 months, and a group of 8% of children still reported functional limitations after 9 months. After 9 months, the highest levels of dysfunction existed for pain/discomfort (7%) and usual activities (5%). Female gender and hospitalization were significant and independent predictors for long-term disability.

Hospitalized children had a 3- to 5-fold risk for suboptimal functioning in the long term compared with nonadmitted children. Almost one fifth of injured children who stayed in the hospital for >3 days still have pain and problems with usual activities after 9 months. Girls had a 3-fold risk for showing at least 1 functional limitation in the long term, compared with boys, and had higher prevalences of disability in all health domains.

The strength of our study is that it contributes to the empirical knowledge about the health status of a comprehensive group of injured children over time

TABLE 4. Unadjusted and Adjusted ORs for Suboptimal Functioning 9 Months After Injury by Key Indicators (Gender, Age, Hospitalization, External Cause, Injury Type, Multiple Injury)

Determinants	Patients, %*	Unadjusted OR (95% CI)	Adjusted OR (95% CI)†
Gender			$P < .05$
Boy	46	1	1
Girl	54	2.9 (1.0–9.9)	3.0 (1.0–11.0)
Age			
5–8	24	1	1
9–11	18	2.1 (0.6–10.5)	0.3 (0.1–1.0)
12–14	58	2.4 (0.7–10.5)	0.4 (0.1–1.6)
Hospitalization		$P < .05$	$P < .05$
Not admitted	74	1	1
1–3 d	23	5.4 (1.4–17.2)	5.8 (1.3–20.9)
≥4 d	3	3.1 (1.2–14.7)	3.6 (1.1–18.9)
External cause			
Traffic injury	15	2.4 (0.8–7.4)	2.0 (0.6–6.7)
Other injury	85	1	1
Type of injury			
Head injury	10	2.9 (0.0–138.2)	2.1 (0.4–130)
Facial injury	11	2.1 (0.0–19.3)	1.7 (0.0–20.1)
Upper extremity fractures	25	1.5 (0.0–72.6)	1.3 (0.1–65.3)
Lower extremity fractures	11	3.4 (0.04–101.6)	2.7 (0.5–89.2)
Dislocation extremity injury	10	3.0 (0.0–72.6)	3.1 (0.4–74.3)
Internal organ injury	1	0.1 (0.0–1.0)	0.0 (0.0–0.6)
Minor external injuries	12	1	1
Other injury‡	20	7.1 (0.8–2021.6)	6.0 (0.5–1971.6)
Multiple injury§			
1	112	1	1
2	7	5.9 (0.1–19.0)	2.2 (0.1–17.5)

Suboptimal functioning was defined as having limitations for at least 1 of the 5 EQ-5D dimensions.
* Percentage of patients after correction for nonresponse and stratification.
† ORs are adjusted for hospitalization (gender, age, external cause, type of injury, multiple injury) or gender (hospitalization).
‡ Consists of spinal cord injury, injury of nerves, whiplash, open wounds, poisoning.
§ Only 1 patient with ≥3 injuries had limitations after 9 months, with an OR of 11 (0.0–29.8).

and differences herein by sociodemographic factors and types of injury. We deliberately included minor injuries and nonhospitalized children in our study. Our study shows that minor (nonhospitalized) injuries cause three quarters of all residual impairments and disabilities. Thus far, this large group of ED attendees with minor or moderate injuries has received little attention.

A major limitation of our study was the relatively low response. From the original study sample of injured children who had visited an ED, 43%, 31%, and 30% were still included after 2, 5, and 9 months, respectively. This is attributable largely to the use of postal questionnaires, because we were limited in the use of response-increasing incentives. Because of privacy reasons, it was not feasible to use reminders for the first questionnaire, but we did so for the second and third questionnaires. However, we had much background information about the nonrespondents and adjusted the data for nonresponse bias after an extensive analysis in which the impact of patient- and injury-related factors were investigated. Moreover, most differences between responders and the original study sample were not substantial.

Another important issue to be discussed is that most of our data on functional outcome of childhood injuries were obtained from parent reports. There is substantial debate in the health outcomes literature about the most appropriate respondent when assessing children's health.[28] First, children's self-report may be theoretically preferable because it is consistent with the subjective nature of the EuroQol (made for self-completion), and evidence is emerging that children are able to provide accurate and reliable information concerning their health status.[7] Hennessy and Kind[29] argued that it is at least possible to use the EQ-5D for self completion with a school-aged population (12–18 years). Particularly younger children are not able to provide reliable information on abstract, health-related concepts.[30] Only a small group of children (10%) who were younger than 12 years completed the questionnaire themselves. Second, functional outcomes may differ after completion of the EQ-5D by child or parent.[31] An advantage of using parents as proxy reporters is that adults generally can be expected to provide more reliable responses on more complex, psychologically oriented measures. The literature mentions that parental reports may overestimate the child's functioning, especially when assessing the physical functioning.[7] This can also be confirmed by our research outcomes, because parents valued their children's health better than children themselves (0.93 vs 0.91 after 2.5 months). The higher prevalence of disability of girls in the long term is not influenced by parent proxy reports. For both boys and girls, the parents reported a worse health state than did the children themselves. The parents may realize that the injury could have resulted in a worse outcome and that, with respect to the initial injury, their child is doing well.[7] Although the exact values between child and adult might be different, previous research suggested that at least the ranking order largely will be the same.[21]

We compared our estimates with EuroQol data from a Dutch study of children in the general population, which found a mean EQ-5D summary score of

0.92 for children (aged 5–15 years).[21] Two months after the injury, the mean summary score for the health state of nonhospitalized patients with childhood injuries (EQ-5D: 0.92) was similar to the general population's health when measured by the EQ-5D summary score. Five and 9 months after the injury, the mean health state of both nonadmitted and admitted patients with childhood injuries was slightly higher than the health state in the general population (0.96 and 0.98, respectively, vs 0.92). For the children in our study, we only found a small increase in average health status between 5 and 9 months (EQ-5D: 0.96 vs 0.98). A possible explanation therefore could be that a significant number of children have achieved their maximum level of functioning after 5 months, leaving no room for additional improvement.[17] Furthermore, as a result of a temporally worse health state at the time after the injury, people might judge their later health state more positive than before the injury, because their frame of reference has changed (response shift).[32]

Caution is needed when the potential clinical relevance of changes in the EQ-5D summary score is considered. The EQ-5D is a valuable instrument to study differences and changes in health status after injury at the population level, but small differences and changes at the level of an individual child can be interpreted only if the scores on the separate EQ dimensions and additional clinical data (eg, chart data, medical examinations) are taken into account as well.

An important finding in our study is that most children demonstrate a quick recovery after an injury: 3 of 4 children were fully recovered after 2.5 months. Other studies also found that young injury victims reported a reasonably good long-term health state.[7,33] Aitken et al[16] studied the health state of children after admission for an injury with the child health questionnaire and found that after 6 months, 28% of children reported some limitations, which is somewhat higher than the 21% of admitted children with limitations after 5 months resulting from our research. Because the child health questionnaire measures health over 14 domains, it might be more sensitive for limitations than the EQ-5D, which possibly explains the higher prevalence of limitations.

A previously performed follow-up study in the Netherlands about functional outcome of injured patients aged 15 years and older[17] also gives uniform information on the levels of functioning and disability in the first 9 months after injury. We observed a better health status for children who were younger than 15 years for all 3 measurements compared with adults. Earlier research also showed a significant negative association of age and the EQ-5D summary measure, indicating better recovery at younger ages.[34]

Whereas the incidence of injuries is higher in boys than in girls, injured girls demonstrate more limitations in the long term. Girls reported more problems for all health domains (except self-care) than boys. Research among adult injury victims also found that female gender was independently associated with worse functional outcome in the United States[35] and the Netherlands.[17,19] We demonstrated that this also applies to children. This finding cannot readily be explained, but it has been hypothesized that physiologic, psychologic, and social differences may influence this association.[19] Residual pain, in particular, was much more frequent in girls (16%) than in boys (3%). Our findings stress the importance of more research into gender differences in injury outcomes, including the development of pain syndromes.[36]

We conclude that the present study gives important insight into levels of functioning and recovery patterns across types of injury and major sociodemographic variables. The proportion of children in the age of 5 to 14 years who annually visit an ED in the Netherlands is 9% (179 000 Dutch children in 2004).[37] On the basis of our current study results, we may conclude that most of these children recover quickly from an injury but that each year, again a considerable group of children (0.6%; 12 500 Dutch children in 2004) experience functional limitations as a result of an injury in the long term. The group of injured children with persistent health problems as identified in this study indicates the importance of health monitoring over a longer period in trauma care, whereas trauma care should be targeted at early identification and management of the particular needs of these patients.

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