

# Helmet use and injuries in children's bicycle crashes in the Gothenburg region



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# Aim: To investigate

- the protective effect of helmets
- changes in injury patterns during a period of increased helmet use

# Injuries in cyclists

- Most common: head and upper extremity
- Brain injuries: a significant cause of permanent disability in children

# Helmet use in school-age children in Sweden

- 5 % in 1988; 40 % in 2004
- Helmet legislation 2005: <16 y
- 60 % in 2012; 40 % in teens

# Subjects

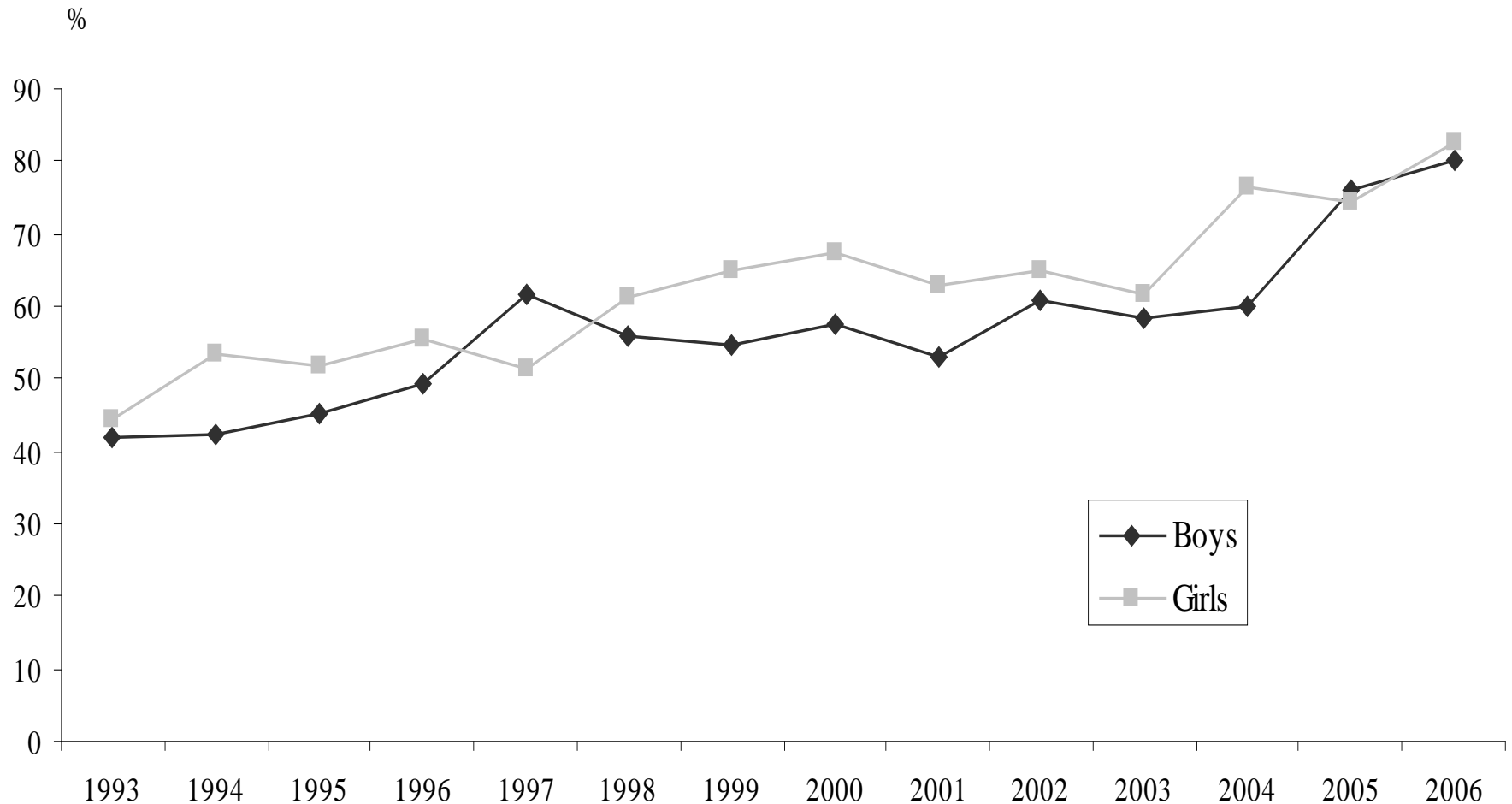
- 4 318 < 16 y 1993-2006
- Queen Silvia's Children Hospital in Gothenburg



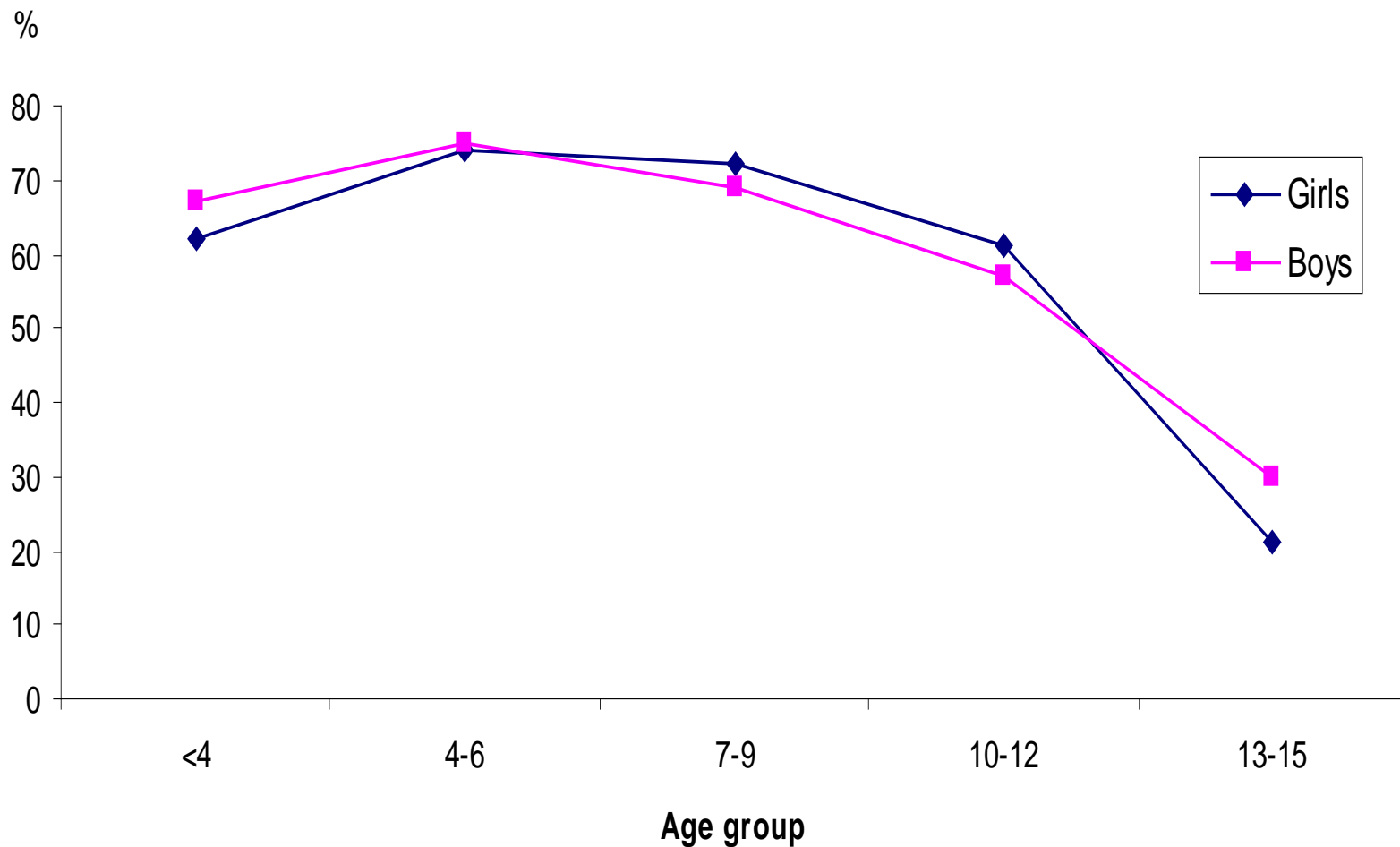
# Study groups

1. **4 246** (excl. 72 with unknown injuries): changes in injury patterns
2. **3 711** (excl. 547 with unknown helmet use): the use and protective effect of helmets

# Results: Helmet use by gender 1993-2006, n=3711



# Helmet use by gender and age group





# The protective effect of helmet

Skull/brain injuries of all severities:

Non-minor (AIS2+) facial injuries:

Significantly less frequent in helmeted  
cyclists

# Adjusted odds ratio (helmet yes/no)

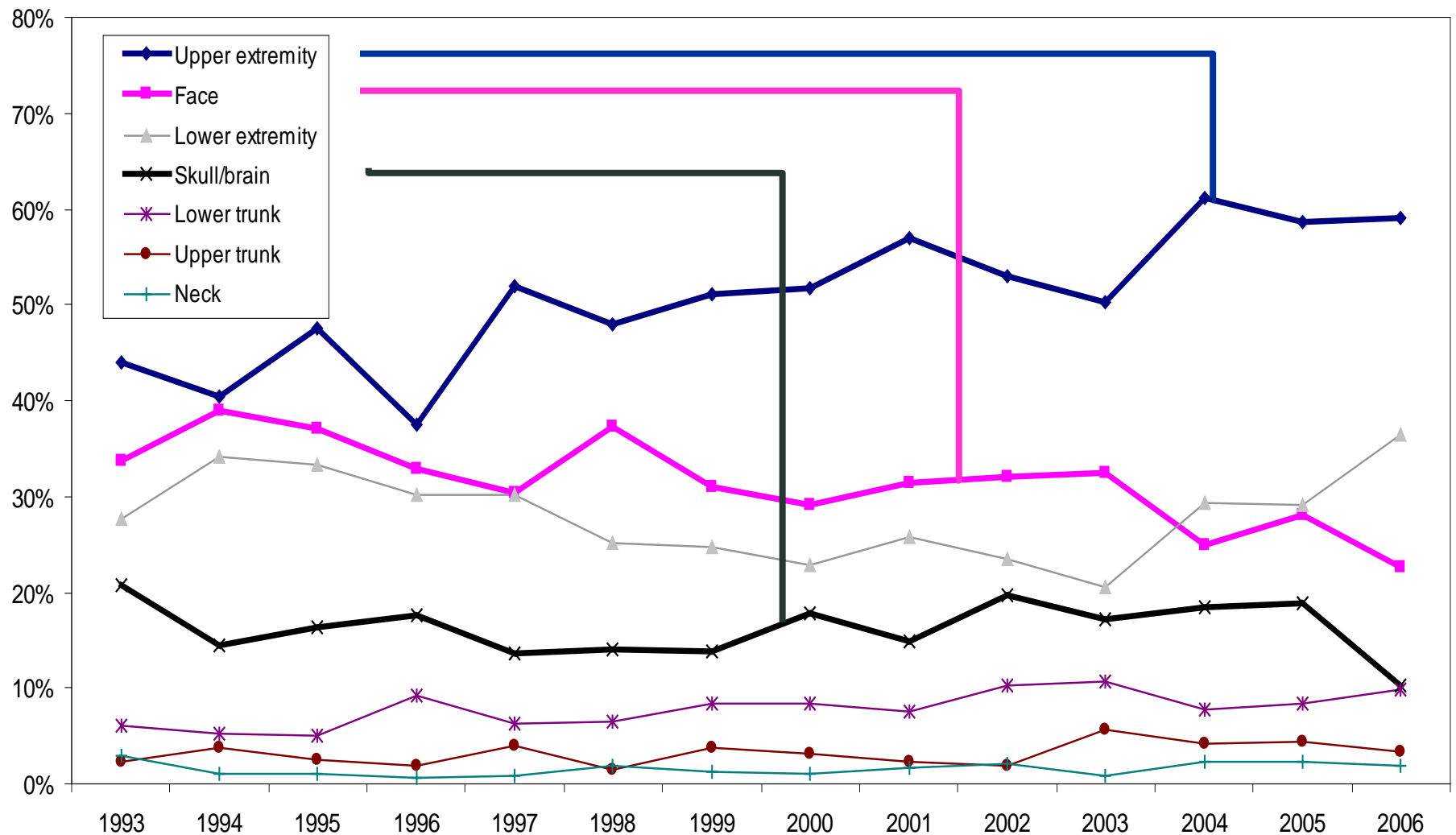
- Serious or more severe (AIS3+) skull/brain injuries: 1/4
- Non-minor (AIS2+) facial injuries: 1/4

# The protective effect of helmets for demographic and crash-related factors (AIS2+ skull/brain injuries)

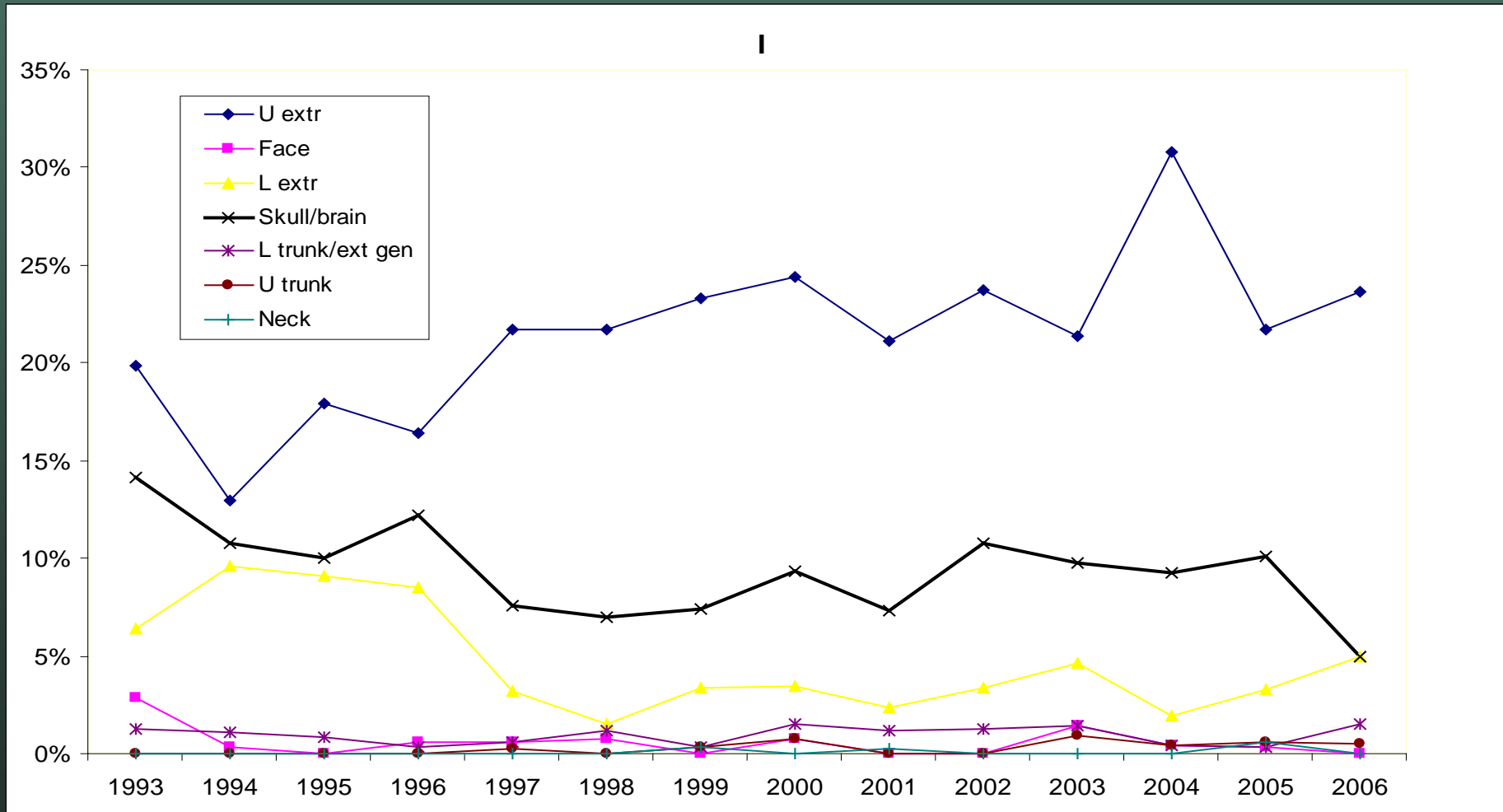
Greater for:

- Girls, at higher age, 2000-2006
- None of helmeted cyclists sustained a serious or more severe skull/brain injury in crashes with motor vehicles

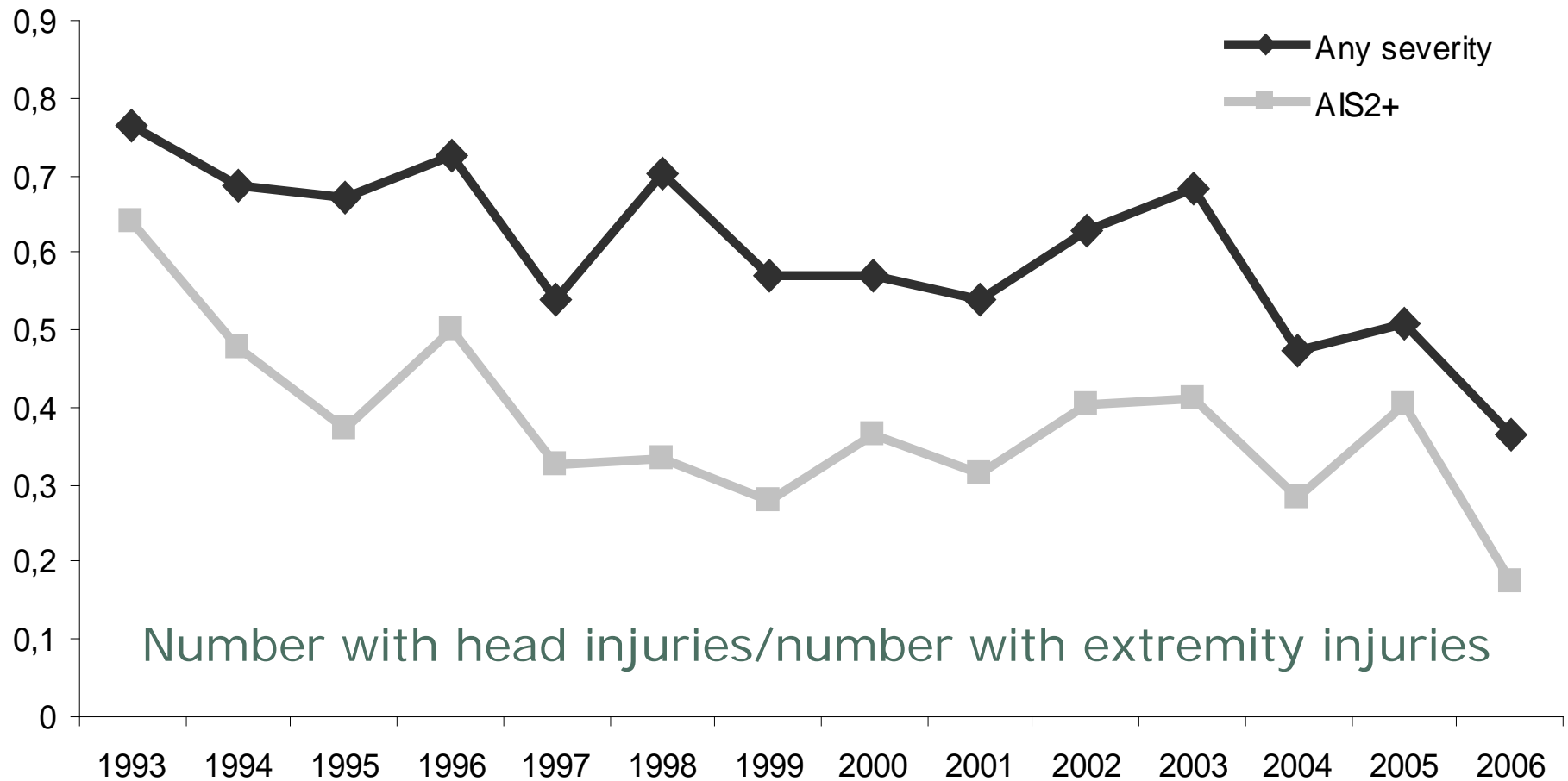
# Injury patterns 1993-2006 n= 4 246



# Moderate or more severe injuries (AIS2+)



# The protective effect of helmets in the population



# Conclusions

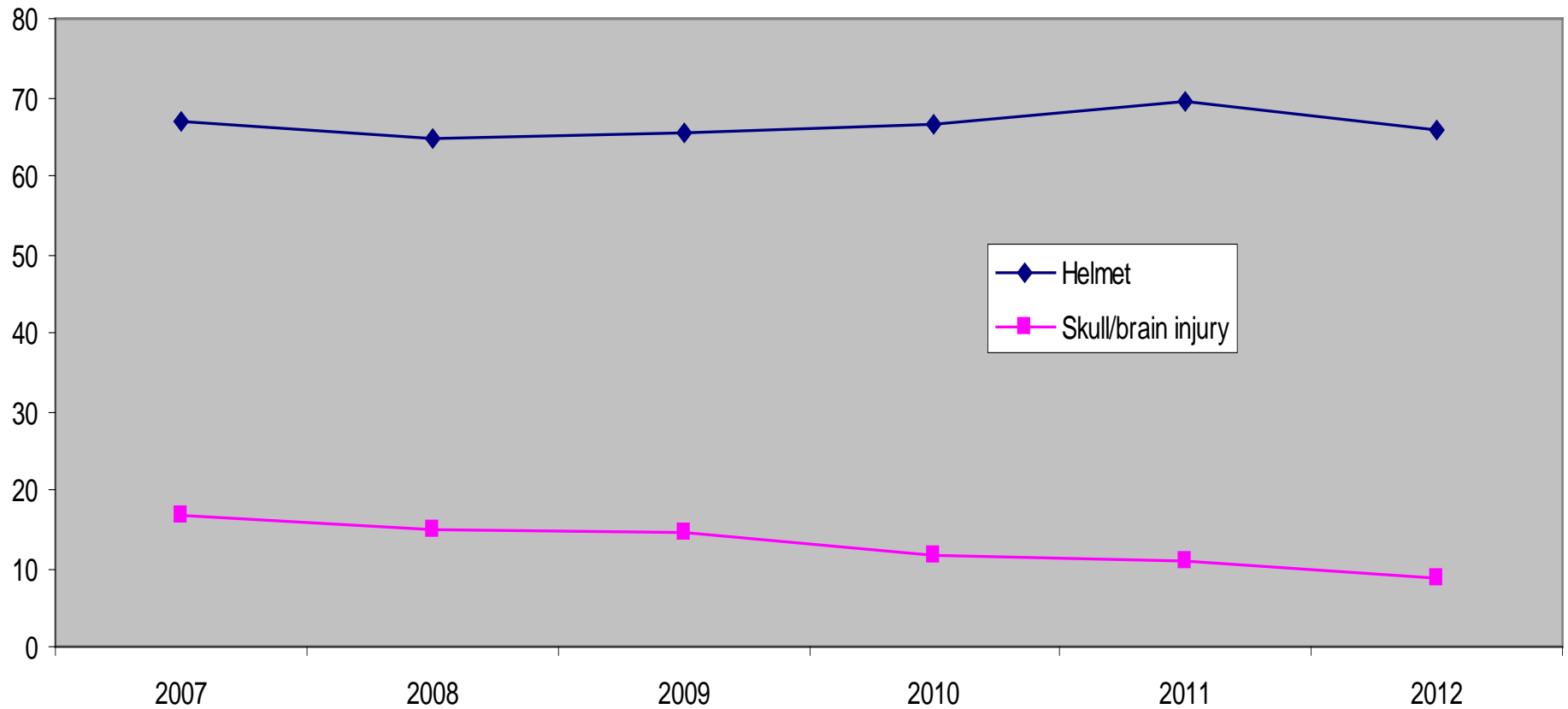
- Bicycle helmets have an obvious protective effect against skull/brain and facial injuries, regardless of the crash circumstances
- The great risk of serious or life-threatening head injuries without helmet use should be emphasised, especially to teenagers
- Attention should be paid to the increasing occurrence of non-negligible injuries to the upper extremities

# Thank You!





# Proportion (%) with helmet and skull/brain injuries 2007-2012 of 7817 cases with known data





# Demographic and crash characteristics

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Boys	64%
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Single crash	86%
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Crash against car	5%
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Bicycle- or walking lane	26 %
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Road	36 %
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Inpatient	22 %
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n=3711 (known helmet use, study group 2)

The protective effect of a helmet against non-minor skull/brain and facial injuries remained significant in multivariate binary logistic regression models

Factors	Skull/brain injury		Face injury	
	AIS2+ (n=326)	AIS3+ (n=22)	AIS1+ (n=1113)	AIS2+ (n=21)
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Used helmet	<b>0.45 (0.35-0.58)*</b>	<b>0.26 (0.10-0.69)*</b>	<b>0.75 (0.63-0.88)*</b>	<b>0.23 (0.09-0.63)*</b>
Female gender	1.08 (0.85-1.38)	1.98 (0.84-4.67)	1.01 (0.87-1.18)	1.01 (0.41-2.49)
Age, per year	0.97 (0.93-1.00)	1.01 (0.88-1.16)	<b>0.86 (0.84-0.88)*</b>	<b>0.86 (0.76-0.98)*</b>
Later period	1.04 (0.82-1.33)	<b>3.82 (1.44-10.11)*</b>	0.99 (0.85-1.16)	0.86 (0.33-2.21)
In Gothenburg	0.85 (0.66-1.09)	0.56 (0.24-1.34)	1.14 (0.97-1.34)	1.71 (0.56-5.19)
Against motor vehicle	1.50 (0.97-2.32)	<b>4.76 (1.74-13.03)*</b>	1.11 (0.81-1.53)	0.89 (0.12-6.87)
Bicycle/walking lane	1.06 (0.81-1.38)	0.60 (0.20-1.83)	<b>1.27 (1.07-1.50)*</b>	1.32 (0.50-3.50)

# Strengths

- Helmet use was assessed at the time of the crash
- All injuries were classified in a standardised way on the basis of medical records
- The same well-trained staff members were responsible for both recording and injury classification
- The same AIS (Abbreviated Injury Scale, version -90) system was used during the whole period 1993-2006

# Limitations

- Children without injuries and with injuries not leading to visiting an A&E ward were not included, so we can only describe the effect of helmets in a subgroup of children. On the other hand, the large sample means that we can control for several confounding factors
- We have not investigated the type of brain injury or the type of helmet, and we cannot draw any conclusions about the risk of brain injury from different types of impact
- We did not analyse the effect of the helmet use legislation on the injuries separately, as the law was in force during only two years of the study period

# Bicycle accidents

- In Sweden, the risk of being killed in road traffic as a cyclist is about six times that of car occupants
- Since 2008, cyclists make up the largest group of severely injured road users (hospitalised at least 24 hours)



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sex	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Boys	207	171	225	209	220	155	179	255	232	222	153	179	225	130
Girls	116	99	133	120	128	106	121	152	110	107	90	88	111	75
Total	323	270	358	329	348	261	300	407	342	329	243	267	336	205





# Bicycle accidents

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Children < 18 years of age severely injured in road traffic crashes during 2005-2009 - annual of average

- **185/100 000** (3 578)

with cyclists being the largest group

- **64/100 000**

Children injured as cyclists, attended accident and emergency (A&E) departments

- **537/100 000** (10 300 children)