Seguí-Gómez M. Application of the Functional Capacity Index to NASS CDS data. NHTSA DOT HS 808 492. National Highway Traffic Safety Administration, U.S. Dept of Transportation, 1996.

U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

DOT HS 808 492

November 1996

Final Report

Application of the Functional Capacity Index to NASS CDS Data

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 808 492		

4. Title and Subtitle	5. Report Date
FINAL REPORT: APPLICATION OF THE FUNCTIONAL CAPACITY INDEX TO NASS CDS DATA	November 1996
	6. Performing Organization Code
	8. Performing Organization Report No.
7. Author(s) Maria Segui-Gomez, M.D., M.P.H., M.Sc.	
9. Performing Organization Name and Address Maria Segui-Gomez, M.D., M.P.H., M.Sc. 36 Concord Square #3 Boston, MA 82118-3102	10. Work Unit No. (TRAIS) 11. Contract or Grant No. DTNH22-96-P-06011 13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590	Contract Final Report 14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The purpose of this report is two-fold: (1) further exploration of the relationship between the Functional Capacity Index (FCI) and the Abbreviated Injury Scale (AIS), and (2) application of the FCI to NASS CDS data. Analysis of the mapping performed by MacKenzie *et al* (1994) between FCI and AIS revealed that only about a quarter of all possible AIS diagnoses are predicted to produce some functional limitation one year post-injury. Head and spine are the two body regions with more diagnoses associated with functional limitations. The most common impairment is the minor limitation of only one FCI dimension (mostly ambulation). Application of FCI to the diagnoses of injuries sustained by passengers involved in towed-away, police reported motor-vehicle crashes in the United States (NASS CDS data) provided, among others, the following results:

- Out of approximately 1.5 million people injured (ISS ≠ 0) per year, about 7% sustained at least one injury that is predicted to produce some functional limitation.
- The injuries associated with functional limitation are mostly minor or moderate (AIS 1 or 2) and happen most frequently to the extremities (upper and lower).
- In any given year, the injuries sustained total 1.4 Life-years Lost to Injury (or an average of 13.6 Life-years Lost to Injury per injured patient).

Limitations, further applications, and policy implications of the FCI are discussed.

17. Key Words	18. Distribution Statement
injury outcome; motor vehicle injury data; functional limitations	Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	72	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

INDEX

TABLES

FIGURE

Acknowledgment

The author wishes to thank Stephen Luchter for his many helpful contributions, Marie Walz for extracting the appropriate data from the National Accident Sampling System, and for Patricia Breslin and Joan Harris for their detailed review of the manuscript.

SUMMARY

The purpose of this report is twofold: (1) further exploration of the relationship between the FCI and the AIS, and (2) application of the FCI to NASS CDS data.

Analysis of the mapping performed by MacKenzie *et al* (1994) between FCI and AIS revealed that only about a quarter of all possible AIS diagnoses are predicted to produce some functional limitation one year post-injury. Head and Spine are the two body regions with more diagnoses associated with functional limitations. The most common impairment is the minor limitation of only one FCI dimension (mostly ambulation).

Application of FCI to the diagnoses of injuries sustained by passengers involved in towed-away, police reported motor-vehicle crashes in the United States (U.S.) (NASS CDS data) provided, among others, the following results:
- Out of approximately 1.5 million people injured (ISS $\neq$ 0) per year, about 7% sustained at least one injury that is predicted to produce some functional limitation.
- The injuries associated with functional limitation are mostly minor or moderate (AIS 1 or 2) and happen most frequently to the extremities (upper and lower).
- In any given year, the injuries sustained total 1.4 Life-years Lost to Injury (LLI) (or an average of 13.6 LLI per injured patient).

Limitations, further applications, and policy implications of the FCI are discussed.

PURPOSE AND OBJECTIVES

PURPOSE

This report has two parts. The first part analyzes in-depth the distribution and characteristics of the FCI and its relationship with another injury scoring system, the AIS. The second part assesses the magnitude of the predicted functional limitation (as defined by the FCI) experienced by people injured in non-fatal motor-vehicle crashes in the U.S.

OBJECTIVES

The objectives of this project were:

- To evaluate the relationship between the AIS and the FCI.
- To analyze the distribution of the predicted functional limitations one year post-injury for people involved in non-fatal motor-vehicle crashes in the U.S.
- To quantify the LLI every year in the U.S. due to motor-vehicle crashes.
- To identify which injuries contribute most to LLI.
- To identify which injured body regions (using AIS categories) contribute most to LLI.

MEASURING INJURY SEVERITY

A number of classification systems have been devised using different concepts and criteria to help measure the impact of non-fatal injuries. Some classification systems measure the acute severity of the injury, either by evaluating the physiological status of the injured (e.g., Glasgow Coma Scale) or the anatomical impact of the injuries (e.g.,--AIS), or a combination of several criteria (e.g., Trauma Revised Injury Scoring System). Efforts to improve the measurement of injury by capturing the impairment resulting from them were initiated in the early 80's by Hirsch and colleagues (1983). Carsten and O'Day (1986), Luchter (1987), and Miller, Luchter and Brinkman (1989) extended and refined Hirsch's work trying to link injury-related impairment with the measurement of societal costs of injuries (introducing a Quality Adjusted Life Years-like approach). The Association for the Advancement of Automotive Medicine (AAAM) published another impairment scale, the Injury Impairment Scale (IIS), based on the earlier work of States and Viano (1990). A comprehensive summary highlighting the main differences among these scales is available in Mackenzie *et al* (1994).

The FCI was recently developed as a different approach to better quantify the long-term individual and societal consequences of non-fatal injuries (MacKenzie *et al*, 1994). The purposes of developing such a scale were to create a measurement tool that would be useful in identifying subgroups of the population at a particularly high risk of functional limitations resulting from injury, to evaluate the relative success of alternative countermeasures aimed at reducing disability, to facilitate the selection of comparable experimental and control groups for evaluating alternative treatment and prevention strategies, and to plan and evaluate acute care and rehabilitation services and systems. The definition of functional capacity used in the development of this index was based on Nagi's conceptual framework that distinguishes among active pathology, impairment, functional limitation or functional capacity, and disability (1965). Functional limitation in this context refers to functional loss or limitations at the level of the organism as a whole (compared to limitation at the organ level--or impairment, or limitations in performing socially defined roles and tasks expected of the individual within a socio-cultural and physical environment--named disability).

Two steps are involved in the FCI scoring process. First, the expected (or predicted) level of functionality one year post-event (or post-injury) is defined across several dimensions. The ten dimensions considered are: eating, excretory function, sexual function, ambulation, hand and arm function, bending and lifting, visual function, auditory function, speech, and cognitive function. Within each dimension, several functional levels are possible, ranging from "a" (no limitation) to "g" (e.g., total visual impairment, black blind, no light perception).[1] Thus, each injury is assigned a 10-letter code that reflects the different levels of limitation in each dimension (in the order previously described). Second, each FCI code is assigned a numerical value obtained through multi-attribute utility theory that weights the relative importance of each dimension-level combination to whole body function. (This numerical value reflects value judgment that is used in this context as a surrogate for utility values.) This numerical value (or FCI score) ranges from 0

[1] Every dimension has a different number of functional levels (e.g,. eating ranges from "a" to "c", whereas visual function ranges from "a" to "g").

(i.e., no limitation at all) to 100 (i.e., total loss of functional capacity).

The FCI, in its current version, is built on the following assumptions: (1) patients are survivors of the injury event, (2) medical care and rehabilitation of the injuries have been timely and appropriate, (3) the subject is a previously healthy adult--age 18 to 34, and (4) there is only one injury per patient. Validation of the levels of functionality per each dimension one year post-event and expansion of the index to the pediatric population are currently underway.

As an alternative method for measuring the societal impact of non-fatal injuries, Luchter (1987) suggested multiplying a whole body impairment score for the injuries sustained by the individual by that person's remaining life expectancy. He named such measure the LLI and they were meant to represent the years lived at a reduced level of functioning since "..if a person's ability to function following an injury is less than it was before, some part of their life is lost." In more recent applications of the LLI, Luchter proposes to use the FCI (previous transformation into a 0.0 to 1.0 scale) as the "impairment" score (Luchter *et al*, 1995, 1996). Thus, the total LLI represents the overall effect on society of a particular injury, and the average LLI (total LLI due to a particular injury divided by incidence of such injury) represents the effect on the "average" injured individual.

DATA AND METHODS

Exploring the relationship between the FCI and the AIS (the first objective of this report) required the in-depth analysis of the mapping between the AIS codes and FCI codes and scores. All AIS codes (except those from skin injuries) had been mapped into FCI codes by making a panel of experts agree in whether each injury would affect the functional capacity of an individual one year post-event in any of the 10 FCI dimensions and if so, determining by how much. An FCI score was then computed for every FCI code using the value judgment scores elicited from several groups and a multiplicative model. This process was done while the FCI was under development (MacKenzie *et al*, 1994, Appendix 3).

Since in the remainder of this report AIS, Maximum Abbreviated Injury Scale, Injury Severity Score, and the FCI are used extensively, a brief explanation on each of them follows:

Abbreviated Injury Scale (AIS). The AIS is a "consensus derived, anatomically based system that classifies individual injuries by body region on a 6-point ordinal severity scale ranging from AIS 1 (minor) to AIS 6 (currently non treatable/virtually unsurvivable)" (AAAM, 1990). The AIS was initially developed to assess the impact of injury based upon several criteria: threat to life, permanent impairment, treatment period, and energy dissipation; although more recent research has shown that AIS is primarily a threat to life scale. In the 1990 version of AIS --the version currently being used-- each injury description is assigned a unique 7-digit numerical code where the first digit identifies the body region (head, face, neck, thorax, abdomen, spine, upper extremities, lower extremities, or external); the second digit identifies the type of anatomic structure (whole area, vessels, nerves, organs, skeletal, or head); the third and four digits identify the specific anatomic structure or the specific nature of the injury; the fifth and sixth digits identify the level of injury within a specific body region and anatomic structure; and, the seventh digit --located after a decimal point-- identifies the AIS score (1-6, or 9 if unknown). AIS has become the most extensively scale used to assess injury severity worldwide.

Maximum Abbreviated Injury Scale (MAIS). MAIS is the highest AIS in a patient with multiple injuries; when several codes have the same severity, a body region priority order helps in selecting the MAIS. The body region priority is: head, spine, lower extremities, upper extremities, abdomen, thorax, face, and skin.

Injury Severity Score (ISS). ISS constitutes the preferred method of computing overall individual severity when multiple injuries coexist in the same individual. It is the sum of the squares of the highest AIS scores in three different body regions. Thus, the ISS ranges from 1 to 75 (if there are three injuries with AIS 5 in different body regions or if there is at least one AIS 6), and takes the value of 99 when at least one AIS is 9 (Baker, 1974).

Functional Capacity Index (FCI). The FCI has been described in previous paragraphs of this report; it constitutes the first multi-attribute score system that reflects the likely extent of functional limitation or reduced capacity one year post-injury. Since a patient can have more than one injury, and every injury translates into a particular FCI, each patient could have more than one FCI. For this report, the Maximum FCI (or MFCI) will be used for descriptive purposes. The MFCI is defined as the highest --or the worst-- functional capacity score a patient can have. If the injury associated with the MFCI needs to be identified for descriptive purposes and the patient has several injuries with the same score (and they are the highest), injuries are ranked by AIS body region using the same criteria used to select the MAIS: head, spine, lower extremities, upper extremities, abdomen, thorax, face, and skin (Luchter, 1996).

Although the FCI is a continuous score (that ranges from 0 to 100), a category grouping is used to facilitate some descriptions. Categories used are: (1) $0 > FCI \leq 20$, (2) $20 > FCI \leq 40$, (3) $40 > FCI \leq 60$, (4) $60 > FCI \leq 80$, and (5) $80 > FCI \leq 100$ (MacKenzie *et al*, 1994).

In an attempt to understand better the nature and magnitude of the functional limitations assigned to each injury, a regrouping of the ten FCI dimensions into broader categories was used. This broader categorization was already used when conceptualizing the FCI (MacKenzie *et al*, 1994) and it is based on some previous work done by Luchter (1987).

These broader functional categories are: (a) basic biologic functions (excretory, eating and sexual function), (b) mechanical neuro-musculoskeletal function (ambulation, hand and arm function, bending and lifting), (c) mechanical sensory function (visual, auditory, speech); and (d) cognitive function.

The remaining objectives of this report had to do with the quantification of injury-related functional limitation one year after a non-fatal motor-vehicle crash in the U.S. The data used for this purpose came from the National Accident Sampling System Crashworthiness Data System (NASS CDS). NASS CDS collects data on police reported crashes of passenger vehicles (cars, light trucks, vans, and utility vehicles) in which at least one of the vehicles is towed from the scene due to damage from the crash. The crashes are selected for investigation using a stratified sampling scheme that is representative of the U.S. Trained crash investigators complete an extensive listing of data elements that describe the crash, the vehicles, and the occupants. Information is obtained from police and hospital records and inspection of the vehicle. About 5,000 crashes are investigated per year--some of them with more than one person injured. Both crashes and passengers get a specific weight that will be used when calculating the national estimates. For the remaining of this report, we will refer to N when we mention the cases in the sample reported in the NASS CDS database. When using the national estimates (after weighted calculations), we will refer to them as N_w--weighted N.

For this report we used NASS CDS data for two years (1993-1994). The unit of analysis for this report was occupants of passenger vehicles. Case inclusion criteria were: (1) the occupant is a crash survivor (no fatalities), (2) the occupant has at least one injury with AIS≠0 (or ISS≠0), and (3) the occupant's age and gender are known. The variables used for this report were the occupant's demographics (age and gender), the number of injuries per person, the AIS codes and injury literal descriptions per injury, and the ISS per occupant. To facilitate the merge of NASS CDS AIS information into FCI codes and scores, injuries with structure type "1" (skin) were recoded as "9" (whole area).

In order to calculate the LLI, the remaining life expectancy for the given age and gender of the injured persons reported in the NASS CDS data was determined from standard life tables (Vital Statistics, 1990). The listings for the white population were used since neither race nor ethnicity is available in the NASS CDS database.

RESULTS

I. Relationship between AIS and FCI codes.

One thousand and seventy-two AIS-90 codes had been mapped into FCI (all AIS codes except skin injuries). Most of them were predicted not to affect any of the 10 FCI dimensions. The percentage of AIS codes rated as "a" for any given dimension ranged from a lowest 86% (for ambulation) to a highest 98.5% (for auditory function). Among the injuries for which some loss of functionality was predicted, the most common case (50%) had a functional level "b," whereas for the remaining injuries functional levels ranged from "c" to "g."

The number of FCI dimensions affected by body region injured varied considerably from only one dimension (e.g., upper extremity injuries with hand and arm function limitations) to all 10 dimensions (e.g., head injuries); all other body region injuries affected three to five dimensions. On the other hand, all FCI dimensions were affected by injuries in more than one body region. An overview of the distribution of the dimensions and levels affected by body region is shown in Table 1.

Table 1. Predicted functional limitations (FCI dimensions and levels) of AIS mapped codes (n=1272). Total and by AIS body region.

	AIS body region injured								Total
	head	**face**	**neck**	**thorax**	**abdom.**	**spine**	**upper extr.**	**lower extr.**	
	n=239	n=85	n=78	n=171	n=226	n=199	n=119	n=155	n=1272
FCI dimension									
level									
eating									
a	205	82	27	70	223	199	113	155	1225
b	18	4	5	1	2	0	0	0	29
c	16	0	1	0	1	0	0	0	18
excretory function									
a	209	85	77	170	221	142	119	155	1178
b	11	0	0	1	3	41	0	0	56
c	7	0	0	0	0	0	0	0	7
d	12	0	1	0	2	16	0	0	31
sexual function									
a	222	85	77	170	222	152	119	140	1187
b	1	0	0	1	3	47	0	15	67
c	16	0	1	0	1	0	0	0	18
ambulation									
a	202	85	69	161	224	138	119	95	1093
b	10	0	6	7	2	4	0	48	77
c	10	0	2	2	0	10	0	12	36
d	3	0	0	0	0	15	0	0	18
e	3	0	0	0	0	0	0	0	3
f	11	0	1	1	0	32	0	0	45

(continued)

hand and arm function									
a	203	85	69	171	226	149	77	155	1135
b	10	0	6	0	0	10	13	0	39
c	11	0	2	0	0	16	15	0	44
d	1	0	0	0	0	2	11	0	14
e	3	0	0	0	0	6	3	0	12
f	11	0	1	0	0	16	0	0	28
bending and lifting									
a	202	85	73	170	226	140	118	129	1144
b	13	0	4	1	0	33	0	25	76
c	10	0	0	0	0	0	0	1	11
d	14	0	1	0	0	26	0	0	41
visual function									
a	219	67	73	171	226	199	118	155	1229
b	11	2	4	0	0	0	0	0	17
c	6	9	0	0	0	0	0	0	15
d	0	1	0	0	0	0	0	0	1
e	1	4	0	0	0	0	0	0	5
f	1	0	0	0	0	0	0	0	1
g	1	2	1	0	0	0	0	0	4
auditory function									
a	226	79	77	171	226	199	119	155	1252
b	1	4	0	0	0	0	0	0	5
c	10	1	0	0	0	0	0	0	11
d	1	1	0	0	0	0	0	0	2
e	1	0	1	0	0	0	0	0	2
speech									
a	207	76	69	171	226	199	119	155	1221
b	13	9	5	0	0	0	0	0	27
c	9	0	2	0	0	0	0	0	11
d	10	0	2	0	0	0	0	0	12
cognitive function									
a	208	85	73	171	226	199	119	155	1236
b	9	0	4	0	0	0	0	0	13
c	7	0	0	0	0	0	0	0	7
d	3	0	0	0	0	0	0	0	3
e	2	0	0	0	0	0	0	0	2
f	10	0	1	0	0	0	0	0	11

Since FCI reflects limitations across 10 dimensions and within each dimension there are between three and seven different functional levels, theoretically 4,354,560 different dimension/level combinations exist. In fact, when AIS codes were mapped into the FCI combination/levels, only 75 different combinations arose. Table 2 shows them sorted by the number of dimensions affected; it shows also the number of AIS codes that were mapped into each combination. Nine hundred and fifty-one AIS codes were predicted not to have any functional limitation one year post-event (FCI code "aaaaaaaaaa"); this constitutes the vast majority of AIS codes mapped (74.7%). Among the remaining 321 AIS codes for which some functional limitation was predicted, half of them (158) consisted of limitations in only one dimension, another 48 had two dimensions affected, 37 had three, and the remaining 78 had up to 10 dimensions affected. The single most common FCI dimension/level combination was "aaabaaaaaa" (with a 13.8% of all AIS

codes). This FCI code reflects moderate problems in ambulation (it is defined as "independent ambulation without a device but has minor limitations in the amount of running or vigorously walking appropriate to age"). All other FCI combinations described in the below table include less than 6% of AIS codes each.

Table 2. FCI dimension/level combinations (n=73) of the 1, 272 mapped AIS codes (n and %).

FCI Code	n	%
No limitation		
aaaaaaaaaa	951	
One dimension affected		
aaaaaaaaba	1	0.3
aaaaaaaaca	2	0.6
aaaaaaaada	1	0.3
aaaaaaabaa	1	0.3
aaaaaaacaa	1	0.3
aaaaaaaeaa	1	0.3
aaaaaabaaa	12	3.7
aaaaaacaaa	13	4
aaaaaadaaa	1	0.3
aaaaaaeaaa	5	1.6
aaaaaagaaa	3	0.9
aaaaabaaaa	1	0.3
aaaabaaaaa	18	5.7
aaaaacaaaa	16	5
aaaadaaaaa	11	3.4
aaaaeaaaaa	5	1.6
aaabaaaaaa	44	13.8
aaacaaaaaa	4	1.3
aabaaaaaaa	1	0.3
aacaaaaaaa	1	0.3
abaaaaaaaa	3	0.9
adaaaaaaaa	2	0.6
baaaaaaaaa	10	3.1
caaaaaaaaa	1	0.3
subtotal	158	49.2
Two dimensions affected		
aaaaaaabba	4	1.3
aaaaaaacba	1	0.3
aaaaaaadba	1	0.3
aaaaaacaab	1	0.3
aaaacbaaaa	9	2.8
aaaadbaaaa	2	0.6
aaaaedaaaa	4	1.3
aaababaaaa	12	3.7
aaabbaaaaa	2	0.6
aaaccaaaaa	2	0.6
abbaaaaaaa	2	0.6
baaaaaaaba	7	2.2
baaaaabaaa	1	0.3
subtotal	48	15
Three dimensions affected		
aaabbbaaaa	1	0.3
aaacabaaac	1	0.3
aabbabaaaa	5	1.6
aabcabaaaa	9	2.8
aabcacaaaa	1	0.3
abacabaaaa	5	1.6
abbdaaaaaa	15	4.6
subtotal	37	11.5
Four dimensions affected		
aaabbbaaab	2	0.6
aaacccaaac	1	0.3
abacbbaaaa	5	1.6
abacccaaaa	1	0.3
abbfabaaaa	11	3.4
subtotal	20	6.2
Five dimensions affected		
aaabbbaabb	1	0.3
aaaeedaacc	1	0.3
aaaefdaacb	1	0.3
abbffdaaaa	6	1.9
acacccaaca	1	0.3
adbfcdaaaa	6	1.9
adbffdaaaa	10	3.1
bbabbbaaaa	1	0.3
subtotal	27	8.4
Six dimensions affected		
aabccbaabc	1	0.3
ababbbaabb	3	0.9
bbabbbaaac	1	0.3
bcacccaaca	2	0.6
ccaccbcaaa	1	0.3
subtotal	8	2.5
Seven dimensions affected		
baabbbbabb	4	1.3
bbabbbaabc	1	0.3
ccacccaacd	1	0.3
cdcfedaaab	1	0.3
subtotal	7	2.2
Eight dimensions affected		
bbccccaabd	1	0.3
bbcdccaacd	1	0.3
cccdccaace	1	0.3
cccdecaabc	1	0.3
cdceddaace	1	0.3
subtotal	5	1.6
Nine dimensions affected		
cdcffdacdf	9	2.8
10 dimensions affected		
cdcffdfddf	1	0.3
cdcffdgedf	1	0.3
subtotal	2	0.6
Some limitation	321	100
Total	1272	

An analysis of the FCI dimensions affected by AIS body region injured confirms that injuries in some areas can affect all 10 dimensions (e.g., head injuries) whereas injuries to some other body regions affect only one (e.g., upper extremity injuries). A detailed distribution of the number of FCI dimensions affected by AIS body region is shown in Table 3.

Table 3. Number of FCI dimensions affected by 1,272 mapped AIS codes. Total (n and %) and by AIS body regions.

	AIS body region								Total	
	head	face	neck	thorax	abdm	spine	upper extr.	lower extr.	n	%
# of FCI dimensions affected										
None	168	58	65	160	214	115	77	94	951	--
Some:										
1	29	18	3	10	10	10	42	36	158	49.2
2	5	9	5	0	2	17	0	10	48	15
3	2	0	0	0	0	20	0	15	37	11.5
4	3	0	0	1	0	15	0	0	19	5.9
5	6	0	0	0	0	26	0	0	28	8.7
6	8	0	0	0	0	0	0	0	8	2.5
7	3	0	4	0	0	0	0	0	7	2.2
8	5	0	0	0	0	0	0	0	5	1.6
9	9	0	0	0	0	0	0	0	9	2.8
10	1	0	1	0	0	0	0	0	2	0.6
subtotal	71	27	13	11	12	84	42	61	321	100

The FCI distribution by the four broader functional categories previously described (basic biologic, mechanical neuro-musculoskeletal, mechanical sensory, and cognitive) reveals that most of the 321 FCI codes with some functional limitation had only one category affected (61.7%), followed by two categories affected (26.8%), all four categories affected (8.1%), and only three categories affected (3.4%). Mechanical neuro-musculoskeletal functions (motor functions) are the single most frequently affected category (40.9%), followed by the affectation of basic biologic and mechanical neuro-musculoskeletal functions (22.8%). A detailed description of these categories is shown in Table 4.

Table 4. Distribution of the FCI ≠ 0 by broader functional areas affected (n=321)

	n	%
Functions affected:		
Basic biologic	20	6.2
Mechanical neuro-skeletal	131	40.9
Mechanical sensory	47	14.6
Cognitive	0	
Basic biologic + Mechanical neuro-musculoskeletal	73	22.8
Basic biologic + Mechanical sensory	8	2.5
Basic biologic + Cognitive	0	
Mechanical neuro-skeletal + Mechanical sensory	0	
Mechanical neuro-skeletal + Cognitive	4	1.2
Mechanical sensory + Cognitive	1	0.3
Basic biologic + Mechanical neuro-skeletal + Mechanical sensory	5	1.6
Basic biologic + Mechanical neuro-skeletal + Cognitive	3	0.9
Basic biologic + Mechanical sensory + Cognitive	0	
Mechanical neuro-skeletal + Mechanical sensory + Cognitive	3	0.9
Basic biologic + Mechanical neuro-skeletal + Mechanical sensory + Cognitive	26	8.1
Total	321	100

A comparison between injuries with and without predicted functional limitations by AIS body region reveals some differences. For example, spine has the third largest number of AIS codes assigned to it, but it is the body region with the highest proportion of those codes mapped into some functional limitation. Similarly, extremity injuries (lower and upper) and facial injuries have relatively fewer AIS codes, but most of them have some functional limitation, whereas abdomen and thorax, although having quite a big number of AIS codes, are the body regions with a lower proportion of those codes mapped into some functional limitation (see Table 5).

Table 5. Ranking of body regions by frequency. (Numbers of AIS codes per body region.)

Ranking	AIS codes (n=1,272)	FCI code=aaaaaaaaaa (n=951)	FCI code≠aaaaaaaaaa (n=321)
1	head (239)	abdomen (214)	spine (84)
2	abdomen (226)	head (168)	head (71)
3	spine (199)	thorax (160)	lower extr. (61)
4	thorax (171)	spine (115)	upper extr. (42)
5	lower extr. (155)	lower extr. (94)	face (27)
6	upper extr. (119)	upper extr. (77)	neck (13)
7	face (85)	neck (65)	abdomen (12)
8	neck (78)	face (58)	thorax (11)

A detailed listing with all AIS codes with some predicted functional limitation (n=321) and their FCI codes, sorted by the number of FCI dimensions affected and body regions where the injuries are located, is presented in Appendix A.

II. Relationship between AIS and FCI scores

Every FCI code is assigned a value judgment score (or utility value). Obviously, injuries with no functional limitations predicted receive the best possible FCI score (FCI=0). Thus, out of the 1,272 AIS codes mapped into FCI, 951 have a FCI=0. The remaining 321 AIS codes received FCI values ranging from 6.82 to 100. A frequency distribution of FCI scores shows quite a uniform distribution with 22.7% of the scores being equal or lower than 20, 20.1% between 21 and 40, 23.9% between 41 and 60, 12.9% between 61 and 80, and 20.4% with scores between 80 and 100.

The percentage of AIS scores that are predicted to produce some functional limitation by AIS score ranges from a low of 13% for AIS=1 to a high of 79% for AIS=6 with some interesting fluctuation in the intermediate AIS scores (see Table 6).

Table 6. Distribution (n and % of Total) of injuries with and without predicted functional limitation by AIS severity score.

AIS	FCI=0		FCI ≠0		Total
	n	%	n	%	N
1	207	87.3	30	12.7	237
2	282	72.8	106	27.2	388
3	283	84.2	53	15.8	336
4	111	75.0	37	25.0	148
5	59	43.1	79	56.9	138
6[2]	4	21.1	16	78.9	20
9	5	100	0	-	5
total	951	74.8	321	25.2	1272

Further exploration of the association between AIS and FCI scores confirms the different nature of both scales and shows patterns of association that vary by body region. For example, facial injuries have, in general, low AIS and FCI scores, whereas thoracic injuries, although having high AIS scores, score low in FCI. The opposite situation--low AIS scores and high FCI values--can be seen in spinal cord injuries. (See Tables 7.1 to 7.8.)

A listing with all 321 AIS codes with some functional limitation predicted (FCI≠0), their FCI codes, FCI scores and FCI score categories is shown in Appendix B.

[2] AIS 6 injuries are usually not survivable. For a few injuies, if the injury is survived, the expert opinion is that FCI = 0.

Tables 7.1-7.8. Distribution of AIS scores and FCI scores (in categories) by AIS body region.

1. Body region : Head						
AIS\FCI	1	2	3	4	5	total
1	0	0	0	0	0	0
2	14	8	5	0	0	27
3	1	1	0	1	1	4
4	1	1	2	1	3	8
5	1	2	1	3	21	28
6	0	0	0	0	4	4
9	0	0	0	0	0	0
total	17	12	8	5	29	71

2. Body region: Face						
AIS\FCI	1	2	3	4	5	total
1	8	9	0	0	0	17
2	2	2	4	0	0	8
3	1	0	1	0	0	2
4	0	0	0	0	0	0
5	N/A	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	N/A	N/A	N/A
total	11	11	5	0	0	27

3. Body region: Neck						
AIS\FCI	1	2	3	4	5	total
1	0	0	0	0	0	0
2	0	0	1	0	0	1
3	0	0	1	0	2	1
4	0	2	1	1	2	6
5	0	0	0	2	0	2
6	0	0	0	0	1	1
9	N/A	N/A	N/A	N/A	N/A	N/A
total	0	2	3	3	5	13

4. Body region: Thorax						
AIS\FCI	1	2	3	4	5	total
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	1	2	0	0	0	3
5	5	1	0	0	1	7
6	1	0	0	0	0	1
9	0	0	0	0	0	0
total	7	3	0	0	1	11

5. Body region: Abdomen and Pelvic contents						
AIS\FCI	1	2	3	4	5	total
1	0	0	0	0	0	0
2	0	1	0	0	0	1
3	0	0	2	1	0	3
4	2	1	0	1	0	4
5	0	2	1	1	0	4
6	0	0	0	0	0	0
9	0	0	0	0	0	0
total	2	4	3	3	0	12

6. Body region: Spine						
AIS\FCI	1	2	3	4	5	total
1	0	0	0	0	0	0
2	0	5	6	1	0	12
3	2	2	0	5	0	9
4	0	0	5	10	0	15
5	0	0	6	10	22	38
6	0	0	0	0	10	10
9	N/A	N/A	N/A	N/A	N/A	N/A
total	2	7	17	26	32	84

7. Body region: Upper Extremities						
AIS\FCI	1	2	3	4	5	total
1	0	4	4	0	0	8
2	0	8	14	1	0	23
3	0	1	8	2	0	11
4	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	N/A	N/A	N/A
total	0	13	26	3	0	42

9. Body region: Lower Extremities						
	1	2	3	4	5	total
1	5	0	0	0	0	5
2	19	8	7	0	0	34
3	10	4	6	1	0	21
4	0	0	1	0	0	1
5	0	0	0	0	0	0
6	0	0	0	0	0	0
9	N/A	N/A	N/A	N/A	N/A	N/A
total	34	12	14	1	0	61

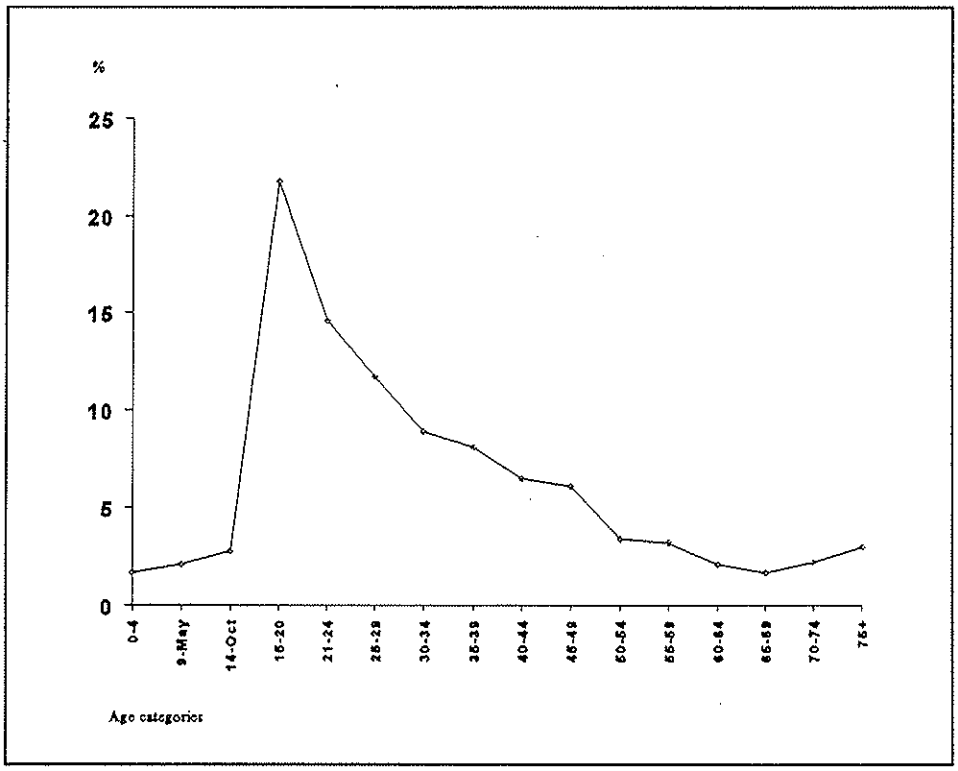
Notes: N/A means that there are no AIS codes for that particular body region with that severity level.
FCI categories are: (1) 0 > FCI≤20, (2) 20 > FCI≤40, (3) 40 > FCI≤60, (4) 60 > FCI≤80, and (5) 80 > FCI≤100

III. Results from the analysis of NASS CDS data.

For the years 1993 and 1994, there were 11,908 cases (N) in the NASS CDS database that met the inclusion criteria; this represents an estimate of 3,181,013 cases (N_w) involved in non-fatal motor-vehicle crashes in the U.S. resulting in some injuries (or approximately 1,590,507 cases per year). Results in this section always refer to the U.S. population estimates (N_w) unless otherwise indicated.

Occupants' ages ranged from less than one to 97+ years old. The mean age was 32.3 and the median age was 27. Less than 7% of the cases were younger than 15 years old. Most of the cases (57%) were between 15 and 34 years old. The age distribution is shown in Figure 1. More than half of the cases were males (52%).

Figure 1. Age distribution. (NASS CDS 1993, 1994.)



A total of 8,335,408 injuries were reported for these cases. This represents an estimate of 4,167,704 injuries per year. The mean number of diagnoses per case was 2.6.

The majority of the injuries reported (97%) were minor (AIS 1) or moderate (AIS 2). About half of the injuries (43%) occurred in only two AIS body regions: upper and lower extremities. Only some head, thoracic, abdominal and spinal cord injuries reached a critical AIS score (AIS=5). A detailed distribution of the reported injuries by AIS body region and their severity levels is shown in Table 8.

Table 8. Distribution (n and %) of all reported injuries (n=8,335,408) by AIS body region and AIS severity score. (NASS CDS 1993, 1994.)

AIS score body region	1	2	3	4	5	Total
head	639,862 *7.7*	140,740 *1.7*	34,202 *0.4*	13,374 *0.2*	6,708 *0.1*	834,886 *10*
face	1,624,028 *19.5*	48,440 *0.6*	8,493 *0.1*	0	N/A	1,680,961 *20.2*
neck	109,912 *1.3*	203 *	19 *	67 *	0	110,201 *1.3*
thorax	656,603 *7.9*	50,993 *0.6*	55,189 *0.7*	9,218 *0.1*	198 *	772,200 *9.3*
abdomen	258,782 *3.1*	38,306 *0.5*	5,092 *0.06*	2,352 *0.03*	1,989 *0.02*	306,521 *3.7*
spine	1,017,196 *12.2*	43,982 *0.5*	12,067 *0.1*	827 *0.01*	697 *0.01*	1,074,769 *12.9*
upper extr.	1,430,701 *17.2*	141,641 *1.7*	37,327 *0.5*	N/A	N/A	1,609,669 *19.3*
lower extr.	1,731,141 *20.8*	160,644 *1.9*	54,332 *0.7*	84 *	0	1,946,201 *23.4*
Total	7,468,226 *89.6*	624,947 *7.5*	206,721 *2.5*	25,923 *0.3*	9,591 *0.1*	8,335,408 *100*

Notes: N/A means that there are no AIS codes for that particular body region with that severity score.
* means that the percentage is less than 0.01.

When the most severe AIS (MAIS) is used to describe the patients' overall severity level, a very similar distribution, both regarding severity level and body region affected, is found: minor and moderate injuries are still the most common (95%) injuries and extremity injuries (upper and lower) are about 40% of the MAIS. The only difference (as expected) is that head and spine injuries increase in proportion. A detailed distribution with all body regions and severity levels for the MAIS of the 3,181,013 patients is shown in Table 9.

Table 9. Distribution (N_w & %) of all MAIS by body region and severity score (N_w=3,181,013) (NASS CDS 1993,1994.)

MAIS score body region	1	2	3	4	5	Total
head	441,512 *13.9*	105,749 *3.3*	18,609 *0.6*	10,049 *0.3*	4,817 *0.2*	580,736 *18.3*
face	241,557 *7.6*	24,202 *0.8*	3,810 *0.1*	0	N/A	269,569 *8.5*
neck	39,955 *1.3*	86 *	4 *	67 *	0	40,112 *1.3*
thorax	116,357 *3.7*	26,025 *0.8*	37,538 *1.2*	7,682 *0.2*	196 *0.01*	187,798 *5.9*
abdomen	69,071 *2.2*	9,994 *0.3*	2,550 *0.1*	1,800 *0.1*	1,840 *0.1*	85,255 *2.7*
spine	709,246 *22.3*	17,968 *0.6*	7,501 *0.2*	753 *0.02*	697 *0.02*	736,164 *23.1*
upper extr.	345,069 *10.9*	88,194 *2.8*	25,633 *0.8*	N/A	N/A	458,897 *14.4*
lower extr.	699,388 *22*	83,588 *2.6*	39,481 *1.2*	25 *	0	822,482 *25.9*
Total	2,662,156 *83.7*	355,806 *11.2*	135,125 *4.3*	20,376 *0.6*	7,550 *0.2*	3,181,013 *100*

Notes: N/A means that there are no AIS codes for that particular body region with that severity score,
* means that the percentage is less than 0.01.

All reported injuries were assigned FCI codes (and their scores) using the mapping between AIS and FCI discussed in the previous section. The majority of injuries (96.5%) were not associated with any functional limitation--FCI=0. For the remaining 294,710 injuries, the functional limitation was predominantly FCI ≤ 60 (94%), with very few injuries associated with higher FCI scores (only head and spine injuries were mapped into FCI scores between 80 and 100). Extremity injuries (lower and upper) constitute the majority of injuries mapped into some functional limitation (53% and 37% respectively). Table 10 shows in detail the distribution of all reported injuries by AIS body region and FCI scores.

Table 10. Distribution (n & %) of all reported injuries by AIS body region and FCI categories (n=8,335,408) (NASS CDS 1993, 1994.)

AIS\FCI	0	1	2	3	4	5	total
head	827,059 *9.9*	64 *	122 *	103 *	2,251 *0.3*	5,287 *0.1*	834,886 *10*
face	1,666,581 *20*	9,246 *0.1*	3,160 *0.04*	1,974 *0.02*	0	0	1,680,961 *20*
neck	110,161 *1.3*	0	0	40 *	0	0	110,201 *1.3*
thorax	768,789 *9.2*	3,387 *0.04*	24 *	0	0	0	772,200 *9.3*
abdomen	305,907 *3.7*	0	237 *	206 *	171 *	0	306,521 *3.7*
spine	1,072,938 *12.9*	0	319 *	648 *0.01*	296 *	568 *	1,074,769 *12.9*
upper extr.	1,499,375 *18*	0	55,189 *0.7*	55,062 *0.7*	43 *	0	1,609,669 *19.4*
lower extr.	1,789,923 *21.5*	82,810 *1*	23,767 *0.3*	40,661 *0.5*	9,040 *0.4*	0	1,946,201 *23.4*
total	8,040,698 *96.5*	95,505 *1.1*	82,854 *1*	98,694 *1.2*	11,801 *0.1*	5,855 *0.1*	8,335,408 *100*

Notes: FCI categories are: (1) 0 > FCI≤20, (2) 20 > FCI≤40, (3) 40 > FCI≤60, (4) 60 > FCI≤80, and (5) 80 > FCI≤100.
* means that the percentage is less than 0.01.

If the highest FCI per individual (or MFCI) is selected per description, a similar pattern is found. The majority of U.S. vehicle occupants (93.4%) are predicted not to suffer any functional limitation from their motor-vehicle related injuries one year post-event. Only 210,849 occupants (or 6.6%) were predicted to have some functional limitation. About 56% of the functional limitations reported had an MFCI ≤ 40. The AIS codes associated with the MFCI are used to describe the patients' injuries. Among these patients, injuries to the extremities (upper and lower)

constitute 91.6% of the injuries associated with a MFCI ≠ 0. Facial injuries are 3.6%; followed by head injuries (3.2%), spinal injuries (0.8%), thoracic injuries (0.6%), and abdominal injuries (0.1%). Table 11 shows the distribution of all occupants by AIS body region injured and MFCI score.

Table 11. Distribution (n & %) of the reported injuries associated with MFCI (N_w =3,181,013) by AIS body region and MFCI categories. (NASS CDS 1993, 1994.)

MFCI AIS	0 (a)	1 (b)	2 (c)	3 (d)	4 (e)	5 (f)	some FCI (b+c+d+e+f)	Total (a+b+c+d+e+f)
head	586,922 *18.4*	0	17 *	22 *	1,462 *0.03*	5,287 *0.05*	6,788	593,710 *18.7*
face	254,658 *8*	4,759 *0.1*	1,590 *	1,291 *0.04*	0	0	7,640	262,298 *8.2*
neck	42,107 *1.3*	0	0	40 *	0	0	40	42,147 *1.3*
thorax	142,693 *4.5*	1,233 *0.03*	24 *	0	0	0	1,257	143,950 *4.5*
abdomen	71,570 *2.2*	0	106 *	0	146 *	0	252	71,822 *2.2*
spine	742,657 *23.3*	0	309 *	546 *	296 *	568 *	1,719	744,376 *23.3*
upper extr.	369,027 *11.6*	0	42,012 *1.3*	47,573 *1.5*	43 *	0	89,628	458,655 *14.4*
lower extr.	760,530 *23.9*	47,462 *1.5*	20,511 *0.6*	28,142 *0.9*	7,410 *0.2*	0	103,525	864,055 *27.2*
total	2,970,164 *93.4*	53,454 *1.7*	64,569 *2*	77,614 *2.4*	9,357 *0.3*	5,855 *0.2*	210,849	3,181,013 *100*

Notes: FCI categories are: (1) 0 > FCI≤20, (2) 20 > FCI≤40, (3) 40 > FCI≤60, (4) 60 > FCI≤80, and (5) 80 > FCI≤100.
* means that the percentage is less than 0.01.

There were 400 different AIS associated with the MFCI among the 3,181,013 patients. Ninety of these 400 AIS codes were head injuries; 77 were lower extremity injuries; 60 were upper extremity injuries; 58 were spinal injuries; 48 were facial injuries; 29 were abdominal injuries; 27 were thoracic injuries; and, the remaining 11 AIS codes were neck injuries. The single most frequently reported AIS code associated with an MFCI ≠ 0 (with 103 cases reporting it) was "fracture of carpus or metacarpus" (752002.2). All the other AIS codes associated with MFCI ≠ 0 constituted less than 10% of all AIS reported.

These 400 AIS codes, when mapped into the FCI, yielded 44 different FCI dimension/level combinations. Of the 400 AIS codes, only 132 (33%) had some functional limitation (MFCI ≠ 0).

Among them, the most common situation was that only one dimension was affected. No reported injury had all 10 FCI dimensions affected. The single most common MFCI dimension/level combination (both measured by the number of AIS codes associated with such combination and by the number of patients affected with such injury) was "aaabaaaaaa" (minor limitations in ambulation). Any other FCI dimension/level combination account for less than 10% of all AIS codes associated with the MFCI and less than 20% of all patients in the sample. Table 12 shows the different FCI dimension/level combinations, together with the number of AIS codes that were mapped into them, the number of cases in the sample --N-- and the number of cases in the population --N_w--, sorted by the number of dimensions affected.

Table 12. Distribution of the MFCI dimension/level combinations (n=44). AIS codes (n=400), N (11,908), and N_w (3,181,013) associated with them. (NASS CDS 1993, 1994.)

FCI code	#AIS	N	N_w
No Limitations			
aaaaaaaaaa	268	10,153	2,970,164
One dimension affected			
aaaaaaaaba	1	4	137
aaaaaaaaca	1	1	40
aaaaaabaaa	1	43	3997
aaaaaacaaa	3	7	626
aaaaaadaaa	1	7	848
aaaaaaeaaa	1	6	386
aaaaaagaaa	1	1	54
aaaabaaaaa	12	169	42,255
aaaaacaaaa	11	228	25,377
aaaadaaaaa	9	138	22,198
aaaaeaaaaa	1	2	43
aaabaaaaaa	25	443	48,694
aaacaaaaaa	1	1	24
adaaaaaaaa	1	3	146
baaaaaaaaa	3	4	123
subtotal	72	1,057	144,948
Two dimensions affected			
aaaaaaabba	4	9	357
aaaacbaaaa	2	2	220
aaaaedaaaa	1	1	4
aaababaaaa	7	122	20,511
baaaaaaaba	1	18	1,237
subtotal	15	152	22,329
Three dimensions affected			
aabbabaaaa	4	295	28,043
aabcabaaaa	3	4	99
aabcacaaaa	1	96	7,410
abacabaaaa	4	6	390
abbdaaaaaa	1	2	28
subtotal	13	403	35,970
Four dimensions affected			
aaabbbaaab	2	2	22
aaacccaaac	1	4	264
abacbbaaaa	5	10	267
abacccaaaa	1	1	12
abbfabaaaa	4	5	142
subtotal	13	22	707
Five dimensions affected			
abbffdaaaa	1	1	321
adbfcdaaaa	2	4	101
subtotal	3	5	422
Six dimensions affected			
aabccbaabc	1	1	24
ababbbaabb	3	30	1,431
bbabbbaaac	1	12	385
subtotal	5	43	1,840
Seven dimensions affected			
bbabbbaabc	1	1	110
ccacccaacd	1	24	982
subtotal	2	25	1,092
Eight dimensions affected			
bbccccaabd	1	5	25
bbcdccaacd	1	1	32
cccdccaace	1	15	316
cccdecaabc	1	3	84
cdceddaace	1	8	461
subtotal	5	28	918
Nine dimensions affected			
cdcffdacdf	4	20	2,624
Some limitation	132	1,755	210,849
Total	400	11,908	3,181,013

The 132 MFCI ≠ 0 were grouped into the broader functional categories (basic biologic, mechanical neuro-musculoskeletal, mechanical sensory, and cognitive). Only nine different combinations were observed. Most of the MFCI affected only the mechanical neuro-musculoskeletal function (75.6%), followed by affectation of basic biologic and mechanical neuro-musculoskeletal functions (17.5%), and affectation of all four functions (2.9%). Table 13 shows the distribution of cases suffering some functional limitation by function categories.

Table 13. MFCI distribution (n and %) by FCI broader categories. (NASS CDS 1993, 1994.)

	Nw	
Functions affected:	**n**	**%**
Basic biologic	269	0.1
Mechanical neuro-musculoskeletal	159,327	75.6
Mechanical sensory	6,443	3.0
Basic biologic + Mechanical neuro-musculoskeletal	36,814	17.5
Basic biologic + Mechanical sensory	1,237	0.6
Mechanical neuro-musculoskeletal + Cognitive	22	0
Basic biologic + Mechanical neuro-musculoskeletal + Cognitive	385	0.2
Cognitive + Mechanical: neuro-musculoskeletal + sensory	264	0.1
Basic biologic + Mechanical: neuro-musculoskeletal + sensory + Cognitive	6,088	2.9
Total	210,849	100

A comparison of the injuries with and without functional limitations by AIS body region reveals that lower and upper extremity injuries are the body regions with a higher proportion of their injury codes mapped into some functional limitation. Table 14 shows a ranking of the AIS codes by body region.

Table 14. Ranking of AIS body regions by frequency. Numbers of AIS codes per body region are in parentheses.

Ranking	**AIS codes** (n=400)	**FCI code=aaaaaaaaaa** (n=268)	**FCI code≠aaaaaaaaaa** (n=132)
1	head (90)	head (68)	lower extr. (39)
2	lower extr. (77)	lower extr. (38)	upper extr. (32)
3	upper extr. (60)	spine (37)	head (22)
4	spine (58)	face (35)	spine (21)
5	face (48)	upper extr. (28)	face (13)
6	abdomen (29)	abdomen (27)	abdomen/thorax (2)
7	thorax (27)	thorax (25)	neck (1)
8	neck (11)	neck (10)	--

For every patient suffering some functional limitation, the number of LLI was computed. The total amount of LLI from motor-vehicle crash-related injuries in the U.S. in 1993 and 1994 is 2,867,887 years. This implies that every year, in the U.S., the number and type of motor-vehicle crash-related injuries generate a functional limitation loss that equals an overall loss to society of approximately 1.4 million years. Almost 86% of this lost is due to injuries to the extremities (upper and lower). Head injuries represent another 9% of the total LLI. The remaining 5% LLI is due to injuries to the remaining body regions. If the average number of LLI per case with an MFCI ≠ 0 is computed, it ranges from 5.5 LLI due to thorax injuries to 38.5 LLI due to head injuries. The overall average LLI per injured patient (with an MFCI ≠ 0) equals 13.6. A detailed distribution of total and average LLI by AIS body region is shown in table 15.

Table 15. Total (n and %) and average Life-years Lost to Injury (LLI) by AIS body region. (NASS CDS 1993, 1994.)

	LLI		
AIS body region	**total**	**%**	**average**
head	261508	9.1	38.5
face	82,819	2.9	10.8
neck	894	0	22.4
thorax	6,942	0.3	5.5
abdomen	6,235	0.2	24.7
spine	49,348	1.7	28.7
upper extr.	1,318,046	46.0	14.7
lower extr.	1,142,095	39.8	11.0
total	2,867,887	100	13.6

If the LLI computation is analyzed using the FCI broader categories described before, 63.5% of all LLI are due to the single limitation of the mechanical neuro-musculoskeletal function. When average LLIs per broader categories are calculated, a range of values is observed, from a low 9.6 years per case with mechanical sensory limitations to a high 47.1 in a case with limitations of basic biologic, mechanical neuro-musculoskeletal and cognitive functions. Table 16 contains a description of total and average LLI distributions by broader FCI categories.

Table 16. Life-years Lost to Injury (LLI). Total (n & %) and average by FCI broader categories. (NASS CDS 1993, 1994.)

		LLI	
Functions affected:	**n**	**%**	**average**
Basic biologic	6,459	0.2	24.0
Mechanical neuro-musculoskeletal	1,822,650	63.5	11.4
Mechanical sensory	61,685	2.2	9.6
Basic biologic + Mechanical neuro-musculoskeletal	694,060	24.2	18.9
Basic biologic + Mechanical sensory	22,028	0.8	17.8
Mechanical neuro-musculoskeletal + Cognitive	400	0	18.2
Basic biologic + Mechanical neuro-musculoskeletal + Cognitive	18,126	0.6	47.1
Cognitive + Mechanical: neuro-musculoskeletal + sensory	11,239	0.4	42.6
Basic biologic + Mechanical: neuro-musculoskeletal + sensory + Cognitive	231,240	8.1	38.0
Total	2,867,887	100	13.6

A detailed listing of all AIS codes with some predicted functional limitation (and their literal description), their FCI codes, FCI scores, the number of people in the sample with those injuries, the estimated number of people in the U.S. population, and the LLI is presented in Appendix C.

IV. Comparing different injury classification criteria.

Six listings of the 20 injuries most frequently reported in the NASS CDS data (according to different criteria) were compiled. The injuries are described by the AIS code associated with the MFCI. These different listings were done to identify the different body regions involved in the most frequent injuries. The main findings of this comparison are summarized in Table 17.

The two first listings included all patients in the NASS CDS data (irrespective of whether their MFCI was 0). The first listing, with the 20 injuries most frequently reported, showed that these injuries constitute about 75% of the total injuries reported. The average AIS of these 20 injuries is 1.1 and only one such AIS code was associated with some functional limitation at all (which by itself represents 12.2% of all LLI reported in the NASS CDS data). These AIS codes relate to injuries in all AIS body regions except Neck. The injuries reported include head injuries (scalp abrasion, minor scalp laceration, and several codes related to minor affectation of the level of consciousness); facial, thoracic and abdominal injuries (skin contusions and abrasions); spinal cord injuries (strains); upper extremity injuries (skin abrasions, contusions, and lacerations, fracture of carpus or metacarpus); and lower extremity injuries (skin contusions, abrasions and lacerations). For the second listing, the 20 injuries more frequently reported and with the highest AIS scores were ranked, and a different distribution was revealed. Out of these 20 injuries (which constitute only 0.2% of all injuries reported), only one did not have any functional limitations associated with it. Although most of these injuries are associated with some functional limitation (average MFCI = 84.2), they constitute 8.5% of all LLI lost in the NASS CDS data. The injuries listed in

this sorting are head (brain stem compression, contusion and hemorrhage, cerebrum contusion, diffuse axonal injury, cerebrum hematoma, and unconsciousness longer than 24 hours); spine (cord contusion and laceration); and, abdomen injuries (massive laceration of the duodenum).

The remaining listings included only patients whose injuries were associated with some functional limitation (measured by MFCI ≠ 0). Four sortings of this subset of the data were done using different criteria: (a) the most frequently reported injuries, (b) the most severe AIS codes most frequently reported, (c) the highest MFCI most frequently reported, and (d) injuries associated with the highest LLI and most frequently reported. The 20 first injuries sorted with each criterion are compared next:

(a) Of the 20 most frequently reported injuries associated with an MFCI ≠ 0, 19 were injuries to the extremities (upper and lower) and one was a facial injury. These injuries constitute about 83% of all injuries reported for this subset of NASS CDS data. Their average AIS severity was 2.4, their average MFCI level was 29.9 and they represented about 78% of all LLI estimated in the NASS CDS data. Among the injuries listed in the extremities: joint lacerations and dislocation, fractures (carpus, humerus, radius, femur, foot, patella, pelvis, and tibia), and fibula contusion; the orbit fracture was the facial injury in this classification.

(b & c) When the most severe injuries more frequently reported associated with an MFCI ≠ 0 were listed, a very similar distribution pattern was observed between the listing using the AIS as the severity criterion and the listing using the FCI. The only differences between the two listings were the absence of abdominal injuries leading to high MFCI and the introduction of some head and spinal injuries.

(d) Finally, the 20 injuries associated with highest LLI and most frequently reported were analyzed. These 20 AIS codes constitute about 83% of all LLI estimated with the NASS CDS data. Their mean MFCI was 42.9 and their average AIS severity was 2.75. The number of patients with these AIS codes are about 78% of all NASS CDS cases with MFCI ≠ 0. The injuries reported are to the: head (brain stem injuries and loss of consciousness); face (orbit fracture); and extremities (joint laceration and dislocation, fractures or carpus, humerus, radius, femur, foot, pelvis, and tibia).

Table 17. Selecting the 20 most frequent AIS codes by different criteria. (NASS CDS 1993, 1994.)

	All cases (N_w= 3,181,013)		Only cases with MFCI ≠ 0 (N_w=210,849)			
Rating criteria	**Frequency**	**AIS**	**Frequency**	**AIS**	**FCI**	**LLI**
AIS codes	110202.1	140202.5	251204.3	140202.5	140202.5	140210.5
	110602.1	140204.5	740600.2	140204.5	140204.5	160820.4
	160402.1	140210.5	750230.2	140210.5	140210.5	160824.5
	160410.2	140299.5	751030.2	140299.5	140299.5	251204.3
	160499.1	140610.5	752002.2	140610.5	140610.5	740600.2
	210402.1	140626.5	752604.3	140626.5	140618.5	750230.2
	210600.1	140628.5	752802.2	140628.5	140626.5	751030.2
	210602.1	140646.5**	752804.3	140648.5	140628.5	751430.2
	410402.1	140648.5	850806.2	140656.5	140636.5	752002.2
	510402.1	140656.5	851612.2	160214.5	140648.5	752604.3
	640278.1	160214.5	851814.3	160822.5	140656.5	752802.2
	640478.1	160822.5	852000.2	160824.5	150206.4	752804.3
	640678.1	160824.5	852200.2	541028.5	160214.5	850806.2
	710202.1	541028.5	852400.2	640228.5	160824.5	851814.3
	710402.1	640228.5	852600.2	640250.5	640226.5	852000.2
	710602.1	640250.5	852602.2	640268.5	640228.5	852600.2
	752002.2*	640268.5	852604.3	640422.5	640268.5	852602.2
	810202.1	640422.5	853408.3	640426.5	640422.5	852604.3
	810402.1	640426.5	853420.2	640428.5	640426.5	853408.3
	810602.1	640428.5	853422.3	640628.5	640428.5	853422.3
N_w	2,352,847	6,420	174,498	6,365	5,862	163,921
% of N_w	74	0.2	82.9	3	2.8	77.7
LLI	350,007	245,166	2,240,028	246,281	228,823	2,364,819
% of 2,867,887	12.2	8.5	78.1	8.6	8	82.5
mean MFCI	1.15	84.2	29.9	87.8	94.85	42.9
mean AIS	1.1	5	2.4	5	4.9	2.75
AIS body regions	1, 7, 8, 6, 2, 5, 4	1, 6, 5	8, 7, 2	1, 6, 5	1, 6	8, 7, 1, 2

Note: (*) only one injury had MFCI ≠ 0; (**) only one injury had MFCI =0.

CONCLUSION AND DISCUSSION

Only 25% of the AIS codes (injury descriptors) are predicted to produce some functional limitation one year post-injury. Of the multiple FCI dimension/level combinations theoretically possible, the prediction of functional limitation for all these AIS codes only revealed 73 different patterns (excluding the absence of limitation). About 50% of the limitations are only minor (rated as function level "b") and slightly less than 25% are predicted to have only one dimension affected (out of the possible 10). The most frequently predicted limitation affects the ambulatory function (and thus, the mechanical neuro-musculoskeletal function).

Higher AIS severity scores tend to be associated with higher FCI scores (and lower AIS scores with lower FCI scores). But there is not a linear relationship between them, and the relationship varies by body region.

Approximately 1.5 million people are injured in non-fatal, police-reported, tow-away motor-vehicle crashes in the U.S. every year. The majority of these are young and male. Some of them sustain multiple injuries (average 2.6). The injuries sustained are predominantly minor (95% of these occupants have MAIS of 1 or 2). About 92% of the injuries with a MAIS $\neq$ 0 are injuries to the extremities (upper and lower); followed by injuries to the face (4%) and head (3%). Only around 7% of the injured occupants are predicted to have some functional limitation one year post-injury (with 60% of them having MFCI < 40). The most common type of limitation affects only one dimension (out of the 10 dimensions that the FCI evaluates). One hundred and thirty-two AIS codes are sufficient to describe the injuries of this 7% of patients with some functional limitation (out of a total 1,272 AIS codes available). Injuries to the extremities (upper and lower) constitute about 92% of such injuries; which relates to the fact that the most common limitation resulting from motor-vehicle crashes is in the dimension of ambulation--or in a broader categorization, the affectation of mechanical neuro-musculoskeletal functions. The amount of total LLI per year due to these motor-vehicle related injuries is approximately 1.4 million (with an average of 13.6 years lost per injured patient). About 86% of the total LLI is due to extremity injuries.

A closer look into all injuries sustained by these occupants reveals that these injuries are mostly of minor severity (AIS 1 and 2). The vast majority of them (96.5%) are predicted not to produce any functional limitation. Among the ones associated with some FCI, extremity injuries constitute the majority. Only head and spinal injuries are associated with FCI > 60 and they constitute about 0.1% of all reported injuries.

Using 1993 NASS CDS data, Luchter (1996) did a similar analysis to explore the uses of FCI. His functional limitation incidence estimates as well as the LLI computed are very similar to the results reported here. Additional work with the subset of car occupants with head injuries reveals slightly lower incidence rates for head injuries and higher average LLI (Luchter and Waltz, 1995). These differences are probably due to the fact that in their calculations, some head injuries (i.e., nerve injuries and skull fractures) were excluded from the analysis because of their low incidence in the sample.

This report is intended to explore the potential uses of a utility-based functional limitation scale such as the FCI. The results presented here should be interpreted cautiously since the scale itself is still under review. Among the most relevant limitations, the reader should be reminded that:

- FCI assesses predicted functional limitation. Whether the injuries really produce the limitations is yet to be confirmed. Validation efforts with a one year post-event follow-up of injured patients are currently underway. Several refinements in the FCI are expected as a result of the validation.

- The value judgments used in computing the FCI scores are subject to improvement. During the FCI development, reliability issues were analyzed by comparing the utility values assigned by different groups of people. Although quite a reliable response was found among the different rater groups as to the value levels (i.e., the relative importance of some level of functioning with respect to the lack of limitation or the worst possible limitation within a given dimension) a higher variability was reported for the dimension weights (i.e., the relative value of one dimension versus the others). The sensitivity of FCI scores to such variability remains to be explored. Furthermore, the representability of the rater groups is questionable; raters were not random samples of the populations they intended to represent; values from one group -the elderly- had to be dropped out of the computations because of reliability problems; perhaps additional populations should be added to get "societal" utility values (e.g., relatives of disabled people). A last issue to consider in this regard is the possibility that individual utility values change over time. Therefore, applying values assessed at some particular age for the remainder of the individual's life requires further consideration.

- FCI assumes the subjects are 18 to 34 years old. Current work in the development of the Pediatric FCI may lower the lower age limit of this assumption if the existing dimensions and functional levels are considered appropriate for younger patients. In our analysis of NASS CDS data, 6.6% of the cases were younger than 15 years old and 36.4% were older than 34. Future uses of FCI should be restricted to the 18-34 age category until more work demonstrates whether there are differences in the index associated with age.

- FCI was constructed with the assumption that patients were previously healthy. There is not enough detail in the NASS CDS database to provide us with any insight about the health status of patients prior to the motor-vehicle crash.

- FCI assumes that patients suffered only one injury. We could not identify which percentage of the injured population with some predicted functional limitation had only one injury. For the cases suffering multiple injuries, we used the MFCI as the best available descriptor. That decision was driven by two reasons. First, since a very small percentage of injuries involve any functional limitation at all, the probability of any other injury contributing to a functional limitation is low. Second, even where an individual sustains several injuries that lead to functional limitation, the rationale is that provided that

FCI is a scale bounded between 0 and 100: (a) given any high MFCI, any other FCI would add little to the score, and (b) in the opposite situation, a low MFCI could increase little if any lower FCI score were to be added to it. Obviously, the effect of multiple FCI in the intermediate range remains to be assessed. Clearly, there is a need for determining how to compute overall FCI in the case of multiple injuries leading to functional limitations. The use of the worst possible state to define the overall limitation of patients has also been used by other authors (Torrance, 1992).

- FCI assumes a steady functional state after one year post-event. At the time when the scale was being developed, experts were asked to evaluate whether some limitations were predicted to evolve over time. Some injuries were predicted to restrict even further the functional capacity beyond the first year assessment whereas other injuries were predicted to improve their limitations over time. Almost no literature is available on the topic and further research is needed to evaluate this topic. Evolving functional limitation patterns would certainly modify the overall and average LLI calculations.

An additional issue related to the FCI to consider is that because FCI assesses functional limitation one year post-event, it misses any functional limitation that happens during the first days or months but is resolved before a year. As MacKenzie *et al* acknowledge (1994), these short-term limitations can have a significant impact at the individual and societal level which should be measured in order to obtain a complete assessment of the impact of injuries.

The data used for the analysis also have some limitations. Although it is probably the currently best available data on non-fatal injuries in the U.S., it is generated from a small sample (which produces some instability in the estimates). Also, the lack of recording of race and/or ethnicity limits the refinement in life-expectancy calculations using the available life tables.

LLI constitute the first Quality of Life-type of measurement applied to the injury field which enables the researchers to use a common metric across specific injuries. Quality Adjusted Life Years (QALYs) is a metric commonly used in the health-related environment which is rooted in the utility theory. Years of Potential Life Years Lost (YPLL), a measure applied to quantify the years lost due to premature death (or death before a given age) have been proven a very useful tool in advocacy and decision making. Several theoretical issues related to the use of LLI (e.g., whether to consider discounting) should be discussed by the injury community.

The uses of FCI and its most direct application, LLI, have significant implications. First, they provide a source of additional information on the medium- and long-term effect of injuries (which has direct implications for prevention strategies and advocacy). Second, the FCI provides the first estimates of the value judgments associated with injury-related functional limitations. Third, they represent a new metric to use when evaluating the effectiveness (and the cost-utility) of multiple injury-prevention programs. Last, they can be used as an alternative (or complementary) criteria when ranking injuries to prioritize interventions.

REFERENCES

The Abbreviated Injury Scale. 1990 Revision. Association for the Advancement of Automotive, Des Plaines, IL; 1990.

Baker SP, O'Neill B, Haddon W, Long WB. The Injury Severity Score: A Method for describing patients with multiple injuries and evaluating emergency care. J Trauma 14: 187-196; 1974.

Carsten O, O'Day J. Relationship of accident type to occupant injuries. UMTRI 84-24; 1986.

Hirsch A, Eppinger R, Shame T, Nguyen R, Levine R, Machenzie J, Marks M, Ommaya A. Impairment scaling from the Abbreviated Injury Scale. National Highway Traffic Safety Administration. DOT HS 806 648. DOT. Washington, DC; 1983.

Injury Impairment Scale - 1994.Association for the Advancement of Automotive, Des Plaines, IL; 1994.

Luchter S. The Use of Impairment for Establishing Accident Injury Research Priorities. Society of Automotive Engineers. SAE 871078; 1987.

Luchter S., Waltz MC. Long Term Consequences of Head Injury. Changes in Functional Capacity Resulting from Head Injury. J Neurotrauma 12:517-526; 1995.

Luchter S. Reduction in Functional Capacity as a Measure of Morbidity Resulting from Motor Vehicle Injury [oral communication]. Presented at the Third Injury World Conference; Melbourne, Australia; 1996.

Nagi SZ. Some conceptual issues in disability and rehabilitation. In: Sussman MB (ed); Sociology and Rehabilitation. American Sociology Association. Washington, DC; 1965.

MacKenzie EJ, Damiano AM, Ditunno JF, Luchter S, Miller TR. Development of the Functional Capacity Index (FCI). National Highway Traffic Safety Administration. DOT HS 808 160; 1994.

MacKenzie EJ, Damiano AM, Miller TR, Luchter S. The Development of the Functional Capacity Index. [mimeo, accepted at J Trauma; 1996.]

Miller TR, Luchter S, Brinkman P. Crash Cost and Safety Investment. Acc Anal Prev 21:303-315; 1989.

States JF, Viano DC. Injury Impairment and Disability Scales to assess the permanent consequences of trauma. Accid Anal Prev 22:151-; 1990.

Appendix A.
FCI Dimensions affected in AIS codes.

AIS Code	Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog
One FCI dimension affected										
Head										
120602.4	a	a	a	a	a	a	b	a	a	a
120804.5	a	a	a	a	a	a	c	a	a	a
120806.3	a	a	a	a	a	a	b	a	a	a
130602.2	a	a	a	a	a	a	c	a	a	a
130604.2	a	a	a	a	a	a	c	a	a	a
130606.2	a	a	a	a	a	a	e	a	a	a
130608.2	a	a	a	a	a	a	g	a	a	a
130699.2	a	a	a	a	a	a	c	a	a	a
130802.2	a	a	a	a	a	a	b	a	a	a
130804.2	a	a	a	a	a	a	b	a	a	a
130899.2	a	a	a	a	a	a	b	a	a	a
131002.2	a	a	a	a	a	a	b	a	a	a
131004.2	a	a	a	a	a	a	b	a	a	a
131099.2	a	a	a	a	a	a	b	a	a	a
131402.2	a	a	a	a	a	a	b	a	a	a
131404.2	a	a	a	a	a	a	b	a	a	a
131499.2	a	a	a	a	a	a	b	a	a	a
131602.2	b	a	a	a	a	a	a	a	a	a
131604.2	b	a	a	a	a	a	a	a	a	a
131699.2	b	a	a	a	a	a	a	a	a	a
131802.2	a	a	a	a	a	a	a	c	a	a
131804.2	a	a	a	a	a	a	a	e	a	a
131899.2	a	a	a	a	a	a	a	b	a	a
132204.2	b	a	a	a	a	a	a	a	a	a
132602.2	b	a	a	a	a	a	a	a	a	a
132699.2	b	a	a	a	a	a	a	a	a	a
140404.4	a	b	a	a	a	a	a	a	a	a
140406.5	a	b	a	a	a	a	a	a	a	a
140458.3	b	a	a	a	a	a	a	a	a	a
Face										
230202.2	a	a	a	a	a	a	c	a	a	a
230204.2	a	a	a	a	a	a	e	a	a	a
230206.2	a	a	a	a	a	a	g	a	a	a
230299.1	a	a	a	a	a	a	c	a	a	a
240402.2	a	a	a	a	a	a	g	a	a	a
240412.1	a	a	a	a	a	a	c	a	a	a
240499.1	a	a	a	a	a	a	d	a	a	a
240604.1	a	a	a	a	a	a	c	a	a	a
240606.1	a	a	a	a	a	a	c	a	a	a
240699.1	a	a	a	a	a	a	c	a	a	a
240800.1	a	a	a	a	a	a	c	a	a	a
241000.1	a	a	a	a	a	a	c	a	a	a
241002.2	a	a	a	a	a	a	c	a	a	a
241202.2	a	a	a	a	a	a	e	a	a	a
241499.1	a	a	a	a	a	a	e	a	a	a
241699.1	a	a	a	a	a	a	e	a	a	a
243206.1	a	a	a	a	a	a	a	a	b	a
251204.3	a	a	a	a	a	a	b	a	a	a

AIS Code	Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog
----------continued----------										
Neck										
340210.4	a	a	a	a	a	a	a	a	c	a
340212.5	a	a	a	a	a	a	a	a	d	a
341804.3	a	a	a	a	a	a	a	a	c	a
Thorax										
413000.6	a	a	a	b	a	a	a	a	a	a
420800.5	a	a	a	b	a	a	a	a	a	a
440210.4	a	a	a	c	a	a	a	a	a	a
440216.4	a	a	a	c	a	a	a	a	a	a
440810.5	b	a	a	a	a	a	a	a	a	a
441200.5	a	a	a	b	a	a	a	a	a	a
441300.5	a	a	a	b	a	a	a	a	a	a
441410.4	a	a	a	b	a	a	a	a	a	a
442610.5	a	a	a	b	a	a	a	a	a	a
442616.5	a	a	a	b	a	a	a	a	a	a
Abdomen										
520408.5	c	a	a	a	a	a	a	a	a	a
520608.4	a	a	a	b	a	a	a	a	a	a
520806.4	a	a	a	b	a	a	a	a	a	a
540426.4	a	b	a	a	a	a	a	a	a	a
541028.5	b	a	a	a	a	a	a	a	a	a
542832.5	b	a	a	a	a	a	a	a	a	a
543026.3	a	a	c	a	a	a	a	a	a	a
544024.2	a	a	b	a	a	a	a	a	a	a
545026.3	a	d	a	a	a	a	a	a	a	a
545028.4	a	d	a	a	a	a	a	a	a	a
Spine										
630202.2	a	a	a	a	c	a	a	a	a	a
630204.2	a	a	a	a	b	a	a	a	a	a
630206.2	a	a	a	a	b	a	a	a	a	a
630208.3	a	a	a	a	e	a	a	a	a	a
630260.2	a	a	a	a	b	a	a	a	a	a
630261.3	a	a	a	a	e	a	a	a	a	a
630262.2	a	a	a	a	b	a	a	a	a	a
630264.2	a	a	a	a	b	a	a	a	a	a
630666.3	a	a	a	b	a	a	a	a	a	a
6306723	a	a	a	b	a	a	a	a	a	a
Upper extremities										
710804.2	a	a	a	a	b	a	a	a	a	a
711000.3	a	a	a	a	c	a	a	a	a	a
713000.3	a	a	a	a	e	a	a	a	a	a
714002.2	a	a	a	a	d	a	a	a	a	a
714004.2	a	a	a	a	b	a	a	a	a	a
714006.3	a	a	a	a	b	a	a	a	a	a
716004.2	a	a	a	a	d	a	a	a	a	a
730204.1	a	a	a	a	b	a	a	a	a	a
730420.1	a	a	a	a	c	a	a	a	a	a
730430.2	a	a	a	a	c	a	a	a	a	a
730440.2	a	a	a	a	c	a	a	a	a	a
730450.2	a	a	a	a	c	a	a	a	a	a

AIS Code	Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog
----------continued----------										
740200.1	a	a	a	a	b	a	a	a	a	a
740210.1	a	a	a	a	c	a	a	a	a	a
740220.1	a	a	a	a	c	a	a	a	a	a
740400.2	a	a	a	a	b	a	a	a	a	a
740600.2	a	a	a	a	b	a	a	a	a	a
750230.2	a	a	a	a	d	a	a	a	a	a
750404.1	a	a	a	a	b	a	a	a	a	a
750630.1	a	a	a	a	d	a	a	a	a	a
750644.2	a	a	a	a	c	a	a	a	a	a
750646.2	a	a	a	a	e	a	a	a	a	a
750650.3	a	a	a	a	e	a	a	a	a	a
750800.1	a	a	a	a	b	a	a	a	a	a
751030.2	a	a	a	a	d	a	a	a	a	a
751040.2	a	a	a	a	d	a	a	a	a	a
751050.3	a	a	a	a	d	a	a	a	a	a
751230.2	a	a	a	a	d	a	a	a	a	a
751430.2	a	a	a	a	c	a	a	a	a	a
751440.2	a	a	a	a	b	a	a	a	a	a
751450.3	a	a	a	a	c	a	a	a	a	a
751600.2	a	a	a	a	d	a	a	a	a	a
752002.2	a	a	a	a	b	a	a	a	a	a
752004.2	a	a	a	a	c	a	a	a	a	a
752402.2	a	a	a	a	b	a	a	a	a	a
752406.2	a	a	a	a	b	a	a	a	a	a
752604.3	a	a	a	a	d	a	a	a	a	a
752606.3	a	a	a	a	d	a	a	a	a	a
752802.2	a	a	a	a	c	a	a	a	a	a
752804.3	a	a	a	a	c	a	a	a	a	a
752806.3	a	a	a	a	c	a	a	a	a	a
753206.3	a	a	a	a	c	a	a	a	a	a
Lower extremities										
815006.3	a	a	a	c	a	a	a	a	a	a
816004.2	a	a	a	b	a	a	a	a	a	a
820406.3	a	a	a	b	a	a	a	a	a	a
830406.3	a	a	a	c	a	a	a	a	a	a
830606.2	a	a	a	a	a	b	a	a	a	a
840204.2	a	a	a	b	a	a	a	a	a	a
840404.2	a	a	a	b	a	a	a	a	a	a
840406.3	a	a	a	b	a	a	a	a	a	a
840804.2	a	a	a	b	a	a	a	a	a	a
850210.2	a	a	a	b	a	a	a	a	a	a
850214.2	a	a	a	b	a	a	a	a	a	a
850218.2	a	a	a	b	a	a	a	a	a	a
850222.2	a	a	a	b	a	a	a	a	a	a
850402.1	a	a	a	b	a	a	a	a	a	a
851010.1	a	a	a	b	a	a	a	a	a	a
851014.1	a	a	a	b	a	a	a	a	a	a
851204.1	a	a	a	b	a	a	a	a	a	a
851206.1	a	a	a	b	a	a	a	a	a	a
851400.2	a	a	a	b	a	a	a	a	a	a

AIS Code	Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog
----------continued----------										
851610.2	a	a	a	b	a	a	a	a	a	a
851612.2	a	a	a	b	a	a	a	a	a	a
851804.3	a	a	a	b	a	a	a	a	a	a
851808.3	a	a	a	b	a	a	a	a	a	a
851810.3	a	a	a	b	a	a	a	a	a	a
851812.3	a	a	a	b	a	a	a	a	a	a
851814.3	a	a	a	b	a	a	a	a	a	a
851818.3	a	a	a	b	a	a	a	a	a	a
851822.3	a	a	a	b	a	a	a	a	a	a
852000.2	a	a	a	b	a	a	a	a	a	a
852200.2	a	a	a	b	a	a	a	a	a	a
852400.2	a	a	a	b	a	a	a	a	a	a
853410.2	a	a	a	b	a	a	a	a	a	a
853414.2	a	a	a	b	a	a	a	a	a	a
853416.2	a	a	a	b	a	a	a	a	a	a
853418.3	a	a	a	b	a	a	a	a	a	a
853420.2	a	a	a	b	a	a	a	a	a	a
Two FCI dimensions affected										
Head										
121802.5	a	a	a	a	a	a	c	a	a	b
132002.2	b	a	a	a	a	a	a	a	b	a
132004.2	b	a	a	a	a	a	a	a	b	a
132099.2	b	a	a	a	a	a	a	a	b	a
132604.2	b	a	a	a	a	a	a	a	b	a
Face										
210804.2	b	a	a	a	a	a	a	a	b	a
210806.3	b	a	a	a	a	a	a	a	b	a
216004.2	b	a	a	a	a	a	b	a	a	a
240204.1	a	a	a	a	a	a	a	b	b	a
240208.1	a	a	a	a	a	a	a	b	b	a
240212.1	a	a	a	a	a	a	a	c	b	a
240216.1	a	a	a	a	a	a	a	b	b	a
240220.1	a	a	a	a	a	a	a	d	b	a
240299.1	a	a	a	a	a	a	a	b	b	a
Neck										
320210.4	a	a	a	b	b	a	a	a	a	a
320214.5	a	a	a	c	c	a	a	a	a	a
320218.4	a	a	a	b	b	a	a	a	a	a
320222.4	a	a	a	c	c	a	a	a	a	a
341802.2	b	a	a	a	a	a	a	a	b	a
Abdomen										
543226.3	a	b	b	a	a	a	a	a	a	a
543626.5	a	b	b	a	a	a	a	a	a	a
Spine										
630210.2	a	a	a	a	c	b	a	a	a	a
630212.2	a	a	a	a	c	b	a	a	a	a
630214.2	a	a	a	a	d	b	a	a	a	a
630216.2	a	a	a	a	d	b	a	a	a	a
630220.2	a	a	a	a	e	d	a	a	a	a

AIS Code	Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog
----------continued----------										
630222.3	a	a	a	a	e	d	a	a	a	a
630224.3	a	a	a	a	e	d	a	a	a	a
630226.3	a	a	a	a	e	d	a	a	a	a
630299.2	a	a	a	a	c	b	a	a	a	a
630408.3	a	a	a	b	a	b	a	a	a	a
630414.3	a	a	a	b	a	b	a	a	a	a
640240.5	a	a	a	a	c	b	a	a	a	a
640242.5	a	a	a	a	c	b	a	a	a	a
640244.5	a	a	a	a	c	b	a	a	a	a
640246.5	a	a	a	a	c	b	a	a	a	a
640248.5	a	a	a	a	c	b	a	a	a	a
640250.5	a	a	a	a	c	b	a	a	a	a
Lower extremities										
815000.2	a	a	a	b	a	b	a	a	a	a
840600.2	a	a	a	b	a	b	a	a	a	a
841004.2	a	a	a	b	a	b	a	a	a	a
850614.2	a	a	a	b	a	b	a	a	a	a
850806.2	a	a	a	b	a	b	a	a	a	a
850810.2	a	a	a	b	a	b	a	a	a	a
850814.2	a	a	a	b	a	b	a	a	a	a
853406.2	a	a	a	b	a	b	a	a	a	a
853408.3	a	a	a	b	a	b	a	a	a	a
853422.3	a	a	a	b	a	b	a	a	a	a
Three FCI dimensions affected										
Head										
120204.3	a	a	a	c	a	b	a	a	a	c
140690.5	a	a	a	b	b	b	a	a	a	a
Spine										
630630.4	a	b	b	d	a	a	a	a	a	a
630632.4	a	b	b	d	a	a	a	a	a	a
630634.4	a	b	b	d	a	a	a	a	a	a
630636.4	a	b	b	d	a	a	a	a	a	a
630638.4	a	b	b	d	a	a	a	a	a	a
640410.4	a	b	a	c	a	b	a	a	a	a
640412.4	a	b	a	c	a	b	a	a	a	a
640414.4	a	b	a	c	a	b	a	a	a	a
640416.4	a	b	a	c	a	b	a	a	a	a
640418.4	a	b	a	c	a	b	a	a	a	a
640620.5	a	b	b	d	a	a	a	a	a	a
640622.5	a	b	b	d	a	a	a	a	a	a
640624.5	a	b	b	d	a	a	a	a	a	a
640626.5	a	b	b	d	a	a	a	a	a	a
640628.5	a	b	b	d	a	a	a	a	a	a
640660.5	a	b	b	d	a	a	a	a	a	a
640662.5	a	b	b	d	a	a	a	a	a	a
640664.5	a	b	b	d	a	a	a	a	a	a
640666.5	a	b	b	d	a	a	a	a	a	a
640668.5	a	b	b	d	a	a	a	a	a	a
Lower extremities										

AIS Code	Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog
----------continued----------										
811000.3	a	a	b	c	a	b	a	a	a	a
811002.3	a	a	b	c	a	b	a	a	a	a
811004.4	a	a	b	c	a	b	a	a	a	a
813000.2	a	a	b	c	a	b	a	a	a	a
813002.2	a	a	b	c	a	b	a	a	a	a
813004.3	a	a	b	c	a	b	a	a	a	a
830408.3	a	a	b	c	a	b	a	a	a	a
830608.2	a	a	b	c	a	b	a	a	a	a
830610.2	a	a	b	c	a	b	a	a	a	a
850618.2	a	a	b	b	a	b	a	a	a	a
852600.2	a	a	b	b	a	b	a	a	a	a
852602.2	a	a	b	b	a	b	a	a	a	a
852604.3	a	a	b	c	a	c	a	a	a	a
852800.3	a	a	b	b	a	b	a	a	a	a
853000.3	a	a	b	b	a	b	a	a	a	a
Four FCI dimensions affected										
Head										
140405.5	a	b	a	c	c	c	a	a	a	a
150206.4	a	a	a	c	c	c	a	a	a	c
150406.4	a	a	a	b	b	b	a	a	a	b
150408.4	a	a	a	b	b	b	a	a	a	b
Thorax										
420214.5	a	b	b	f	a	b	a	a	a	a
Spine										
640210.4	a	b	a	c	b	b	a	a	a	a
640212.4	a	b	a	c	b	b	a	a	a	a
640214.4	a	b	a	c	b	b	a	a	a	a
640216.4	a	b	a	c	b	b	a	a	a	a
640218.4	a	b	a	c	b	b	a	a	a	a
640420.5	a	b	b	f	a	b	a	a	a	a
640422.5	a	b	b	f	a	b	a	a	a	a
640424.5	a	b	b	f	a	b	a	a	a	a
640426.5	a	b	b	f	a	b	a	a	a	a
640428.5	a	b	b	f	a	b	a	a	a	a
640460.5	a	b	b	f	a	b	a	a	a	a
640462.5	a	b	b	f	a	b	a	a	a	a
640464.5	a	b	b	f	a	b	a	a	a	a
640466.5	a	b	b	f	a	b	a	a	a	a
640468.5	a	b	b	f	a	b	a	a	a	a
Five FCI dimensions affected										
Head										
121004.4	a	a	a	e	f	d	a	a	c	b
121404.4	a	a	a	e	e	d	a	a	c	c
140478.5	a	c	a	c	c	c	a	a	c	a
160212.5	b	b	a	b	b	b	a	a	a	a
160816.5	a	a	a	b	b	b	a	a	b	b
Spine										
640220.5	a	d	b	f	c	d	a	a	a	a

AIS Code	Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog
					continued					
640221.5	a	d	b	f	c	d	a	a	a	a
640222.5	a	d	b	f	c	d	a	a	a	a
640224.5	a	d	b	f	c	d	a	a	a	a
640226.5	a	d	b	f	c	d	a	a	a	a
640228.5	a	d	b	f	c	d	a	a	a	a
640229.6	a	d	b	f	f	d	a	a	a	a
640230.6	a	d	b	f	f	d	a	a	a	a
640232.6	a	d	b	f	f	d	a	a	a	a
640234.6	a	d	b	f	f	d	a	a	a	a
640236.6	a	d	b	f	f	d	a	a	a	a
640260.5	a	b	b	f	f	d	a	a	a	a
640261.5	a	b	b	f	f	d	a	a	a	a
640262.5	a	b	b	f	f	d	a	a	a	a
640264.5	a	b	b	f	f	d	a	a	a	a
640266.5	a	b	b	f	f	d	a	a	a	a
640268.5	a	b	b	f	f	d	a	a	a	a
640269.6	a	d	b	f	f	d	a	a	a	a
640270.6	a	d	b	f	f	d	a	a	a	a
640272.6	a	d	b	f	f	d	a	a	a	a
640274.6	a	d	b	f	f	d	a	a	a	a
640276.6	a	d	b	f	f	d	a	a	a	a
Six FCI dimensions affected										
Head										
122804.3	c	c	a	c	c	b	c	a	a	a
140434.5	b	c	a	c	c	c	a	a	c	a
140446.5	b	c	a	c	c	c	a	a	c	a
140636.5	a	a	b	c	c	b	a	a	b	c
160214.5	b	b	a	b	b	b	a	a	a	c
160818.5	a	b	a	b	b	b	a	a	b	b
160820.4	a	b	a	b	b	b	a	a	b	b
160822.5	a	b	a	b	b	b	a	a	b	b
Seven FCI dimensions affected										
Head										
120404.5	c	d	c	f	e	d	a	a	a	b
140610.5	b	b	a	b	b	b	a	a	b	c
160824.5	c	c	a	c	c	c	a	a	c	d
Neck										
321004.3	b	a	a	b	b	b	b	a	b	b
321010.3	b	a	a	b	b	b	b	a	b	b
321014.4	b	a	a	b	b	b	b	a	b	b
321020.4	b	a	a	b	b	b	b	a	b	b
Eight FCI dimensions affected										
Head										
140618.5	b	b	c	c	c	c	a	a	b	d
140626.5	b	b	c	d	c	c	a	a	c	d
140628.5	c	c	c	d	c	c	a	a	c	e
140648.5	c	c	c	d	e	c	a	a	b	c

AIS Code	Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog
----------continued----------										
140656.5	c	d	c	e	d	d	a	a	c	e
Nine FCI dimensions affected										
Head										
140202.5	c	d	c	f	f	d	a	c	d	f
140204.5	c	d	c	f	f	d	a	c	d	f
140206.5	c	d	c	f	f	d	a	c	d	f
140208.5	c	d	c	f	f	d	a	c	d	f
140210.5	c	d	c	f	f	d	a	c	d	f
140212.6	c	d	c	f	f	d	a	c	d	f
140214.6	c	d	c	f	f	d	a	c	d	f
140216.6	c	d	c	f	f	d	a	c	d	f
140299.5	c	d	c	f	f	d	a	c	d	f
Ten (all) FCI dimensions affected										
Head										
113000.6	c	d	c	f	f	d	f	d	d	f
Neck										
311000.6	c	d	c	f	f	d	g	e	d	f

Appendix B
List of all AIS with FCI ≠0 (n=321) by AIS body region.

Appendix B.

AIS Code	FCI Code Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog	FCI Score	FCI Category
Head												
113000.6	c	d	c	f	f	d	f	d	d	f	100	5
120204.3	a	a	a	c	a	b	a	a	a	c	69.60	4
120404.5	c	d	c	f	e	d	a	a	a	b	99.83	5
120602.4	a	a	a	a	a	a	b	a	a	a	19.52	1
120804.5	a	a	a	a	a	a	c	a	a	a	14.32	1
120806.3	a	a	a	a	a	a	b	a	a	a	19.52	1
121004.4	a	a	a	e	f	d	a	a	c	b	97.62	5
121404.4	a	a	a	e	e	d	a	a	c	c	97.41	5
121802.5	a	a	a	a	a	a	c	a	a	b	36.71	2
122804.3	c	c	a	c	c	b	c	a	a	a	96.8	5
130602.2	a	a	a	a	a	a	c	a	a	a	14.32	1
130604.2	a	a	a	a	a	a	c	a	a	a	14.32	1
130606.2	a	a	a	a	a	a	e	a	a	a	33.14	2
130608.2	a	a	a	a	a	a	g	a	a	a	41.28	3
130699.2	a	a	a	a	a	a	c	a	a	a	14.32	1
130899.2	a	a	a	a	a	a	b	a	a	a	19.52	1
130802.2	a	a	a	a	a	a	b	a	a	a	19.52	1
130804.2	a	a	a	a	a	a	b	a	a	a	19.52	1
131099.2	a	a	a	a	a	a	b	a	a	a	19.52	1
131002.2	a	a	a	a	a	a	b	a	a	a	19.52	1
131004.2	a	a	a	a	a	a	b	a	a	a	19.52	1
131499.2	a	a	a	a	a	a	b	a	a	a	19.52	1
131402.2	a	a	a	a	a	a	b	a	a	a	19.52	1
131404.2	a	a	a	a	a	a	b	a	a	a	19.52	1
131699.2	b	a	a	a	a	a	a	a	a	a	28.69	2
131602.2	b	a	a	a	a	a	a	a	a	a	28.69	2
131604.2	b	a	a	a	a	a	a	a	a	a	28.69	2
131899.2	a	a	a	a	a	a	a	b	a	a	6.82	1
131802.2	a	a	a	a	a	a	a	c	a	a	12.68	1
131804.2	a	a	a	a	a	a	a	e	a	a	34.79	2
132099.2	b	a	a	a	a	a	a	a	b	a	43.17	3
132002.2	b	a	a	a	a	a	a	a	b	a	43.17	3
132004.2	b	a	a	a	a	a	a	a	b	a	43.17	3
132204.2	b	a	a	a	a	a	a	a	a	a	28.69	2
132699.2	b	a	a	a	a	a	a	a	a	a	28.69	2
132602.2	b	a	a	a	a	a	a	a	a	a	28.69	2
132604.2	b	a	a	a	a	a	a	a	b	a	43.17	3
140299.5	c	d	c	f	f	d	a	c	d	f	100	5
140202.5	c	d	c	f	f	d	a	c	d	f	100	5
140204.5	c	d	c	f	f	d	a	c	d	f	100	5
140206.5	c	d	c	f	f	d	a	c	d	f	100	5
140208.5	c	d	c	f	f	d	a	c	d	f	100	5
140210.5	c	d	c	f	f	d	a	c	d	f	100	5
140212.6	c	d	c	f	f	d	a	c	d	f	100	5
140214.6	c	d	c	f	f	d	a	c	d	f	100	5
140216.6	c	d	c	f	f	d	a	c	d	f	100	5
140404.4	a	b	a	a	a	a	a	a	a	a	31.95	2
140405.5	a	b	a	c	c	c	a	a	a	a	85.46	5
140406.5	a	b	a	a	a	a	a	a	a	a	31.95	2

Appendix B.

AIS Code	FCI Code Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog	FCI Score	FCI Category
						continued						
140434.5	b	c	a	c	c	c	a	a	c	a	95.29	5
140446.5	b	c	a	c	c	c	a	a	c	a	95.29	5
140458.3	b	a	a	a	a	a	a	a	a	a	28.69	2
140478.5	a	c	a	c	c	c	a	a	c	a	93.39	5
140610.5	b	b	a	b	b	b	a	a	b	c	88.91	5
140618.5	b	b	c	c	c	c	a	a	b	d	98.68	5
140626.5	b	b	c	d	c	c	a	a	c	d	99.29	5
140628.5	c	c	c	d	c	c	a	a	c	e	99.93	5
140636.5	a	a	b	c	c	b	a	a	b	c	89.4	5
140648.5	c	c	c	d	e	c	a	a	b	c	99.64	5
140656.5	c	d	c	e	d	d	a	a	c	e	99.97	5
140690.5	a	a	a	b	b	b	a	a	a	a	43.92	3
150206.4	a	a	a	c	c	c	a	a	a	c	86.29	5
150406.4	a	a	a	b	b	b	a	a	a	b	58.58	3
150408.4	a	a	a	b	b	b	a	a	a	b	58.58	3
160212.5	b	b	a	b	b	b	a	a	a	a	89.09	5
160214.5	b	b	a	b	b	b	a	a	a	c	86.09	5
160816.5	a	a	a	b	b	b	a	a	b	b	66.99	4
160818.5	a	b	a	b	b	b	a	a	b	b	77.54	4
160820.4	a	b	a	b	b	b	a	a	b	b	77.54	4
160822.5	a	b	a	b	b	b	a	a	b	b	77.54	4
160824.5	c	c	a	c	c	c	a	a	c	d	99.62	5
Face												
216004.2	b	a	a	a	a	a	b	a	a	a	42.61	3
210804.2	b	a	a	a	a	a	a	a	b	a	43.17	3
210806.3	b	a	a	a	a	a	a	a	b	a	43.17	3
230299.1	a	a	a	a	a	a	c	a	a	a	14.32	1
230202.2	a	a	a	a	a	a	c	a	a	a	14.32	1
230204.2	a	a	a	a	a	a	e	a	a	a	33.14	2
230206.2	a	a	a	a	a	a	g	a	a	a	41.28	3
240299.1	a	a	a	a	a	a	a	b	b	a	25.74	2
240204.1	a	a	a	a	a	a	a	b	b	a	25.74	2
240208.1	a	a	a	a	a	a	a	b	b	a	25.74	2
240212.1	a	a	a	a	a	a	a	c	b	a	30.41	2
240216.1	a	a	a	a	a	a	a	b	b	a	25.74	2
240220.1	a	a	a	a	a	a	a	d	b	a	39.65	2
240499.1	a	a	a	a	a	a	d	a	a	a	21.38	2
240402.2	a	a	a	a	a	a	g	a	a	a	41.28	3
240412.1	a	a	a	a	a	a	c	a	a	a	14.32	1
240699.1	a	a	a	a	a	a	c	a	a	a	14.32	1
240604.1	a	a	a	a	a	a	c	a	a	a	14.32	1
240606.1	a	a	a	a	a	a	c	a	a	a	14.32	1
240800.1	a	a	a	a	a	a	c	a	a	a	14.32	1
241000.1	a	a	a	a	a	a	c	a	a	a	14.32	1
241002.2	a	a	a	a	a	a	c	a	a	a	14.32	1
241202.2	a	a	a	a	a	a	e	a	a	a	33.14	2
241499.1	a	a	a	a	a	a	e	a	a	a	33.14	2

Appendix B.

AIS Code	FCI Code Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog	FCI Score	FCI Category
					—continued—							
241699.1	a	a	a	a	a	a	e	a	a	a	33.14	2
243206.1	a	a	a	a	a	a	a	a	b	a	20.3	1
251204.3	a	a	a	a	a	a	b	a	a	a	19.52	1
Neck												
311000.6	c	d	c	f	f	d	g	e	d	f	100	5
320210.4	a	a	a	b	b	a	a	a	a	a	34.37	2
320214.5	a	a	a	c	c	a	a	a	a	a	60.6	4
320218.4	a	a	a	b	b	a	a	a	a	a	34.37	2
320222.4	a	a	a	c	c	a	a	a	a	a	60.6	4
321004.3	b	a	a	b	b	b	b	a	b	b	81.05	5
321010.3	b	a	a	b	b	b	b	a	b	b	81.05	5
321014.4	b	a	a	b	b	b	b	a	b	b	81.05	5
321020.4	b	a	a	b	b	b	b	a	b	b	81.05	5
340210.4	a	a	a	a	a	a	a	a	c	a	44.96	3
340212.5	a	a	a	a	a	a	a	a	d	a	68.47	4
341802.2	b	a	a	a	a	a	a	a	b	a	43.17	3
341804.3	a	a	a	a	a	a	a	a	c	a	44.96	3
Thorax												
413000.6	a	a	a	b	a	a	a	a	a	a	14.53	1
420214.5	a	b	b	f	a	b	a	a	a	a	84.99	5
420800.5	a	a	a	b	a	a	a	a	a	a	14.53	1
440210.4	a	a	a	c	a	a	a	a	a	a	30.41	2
440216.4	a	a	a	c	a	a	a	a	a	a	30.41	2
440810.5	b	a	a	a	a	a	a	a	a	a	28.69	2
441200.5	a	a	a	b	a	a	a	a	a	a	14.53	1
441300.5	a	a	a	b	a	a	a	a	a	a	14.53	1
441410.4	a	a	a	b	a	a	a	a	a	a	14.53	1
442610.5	a	a	a	b	a	a	a	a	a	a	14.53	1
442616.5	a	a	a	b	a	a	a	a	a	a	14.53	1
Abdomen and Pelvic contents												
520408.5	c	a	a	a	a	a	a	a	a	a	75.18	4
520608.4	a	a	a	b	a	a	a	a	a	a	14.58	1
520806.4	a	a	a	b	a	a	a	a	a	a	14.58	1
540426.4	a	b	a	a	a	a	a	a	a	a	31.95	2
541028.5	b	a	a	a	a	a	a	a	a	a	28.69	2
542832.5	b	a	a	a	a	a	a	a	a	a	28.69	2
543026.3	a	a	c	a	a	a	a	a	a	a	45.69	3
543226.3	a	b	b	a	a	a	a	a	a	a	47.41	3
543626.5	a	b	b	a	a	a	a	a	a	a	47.41	3
544024.2	a	a	b	a	a	a	a	a	a	a	22.73	2
545026.3	a	d	a	a	a	a	a	a	a	a	74.06	4
545028.4	a	d	a	a	a	a	a	a	a	a	74.06	4

Appendix B.

AIS Code	FCI Code Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog	FCI Score	FCI Category
					continued							
Spine												
630299.2	a	a	a	a	c	b	a	a	a	a	51.63	3
630210.2	a	a	a	a	c	b	a	a	a	a	51.63	3
630212.2	a	a	a	a	c	b	a	a	a	a	51.63	3
630214.2	a	a	a	a	d	b	a	a	a	a	49.38	3
630216.2	a	a	a	a	d	b	a	a	a	a	49.38	3
630220.2	a	a	a	a	e	d	a	a	a	a	80.13	4
630222.3	a	a	a	a	e	d	a	a	a	a	80.13	4
630224.3	a	a	a	a	e	d	a	a	a	a	80.13	4
630226.3	a	a	a	a	e	d	a	a	a	a	8013	4
640210.4	a	b	a	c	b	b	a	a	a	a	68.93	4
640212.4	a	b	a	c	b	b	a	a	a	a	68.93	4
640214.4	a	b	a	c	b	b	a	a	a	a	68.93	4
640216.4	a	b	a	c	b	b	a	a	a	a	68.93	4
640218.4	a	b	a	c	b	b	a	a	a	a	68.93	4
640220.5	a	d	b	f	c	d	a	a	a	a	98.08	5
640221.5	a	d	b	f	c	d	a	a	a	a	98.08	5
640222.5	a	d	b	f	c	d	a	a	a	a	98.08	5
640224.5	a	d	b	f	c	d	a	a	a	a	98.08	5
640226.5	a	d	b	f	c	d	a	a	a	a	98.08	5
640228.5	a	d	b	f	c	d	a	a	a	a	98.08	5
640229.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640230.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640232.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640234.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640236.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640240.5	a	a	a	a	c	b	a	a	a	a	51.63	3
640242.5	a	a	a	a	c	b	a	a	a	a	51.63	3
640244.5	a	a	a	a	c	b	a	a	a	a	51.63	3
640246.5	a	a	a	a	c	b	a	a	a	a	51.63	3
640248.5	a	a	a	a	c	b	a	a	a	a	51.63	3
640250.5	a	a	a	a	c	b	a	a	a	a	51.63	3
640260.5	a	b	b	f	f	d	a	a	a	a	97.78	5
640261.5	a	b	b	f	f	d	a	a	a	a	97.78	5
640262.5	a	b	b	f	f	d	a	a	a	a	97.78	5
640264.5	a	b	b	f	f	d	a	a	a	a	97.78	5
640266.5	a	b	b	f	f	d	a	a	a	a	97.78	5
640268.5	a	b	b	f	f	d	a	a	a	a	97.78	5
640269.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640270.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640272.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640274.6	a	d	b	f	f	d	a	a	a	a	99.15	5
640276.6	a	d	b	f	f	d	a	a	a	a	99.15	5
630260.2	a	a	a	a	b	a	a	a	a	a	23.22	2
630202.2	a	a	a	a	c	a	a	a	a	a	43.39	3
630204.2	a	a	a	a	b	a	a	a	a	a	23.22	2
630206.2	a	a	a	a	b	a	a	a	a	a	23.22	2
630208.3	a	a	a	a	e	a	a	a	a	a	60.74	4

Appendix B.

AIS Code	FCI Code Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog	FCI Score	FCI Category
					continued							
630262.2	a	a	a	a	b	a	a	a	a	a	23.22	2
630264.2	a	a	a	a	b	a	a	a	a	a	23.22	2
630261.3	a	a	a	a	e	a	a	a	a	a	60.74	4
640410.4	a	b	a	c	a	b	a	a	a	a	59.54	3
640412.4	a	b	a	c	a	b	a	a	a	a	59.54	3
640414.4	a	b	a	c	a	b	a	a	a	a	59.54	3
640416.4	a	b	a	c	a	b	a	a	a	a	59.54	3
640418.4	a	b	a	c	a	b	a	a	a	a	59.54	3
640420.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640422.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640424.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640426.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640428.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640460.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640462.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640464.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640466.5	a	b	b	f	a	b	a	a	a	a	84.99	5
640468.5	a	b	b	f	a	b	a	a	a	a	84.99	5
630408.3	a	a	a	b	a	b	a	a	a	a	26.97	2
630414.3	a	a	a	b	a	b	a	a	a	a	26.97	2
630630.4	a	b	b	d	a	a	a	a	a	a	71.41	4
630632.4	a	b	b	d	a	a	a	a	a	a	71.41	4
630634.4	a	b	b	d	a	a	a	a	a	a	71.41	4
630636.4	a	b	b	d	a	a	a	a	a	a	71.41	4
630638.4	a	b	b	d	a	a	a	a	a	a	71.41	4
640620.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640622.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640624.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640626.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640628.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640660.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640662.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640664.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640666.5	a	b	b	d	a	a	a	a	a	a	71.41	4
640668.5	a	b	b	d	a	a	a	a	a	a	71.41	4
630666.3	a	a	a	b	a	a	a	a	a	a	14.53	1
630672.3	a	a	a	b	a	a	a	a	a	a	14.53	1
Upper extremities												
711000.3	a	a	a	a	c	a	a	a	a	a	43.39	3
713000.3	a	a	a	a	e	a	a	a	a	a	60.74	4
714002.2	a	a	a	a	d	a	a	a	a	a	40.76	3
714004.2	a	a	a	a	b	a	a	a	a	a	23.22	2
714006.3	a	a	a	a	b	a	a	a	a	a	23.22	2
716004.2	a	a	a	a	d	a	a	a	a	a	40.76	3
710804.2	a	a	a	a	b	a	a	a	a	a	23.22	2
730204.1	a	a	a	a	b	a	a	a	a	a	23.22	2
730420.1	a	a	a	a	c	a	a	a	a	a	43.39	3

Appendix B.

AIS Code	FCI Code Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog	FCI Score	FCI Category
						continued						
730430.2	a	a	a	a	c	a	a	a	a	a	43.39	3
730440.2	a	a	a	a	c	a	a	a	a	a	43.39	3
730450.2	a	a	a	a	c	a	a	a	a	a	43.39	3
740200.1	a	a	a	a	b	a	a	a	a	a	23.22	2
740210.1	a	a	a	a	c	a	a	a	a	a	43.39	3
740220.1	a	a	a	a	c	a	a	a	a	a	43.39	3
740400.2	a	a	a	a	b	a	a	a	a	a	23.22	2
740600.2	a	a	a	a	b	a	a	a	a	a	23.22	2
750230.2	a	a	a	a	d	a	a	a	a	a	40.76	3
750404.1	a	a	a	a	b	a	a	a	a	a	23.22	2
750630.1	a	a	a	a	d	a	a	a	a	a	40.76	3
750644.2	a	a	a	a	c	a	a	a	a	a	43.39	3
750646.2	a	a	a	a	e	a	a	a	a	a	60.74	4
750650.3	a	a	a	a	e	a	a	a	a	a	60.74	4
750800.1	a	a	a	a	b	a	a	a	a	a	23.22	2
751030.2	a	a	a	a	d	a	a	a	a	a	40.76	3
751040.2	a	a	a	a	d	a	a	a	a	a	40.76	3
751050.3	a	a	a	a	d	a	a	a	a	a	40.76	3
751230.2	a	a	a	a	d	a	a	a	a	a	40.76	3
751430.2	a	a	a	a	c	a	a	a	a	a	43.39	3
751440.2	a	a	a	a	b	a	a	a	a	a	23.22	2
751450.3	a	a	a	a	c	a	a	a	a	a	43.39	3
751600.2	a	a	a	a	d	a	a	a	a	a	40.76	3
752002.2	a	a	a	a	b	a	a	a	a	a	23.22	2
752004.2	a	a	a	a	c	a	a	a	a	a	43.39	3
752402.2	a	a	a	a	b	a	a	a	a	a	23.22	2
752406.2	a	a	a	a	b	a	a	a	a	a	23.22	2
752604.3	a	a	a	a	d	a	a	a	a	a	40.76	3
752606.3	a	a	a	a	d	a	a	a	a	a	40.76	3
752802.2	a	a	a	a	c	a	a	a	a	a	43.39	3
752804.3	a	a	a	a	c	a	a	a	a	a	43.39	3
752806.3	a	a	a	a	c	a	a	a	a	a	43.39	3
753206.3	a	a	a	a	c	a	a	a	a	a	43.39	3
Lower Extremities												
811000. 3	a	a	b	c	a	b	a	a	a	a	54.05	3
811002.3	a	a	b	c	a	b	a	a	a	a	54.05	3
811004.4	a	a	b	c	a	b	a	a	a	a	54.05	3
813000.2	a	a	b	c	a	b	a	a	a	a	54.05	3
813002.2	a	a	b	c	a	b	a	a	a	a	54.05	3
813004.3	a	a	b	c	a	b	a	a	a	a	54.05	3
815006.3	a	a	a	c	a	a	a	a	a	a	30.41	2
815000.2	a	a	a	b	a	b	a	a	a	a	26.97	2
816004.2	a	a	a	b	a	a	a	a	a	a	14.53	1
820406.3	a	a	a	b	a	a	a	a	a	a	14.53	1
830406.3	a	a	a	c	a	a	a	a	a	a	30.41	2
830408.3	a	a	b	c	a	b	a	a	a	a	54.05	3
830606.2	a	a	a	a	a	b	a	a	a	a	14.56	1

Appendix B.

AIS Code	FCI Code Eat	Ex	Sex	Amb	Hand	Bend	Vis	Aud	Spch	Cog	FCI Score	FCI Category
						continued						
830608.2	a	a	b	c	a	b	a	a	a	a	54.05	3
830610.2	a	a	b	c	a	b	a	a	a	a	54.05	3
840204.2	a	a	a	b	a	a	a	a	a	a	14.53	1
840404.2	a	a	a	b	a	a	a	a	a	a	14.53	1
840406.3	a	a	a	b	a	a	a	a	a	a	14.53	1
840600.2	a	a	a	b	a	b	a	a	a	a	26.97	2
840804.2	a	a	a	b	a	a	a	a	a	a	14.53	1
841004.2	a	a	a	b	a	b	a	a	a	a	26.97	2
850210.2	a	a	a	b	a	a	a	a	a	a	14.53	1
850214.2	a	a	a	b	a	a	a	a	a	a	14.53	1
850218.2	a	a	a	b	a	a	a	a	a	a	14.53	1
850222.2	a	a	a	b	a	a	a	a	a	a	14.53	1
850402.1	a	a	a	b	a	a	a	a	a	a	14.53	1
850614.2	a	a	a	b	a	b	a	a	a	a	26.97	2
850618.2	a	a	b	b	a	b	a	a	a	a	43.56	3
850806.2	a	a	a	b	a	b	a	a	a	a	26.97	2
850810.2	a	a	a	b	a	b	a	a	a	a	26.97	2
850814.2	a	a	a	b	a	b	a	a	a	a	26.97	2
851010.1	a	a	a	b	a	a	a	a	a	a	14.53	1
851014.1	a	a	a	b	a	a	a	a	a	a	14.53	1
851204.1	a	a	a	b	a	a	a	a	a	a	14.53	1
851206.1	a	a	a	b	a	a	a	a	a	a	14.53	1
851400.2	a	a	a	b	a	a	a	a	a	a	14.53	1
851610.2	a	a	a	b	a	a	a	a	a	a	14.53	1
851612.2	a	a	a	b	a	a	a	a	a	a	14.53	1
851804.3	a	a	a	b	a	a	a	a	a	a	14.53	1
851808.3	a	a	a	b	a	a	a	a	a	a	14.53	1
851810.3	a	a	a	b	a	a	a	a	a	a	14.53	1
851812.3	a	a	a	b	a	a	a	a	a	a	14.53	1
851814.3	a	a	a	b	a	a	a	a	a	a	14.53	1
851818.3	a	a	a	b	a	a	a	a	a	a	14.53	1
851822.3	a	a	a	b	a	a	a	a	a	a	14.53	1
852000.2	a	a	a	b	a	a	a	a	a	a	14.53	1
852200.2	a	a	a	b	a	a	a	a	a	a	14.53	1
852400.2	a	a	a	b	a	a	a	a	a	a	14.53	1
852600.2	a	a	b	b	a	b	a	a	a	a	43.56	3
852602.2	a	a	b	b	a	b	a	a	a	a	43.56	3
852604.3	a	a	b	c	a	c	a	a	a	a	63.4	4
852800.3	a	a	b	b	a	b	a	a	a	a	43.56	3
853000.3	a	a	b	b	a	b	a	a	a	a	43.56	3
853406.2	a	a	a	b	a	b	a	a	a	a	26.97	2
853408.3	a	a	a	b	a	b	a	a	a	a	26.97	2
853410.2	a	a	a	b	a	a	a	a	a	a	14.53	1
853414.2	a	a	a	b	a	a	a	a	a	a	14.53	1
853416.2	a	a	a	b	a	a	a	a	a	a	14.53	1
853418.3	a	a	a	b	a	a	a	a	a	a	14.53	1
853420.2	a	a	a	b	a	a	a	a	a	a	14.53	1
853422.3	a	a	a	b	a	b	a	a	a	a	26.97	2

Appendix C.
AIS Codes and descriptors, FCI codes, FCI scores, number of cases in the sample and, Number of weighted cases and LLI.

AIS Code	FCI Score	FCI Code	N	N_w	LLI	AIS Descriptor
Head						
131604.2	28.69	baaaaaaaaa	1	9.09	135.85	NERVES, CRANIAL VII (FACIAL NERVE) - LACERATION)
131699.2	28.69	baaaaaaaaa	1	8.44	88.34	" - VII (FACIAL NERVE) NFS
140202.5	100	cdcffdacdf	4	129.4	7034.96	BRAIN STEM - COMPRESSION (INCLUDES TRANSTENTORIAL (UNCAL) OR CEREBELLAR TONSILLAR HERNIATION)
140204.5	100	cdcffdacdf	1	1304.18	15482.38	" - CONTUSION
140210.5	100	cdcffdacdf	11	1122	54700.49	" - INJURY INVOLVING HEMORRHAGE
140299.5	100	cdcffdacdf	4	68.83	3291.53	" - (HYPOTHALAMUS, MEDULLA, MIDBRAIN, PONS) NFS
140406.5	81.75	abacccaaaa	1	12	278.67	CEREBELLUM - DIFFUSE AXONAL INJURY (WHITE MATTER SHEARING)
140610.5	88.91	bbabbbaabc	1	109.62	4093.54	CEREBRUM - EXTENSIVE (MASSIVE; >50cc)
140618.5	98.68	bbccccaabd	1	25.22	1209.39	" - EXTENSIVE (MASSIVE; TOTAL VOLUME >50cc)
140626.5	99.29	bbcdccaacd	1	32.24	1462.98	" - MULTIPLE, AT LEAST ONE ON EACH SIDE, EXTENSIVE (MASSIVE; TOTAL VOLUME >50cc)
140628.5	99.93	cccdccace	15	316.26	14600.98	" - DIFFUSE AXONAL INJURY (WHITE MATTER SHEARING)
140634.5	58.58	aaabbbaaab	1	10.64	150.81	" - HEMATOMA - EPIDURAL - BILATERAL
140636.5	89.4	aabccbaabc	1	24.04	1061.53	" - " - " - LARGE (>25cc IF <10 YEARS OLD; >1cm THICK; MASSIVE; EXTENSIVE)
140648.5	99.64	cccdecaabc	3	83.98	2718.75	" - " - INTRACEREBRAL - LARGE (>30cc; >4cm DIAMETER)
140656.5	99.97	cdceddaace	8	461.22	18615.28	" - " - " - " (>50cc ADULT; >25cc IF <10 YEARS OLD; >1cm THICK; MASSIVE; EXTENSIVE)
150206.4	86.29	aaacccaaac	4	263.84	11238.88	SKELETAL - SKULL FRACTURE - COMPLEX (OPEN; WITH LOSS OF BRAIN TISSUE; COMMINUTED; RING; HINGE)
150406.4	58.58	aaabbbaaab	1	11.35	248.75	" - VAULT FRACTURE - COMPLEX (OPEN; WITH LOSS OF BRAIN TISSUE)
160214.5	86.09	bbabbbaaac	12	385.2	18125.6	>24 HOURS UNCONSCIOUSNESS
160818.5	77.54	ababbbaabb	1	11.35	434.9	UNCONSCIOUS ON ADMISSION-> 24 HOURS UNCONSCIOUSNESS
160820.4	77.54	ababbbaabb	20	832.39	28537.87	" - APPROPRIATE MOVEMENTS, BUT ONLY PAINFUL STIMULI NO MATTER THE LENGTH OF UNCONSCIOUSNESS
160822.5	77.54	ababbbaabb	9	587.29	25879.42	" - WITH NEUROLOGICAL DEFICIT
160824.5	99.62	ccacccaacd	24	981.92	52116.33	" - INAPPROPRIATE MOVEMENTS (DECEREBRATE, DECORTICATE, FLACCID, NO RESPONSE TO PAIN) NO MATTER THE LENGTH OF UNCONSCIOUSNESS
Face						
210804.2	43.17	baaaaaaaba	18	1236.97	22028.49	SKIN - AVULSION - MAJOR (>25cm2 BUT BLOOD LOSS ≤20% BY VOLUME)

AIS Code	FCI Score	FCI Code	N	N_w	LLI	AIS Descriptor
----------continued----------						
230299.1	14.32	aaaaaacaaa	2	42.42	287.59	OPTIC NERVE NFS (INTRAORBITAL PORTION ONLY; FOR INTRACRANIAL PORTION OR LOCATION UNKNOWN, CODE UNDER CRANIAL NERVES IN HEAD SECTION)
240204.1	25.74	aaaaaaabba	4	128.38	1494.83	EAR CANAL INJURY
240208.1	25.74	aaaaaaabba	1	142.47	2530.27	INNER OR MIDDLE EAR INJURY
240216.1	25.74	aaaaaaabba	1	8.44	139.18	TYMPANIC MEMBRANE (EAR DRUM) RUPTURE
240299.1	25.74	aaaaaaabba	3	77.86	539.79	EAR NFS
240402.2	41.28	aaaaaagaaa	1	54.01	510.55	EYE AVULSION (ENUCLEATION)
240499.1	21.38	aaaaaadaaa	7	848.23	8649.22	EYE NFS
240604.1	14.32	aaaaaacaaa	2	50.45	524.62	CORNEA - CONTUSION (INCLUDES HYPHEMA)
240606.1	14.32	aaaaaacaaa	3	533.1	2388.98	" - LACERATION
241202.2	33.14	aaaaaaeaaa	6	386.31	6971.44	SCLERA LACERATION INVOLVING GLOBE (INCLUDES RUPTURE)
243206.1	20.3	aaaaaaaaba	4	136.58	1334.58	GINGIVA - AVULSION
251204.3	19.52	aaaaaabaaa	43	3997.12	35419.47	ORBIT FRACTURE - OPEN/DISPLACED/COMMINUTED
Neck						
340210.4	44.96	aaaaaaaaca	1	40.16	893.8	LARYNX - WITH VOCAL CORD INVOLVEMENT
Thorax						
440210.4	30.41	aaacaaaaaa	1	23.99	400.53	BRONCHUS, MAIN STEM - LACERATION - COMPLEX (AVULSION, RUPTURE, TRANSECTION)
441410.4	14.53	aaabaaaaaa	18	1232.58	6540.98	LUNG - CONTUSION - BILATERAL
Abdomen and Pelvic contents						
541028.5	28.69	baaaaaaaaa	2	105.84	1727.59	DUODENUM - MASSIVE (AVULSION; COMPLEX; RUPTURE; TISSUE LOSS; GROSS FECAL CONTAMINATION)
545026.3	74.06	adaaaaaaaa	3	145.57	4506.98	URETHRA - PERFORATION (FULL THICKNESS)
Spine						
630212.2	51.63	aaaacbaaaa	1	51.56	545.7	BRACHIAL PLEXUS - CONTUSION (STRETCH INJURY)
630226.3	80.13	aaaaedaaaa	1	3.7	102.92	" - AVULSION

AIS Code	FCI Score	FCI Code	N	N_w	LLI	AIS Descriptor
----------continued----------						
630299.2	23.22	aaaabaaaaa	4	308.89	3924.35	" - NFS (INCLUDES TRUNKS, DIVISIONS OR CORDS)
640210.4	68.93	abacbbaaaa	1	42.14	851	CORD CONTUSION - INCOMPLETE CORD SYNDROME NFS (PRESERVATION OF SOME SENSATION OR MOTOR FUNCTION; INCLUDES ANTERIOR CORD, CENTRAL CORD, LATERAL CORD (BROWN-SEQUARD) SYNDROME
640212.4	68.93	abacbbaaaa	4	95.55	1063.61	" - " - WITH NO FRACTURE OR DISLOCATION
640214.4	68.93	abacbbaaaa	1	43.89	1633.78	" - " - WITH FRACTURE
640216.4	68.93	abacbbaaaa	2	48.84	1033.03	" - " - WITH DISLOCATION
640218.4	68.93	abacbbaaaa	2	36.7	1336.97	" - " - WITH FRACTURE AND DISLOCATION
640226.5	98.08	adbfcdaaaa	1	9.48	501.96	COMPLETE CORD SYNDROME - C4 OR BELOW - WITH DISLOCATION
640228.5	98.08	adbfcdaaaa	3	91.85	4766.13	" - " - WITH FRACTURE AND DISLOCATION
640250.5	51.63	aaaacbaaaa	1	103.97	2748.49	CORD LACERATION WITH FRACTURE AND DISLOCATION - INCOMPLETE
640268.5	97.78	abbffdaaaa	1	321.08	12589.42	" - COMPLETE CORD SYNDROME - C4 OR BELOW - WITH FRACTURE
640410.4	59.54	abacabaaaa	1	182.57	5761.35	CORD CONTUSION - INCOMPLETE CORD SYNDROME NFS (PRESERVATION OF SOME SENSATION OR MOTOR FUNCTION; INCLUDES LATERAL CORD (BROWN-SEQUARD) SYNDROME
640412.4	59.54	abacabaaaa	1	36.78	1000.89	" - WITH NO FRACTURE OR DISLOCATION
640414.4	59.54	abacabaaaa	2	125.46	3697.21	" - WITH FRACTURE
640418.4	59.54	abacabaaaa	2	44.96	1055.11	" - WITH FRACTURE AND DISLOCATION
640422.5	84.99	abbfabaaaa	1	39.55	1277.32	" - COMPLETE CORD SYNDROME - WITH NO FRACTURE OR DISLOCATION
640426.5	84.99	abbfabaaaa	1	31.99	796.67	" - " - WITH DISLOCATION
640428.5	84.99	abbfabaaaa	2	61.42	3139.25	" - " - WITH FRACTURE AND DISLOCATION
640468.5	84.99	abbfabaaaa	1	9.24	409.02	CORD LACERATION- COMPLETE CORD SYNDROME (PARAPLEGIA WITH NO SENSATION OR MOTOR FUNCTION) - WITH FRACTURE AND DISLOCATION
640628.5	71.41	abbdaaaaaa	2	28.47	1115.02	CORD CONTUSION - COMPLETE CORD SYNDROME - WITH FRACTURE AND DISLOCATION
Upper Extremities						
710804.2	23.22	aaaabaaaaa	1	13.36	156	SKIN AVULSION - MAJOR (>25cm2 ON HAND OR 100cm2 ON ENTIRE EXTREMITY)
711000.3	43.39	aaaaacaaaa	1	3.7	60.07	AMPUTATION (TRAUMATIC) AT ANY POINT OF EXTREMITY EXCEPT FINGER
713000.3	60.74	aaaaeaaaaa	2	42.7	1351.27	(CRUSH) MASSIVE DESTRUCTION OF BONE AND OF MUSCLES/ NERVOUS SYSTEM/ VASCULAR SYSTEM
714002.2	40.75	aaaadaaaaa	2	69.31	1376.35	DEGLOVING INJURY - ARM OR FOREARM
714004.2	23.22	aaaabaaaaa	1	40.82	485.32	" - FINGER(S) ONLY, SINGLE OR MULTIPLE

AIS Code	FCI Score	FCI Code	N	N_w	LLI	AIS Descriptor
			--continued--			
714006.3	23.22	aaaabaaaaa	5	168.5	1270.34	" - HAND, PALM
730420.1	43.39	aaaacaaaaa	1	13.36	280.49	MEDIAN, RADIAL, OR ULNAR NERVE - LACERATION - NFS
730450.2	43.39	aaaacaaaaa	2	166.04	2556.77	" - " - WITH MOTOR LOSS
740200.1	23.22	aaaabaaaaa	15	1142.92	11658.3	TENDON LACERATION (RUPTURE, TEAR) - NFS
740210.1	43.39	aaaacaaaaa	7	145.38	3181.99	" - MULTIPLE TENDONS (IN HAND)
740220.1	43.39	aaaacaaaaa	2	459.22	7620.74	" - MULTIPLE TENDONS (OTHER THAN HAND)
740400.2	23.22	aaaabaaaaa	8	835.46	8769.17	MUSCLE LACERATION (RUPTURE, TEAR, AVULSION)
740600.2	23.22	aaaabaaaaa	13	4258.65	55098.56	JOINT CAPSULE LACERATION (RUPTURE, TEAR, AVULSION)
750230.2	40.75	aaaadaaaaa	28	3086.94	53830.21	ACROMIOCLAVICULAR JOINT - DISLOCATION (SEPARATION)
750404.1	23.22	aaaabaaaaa	10	564.56	3289.81	CARPAL-METACARPAL OR METACARPAL-PHALANGEAL JOINT - DISLOCATION
750630.1	40.75	aaaadaaaaa	9	1140.97	19424.83	ELBOW JOINT - DISLOCATION WITH OR WITHOUT RADIAL HEAD INVOLVEMENT
751030.2	40.75	aaaadaaaaa	22	7651.2	163765.5	SHOULDER - DISLOCATION
751040.2	40.75	aaaadaaaaa	1	373.17	8059.51	" - LACERATION INTO JOINT
751230.2	40.75	aaaadaaaaa	6	242.35	4451.5	STERNOCLAVICULAR JOINT - DISLOCATION
751430.2	43.39	aaaacaaaaa	7	2318.64	59866.68	WRIST - DISLOCATION AT RADIOCARPAL, INTERCARPAL OR PERICARPAL ARTICULATIONS
751440.2	23.22	aaaabaaaaa	1	67.65	431.96	" - LACERATION INTO JOINT
751600.2	40.75	aaaadaaaaa	4	933.43	3959.84	ACROMION FRACTURE
752002.2	23.22	aaaabaaaaa	103	34434.65	350006.5	CARPUS OR METACARPUS - FRACTURE
752004.2	43.39	aaaacaaaaa	1	45.14	556.22	" - MASSIVE DESTRUCTION (CRUSH) OF BONE AND CARTILAGE
752402.2	23.22	aaaabaaaaa	5	427.12	5184.02	FINGER - AMPUTATION
752406.2	23.22	aaaabaaaaa	3	57.22	307.84	" - MASSIVE DESTRUCTION (CRUSH) OF BONE AND CARTILAGE
752604.3	40.75	aaaadaaaaa	63	8547.91	177174.9	HUMERUS FRACTURE - OPEN/DISPLACED/COMMINUTED
752606.3	40.75	aaaadaaaaa	3	153.15	2227.52	" - WITH RADIAL NERVE INVOLVEMENT
752802.2	43.39	aaaacaaaaa	85	8980.37	141294.4	RADIUS FRACTURE - CLOSED
752804.3	43.39	aaaacaaaaa	118	12779.32	221864.8	" - OPEN/DISPLACED/COMMINUTED
752806.3	43.39	aaaacaaaaa	3	449.99	8280.4	" - WITH RADIAL NERVE INVOLVEMENT
753206.3	43.39	aaaacaaaaa	1	15.77	203.27	ULNA FRACTURE - WITH ULNAR NERVE INVOLVEMENT
Lower Extremities						
811002.3	54.05	aabcabaaaa	1	8.44	233.45	AMPUTATION - BELOW KNEE; ENTIRE FOOT; CALCANEUS
813002.2	54.05	aabcabaaaa	2	82.41	1718.36	CRUSH - BELOW KNEE, ENTIRE FOOT, CALCANEUS
815000.2	26.97	aaababaaaa	1	8.02	116.77	EXTREMITY INJURY WITH COMPARTMENT SYNDROME

AIS Code	FCI Score	FCI Code	N	N_w	LLI	AIS Descriptor
----------continued----------						
830610.2	54.05	aabcabaaaa	1	8.44	89.82	FEMORAL, TIBIAL, PERONEAL NERVE - WITH MOTOR LOSS
840404.2	14.53	aaabaaaaaa	11	2025	13941.26	COLLATERAL OR CRUCIATE LIGAMENT LACERATION - KNEE
840406.3	14.53	aaabaaaaaa	1	25.98	182.71	" - " - POSTERIOR CRUCIATE WITH COMPLETE DISRUPTION
840804.2	14.53	aaabaaaaaa	1	8.68	68.09	TENDON LACERATION (RUPTURE; TEAR) - MULTIPLE TENDONS
850210.2	14.53	aaabaaaaaa	6	145.8	1034.07	ANKLE - DISLOCATION - NFS
850214.2	14.53	aaabaaaaaa	1	22.36	142.31	" - " - WITHOUT INVOLVING ARTICULAR CARTILAGE
850218.2	14.53	aaabaaaaaa	2	77.15	533.73	" - " - INVOLVING ARTICULAR CARTILAGE
850402.1	14.53	aaabaaaaaa	2	584.72	4315.96	FOOT JOINT - DISLOCATION
850614.2	26.97	aaababaaaa	2	375.86	4102.94	HIP - DISLOCATION - WITHOUT INVOLVING ARTICULAR CARTILAGE
850806.2	26.97	aaababaaaa	8	7292.78	101772.3	KNEE - DISLOCATION NFS
850814.2	26.97	aaababaaaa	1	13.39	235.15	" - " - INVOLVING ARTICULAR CARTILAGE
851014.1	14.53	aaabaaaaaa	1	8.44	33.71	METATARSAL-PHALANGEAL OR INTERPHALANGEAL JOINT - DISLOCATION - INVOLVING ARTICULAR CARTILAGE
851400.2	14.53	aaabaaaaaa	22	2041.55	9595.07	CALCANEUS FRACTURE
851610.2	14.53	aaabaaaaaa	7	545.4	1881.38	FIBULA - FRACTURE - LATERAL MALLEOLUS - OPEN/DISPLACED/COMMINUTED
851612.2	14.53	aaabaaaaaa	34	4070.69	14142.87	" - " - BIMALLEOLAR OR TRIMALLEOLAR
851804.3	14.53	aaabaaaaaa	8	337.96	1697	FEMUR FRACTURE - CONDYLAR
851808.3	14.53	aaabaaaaaa	4	557.92	2169.31	" - HEAD
851810.3	14.53	aaabaaaaaa	9	656.05	3482.98	" - INTERTROCHANTERIC
851812.3	14.53	aaabaaaaaa	6	114.16	889.42	" - NECK
851814.3	14.53	aaabaaaaaa	106	15152.14	104877.4	" - SHAFT
851818.3	14.53	aaabaaaaaa	7	345.52	1853.63	" - SUBTROCHANTERIC
851822.3	14.53	aaabaaaaaa	4	178.05	473.08	" - SUPRACONDYLAR
852000.2	14.53	aaabaaaaaa	51	7227.44	34501.39	FOOT FRACTURE NFS
852200.2	14.53	aaabaaaaaa	48	3488.31	19700.78	METATARSAL OR TARSAL FRACTURE
852400.2	14.53	aaabaaaaaa	55	4581.21	20711.21	PATELLA FRACTURE
852600.2	43.56	aabbabaaaa	144	18451.54	304257.9	PELVIS - FRACTURE, WITH OR WITHOUT DISLOCATION, OF ANY ONE OR COMBINATION: ACETABULUM, ILIUM, ISCHIUM, COCCYX, SACRUM, PUBIC RAMUS (SIMPLE CLOSED FRACTURE OF SUPERIOR AND INFERIOR RIGHT OR LEFT RAMI ARE NOT CODED AS COMMINUTED FRACTURES, BUT AS CLOSED FRACTURE)
852602.2	43.56	aabbabaaaa	126	8403.13	144266.4	" - " - CLOSED
852604.3	63.4	aabcacaaaa	96	7409.67	175833.9	" - " - OPEN/DISPLACED/COMMINUTED
852800.3	43.56	aabbabaaaa	8	663.74	14606.28	SACROILIUM FRACTURE WITH OR WITHOUT DISLOCATION
853000.3	43.56	aabbabaaaa	17	524.82	10749.46	SYMPHYSIS PUBIS SEPARATION (FRACTURE)

AIS Code	FCI Score	FCI Code	N	N_w	LLI	AIS Descriptor
----------continued----------						
853406.2	26.97	aaababaaaa	18	1828.24	16958.75	TIBIA - FRACTURE - CONDYLES (PLATEAU)
853408.3	26.97	aaababaaaa	26	3190.63	35376.89	" -" - " - OPEN/DISPLACED/COMMINUTED
853414.2	14.53	aaabaaaaaa	25	1473.76	8889.58	" - " - MEDIAL MALLEOLUS - OPEN/DISPLACED/COMMINUTED
853418.3	14.53	aaabaaaaaa	3	101.65	529.48	" - " - POSTERIOR MALLEOLUS - OPEN/DISPLACED/COMMINUTED
853420.2	14.53	aaabaaaaaa	11	3691.71	15875.27	TIBIA FRACTURE - SHAFT
853422.3	26.97	aaababaaaa	66	7802.06	70258.26	" - " - OPEN/DISPLACED/COMMINUTED

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 808 492		

4. Title and Subtitle	5. Report Date
FINAL REPORT: APPLICATION OF THE FUNCTIONAL CAPACITY INDEX TO NASS CDS DATA	November 1996
	6. Performing Organization Code
	8. Performing Organization Report No.
7. Author(s) Maria Segui-Gomez, M.D., M.P.H., M.Sc.	
9. Performing Organization Name and Address Maria Segui-Gomez, M.D., M.P.H., M.Sc. 36 Concord Square #3 Boston, MA 02118-3102	10. Work Unit No. (TRAIS)
	11. Contract or Grant No. DTNH22-96-P-06011
12. Sponsoring Agency Name and Address Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590	13. Type of Report and Period Covered Contract Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The purpose of this report is two-fold: (1) further exploration of the relationship between the Functional Capacity Index (FCI) and the Abbreviated Injury Scale (AIS), and (2) application of the FCI to NASS CDS data. Analysis of the mapping performed by MacKenzie *et al* (1994) between FCI and AIS revealed that only about a quarter of all possible AIS diagnoses are predicted to produce some functional limitation one year post-injury. Head and spine are the two body regions with more diagnoses associated with functional limitations. The most common impairment is the minor limitation of only one FCI dimension (mostly ambulation). Application of FCI to the diagnoses of injuries sustained by passengers involved in towed-away, police reported motor-vehicle crashes in the United States (NASS CDS data) provided, among others, the following results:

- Out of approximately 1.5 million people injured (ISS ≠ 0) per year, about 7% sustained at least one injury that is predicted to produce some functional limitation.
- The injuries associated with functional limitation are mostly minor or moderate (AIS 1 or 2) and happen most frequently to the extremities (upper and lower).
- In any given year, the injuries sustained total 1.4 Life-years Lost to Injury (or an average of 13.6 Life-years Lost to Injury per injured patient).

INDEX