Agreement between asthma questionnaire and health care register data

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Running title: *Agreement between questionnaire and health care register data*

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Key points (take home message):

26   • Parental-reported question on asthma ever can function as a proxy for asthma medication and

27   diagnosis in research

28   • Parental-reported current asthma has good agreement with register-based records in the last 18

29   months

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31   **Word count:** 3081

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Abstract

34   *Purpose:* Risk factors and consequences of asthma can be studied using validated questionnaires. The

35   overall objective of this study was to assess the agreement of parental-reported asthma related

36   questions regarding their children against Swedish health care registers.

37   *Methods:* We linked a population-based twin cohort of 27,055 children aged 9-12 years, to the Swedish

38   Prescribed Drug Register, National Patient Register and the Primary care register. Parent-reported

39   asthma was obtained from questionnaires and diagnoses and medication were retrieved from the

40   registers. For the agreement between the questionnaire and the registers, Cohen's kappa was estimated.

41   *Results* The kappa of the 'reported ever asthma' against a 'register-based ever asthma' was 0.69 and

42   0.57 between the parental-'reported doctor's diagnosis' and 'register-based doctor's diagnosis' '. The

43   highest agreement between 'reported current asthma' and 'register- based current asthma' with at least

44   one dispensed medication or a diagnosis applied to different time-windows was seen for an 18 month

45   window (kappa=0.70).

46   *Conclusions* We found that parent-reported asthma-related questions showed on average good

47   agreement with the Swedish health care registers. This implies that in depth questionnaires with rich

48   information on phenotypes are suitable proxies for asthma in general and can be used for health care

49   research purposes.

50

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Introduction

To study risk factors and consequences of asthma, validated instruments for defining asthma in studies using registers, clinical cohorts and questionnaires are needed. Numerous efforts have been made to ensure that specific questionnaires detecting asthma are standardized, repeatable and can be applied consistently across a range of geographical and cultural settings (1, 2). Both the European Community Respiratory Health Survey (1) and the International Study on Asthma and Allergies in Childhood (ISAAC) (2) were developed, where possible, from pre-existing published questionnaires, where validity had been previously assessed (3, 4).

Several studies have validated questions on 'reported ever asthma' (5-7) and symptom-based outcomes (e.g., wheeze, waking at night, coughing) (8-11), whereas others have focused on doctor's diagnosis (6) or taking asthma medication (6) . Other examples of asthma validation studies include symptoms-based questions against; clinical evaluations (5, 8), structured interviews (12) and patient records of a diagnosis (13). The standardized ISAAC questionnaire (2) has a specific question on 'reported ever asthma' for which validity in other countries has been assessed (5, 7) but not in Sweden. In addition, to our knowledge, no study has assessed the validity of the questions describing 'reported current asthma' and doctor's diagnosis from the ISAAC questionnaire. Furthermore, timing of dispenses has been investigated in a previous study in which agreement between reported and prescribed asthma medication was highest within an 18-months window (14).

Questionnaire studies are relatively low cost, time-efficient, and permit large sample sizes compared to clinical data collections (15, 16). On the other hand, questionnaires are often restricted to specific age groups or specific areas, which can reduce generalizability to other populations (17, 18). Identifying affected individuals often involves retrospective questioning about doctor's diagnosis and previous symptoms, therefore subject to recall bias (19, 20). By using population-based register data for asthma diagnoses and prescriptions, the data are objective and some of the aforementioned errors can be avoided particularly if the coverage of the register is high.

The overall objective for this study was to assess the agreement between parental-reported childhood asthma questions from the nationwide twin cohort Childhood and Adolescent Twin Study in Sweden (CATSS) and population-based Swedish health care registers (National Patient Register, NPR, which contains all inpatient diagnoses and 75-80% of all outpatient diagnoses since 1987 and 2001 respectively,

82   Swedish Prescribed Drug Register, SPDR, which contains all prescribed medications that are dispensed at

83   Swedish pharmacies and Stockholm regional health care data warehouse, VAL, which holds all primary

84   care diagnoses from Stockholm county). Our first aim was to assess the agreement between 'reported

85   ever asthma' and a 'register-based ever asthma' algorithm (21) (at least 2 dispenses of asthma

86   medication or an asthma diagnosis) using SPDR and NPR and between 'reported doctor's diagnosis' and

87   'register-based doctor's diagnosis' from NPR and VAL. Our second aim was to assess the agreement

88   between 'reported asthma medications' and 'register-based asthma medications', with the

89   corresponding data within different time windows in the registers.

90

91   **Method**

92   *Study population*

93   This study included children participating in CATSS (22). CATSS is an ongoing longitudinal twin study

94   targeting all twins born in Sweden since July 1st, 1992 with an overall response rate of 76% until 2012.

95   Since 2004, in connection to the twin's 9th or 12th birthdays, parents are interviewed via telephone

96   regarding the children's somatic, social and mental health (22). CATSS is linked to the Swedish health

97   care registers, NPR, SPDR and VAL. The study was approved by the Regional Ethical Review Board in

98   Stockholm, Sweden. Informed consent was obtained.

99

100   *Study design and data sources*

101   This is an agreement study comparing parental interview answers with data from registers where no

102   measure was considered gold standard(23). Several national health care registers are held by the

103   Swedish National Board of Health and Welfare such as the SPDR (24) and NPR (25). The SPDR contains

104   the Anatomical Therapeutic Chemical [ATC]-codes, date, number of packages, and when possible, daily

105   defined doses) and age, sex and PIN of the patient since July 2005. Information on primary and

106   secondary diagnoses according to the International Classification of Diseases 10th revision (ICD -10) is

107   included in the NPR since 1997. All data were de-identified prior to analyses and kept on a secure server.

108   Linking data from multiple registers is made possible through the Swedish unique personal identity

109   number (PIN) (26).

110

Sub-cohorts

112   The full cohort consisted of N=27,055 twins that were interviewed up until the end of 2012. From this

113   population we derived two sub-cohorts. The first sub-cohort, the National cohort, consisted of twins

114   whose parents had completed the interview since July 1st 2006 (n=18,725). This date was selected

115   because July 1st 2005 was the date that the SPDR was established, covering the whole Swedish

116   population. By selecting this date we were able to retrospectively collect information on dispensed

117   medication from the SPDR for at least one year to assess 'register-based ever asthma'. The second sub-

118   cohort, the Stockholm cohort, included twins that were born from 2001 and who had been living in

119   Stockholm all years between birth and the interview (n=2,226). This subgroup of twins was selected

120   since information on both specialist (NPR) and primary care was available for Stockholm County from

121   2003 by the VAL registry. The reason we selected individuals born from 2001 was because a child with

122   asthma before the age of two years usually comes in contact with the specialist care and gets a diagnosis

123   in the National Patient Register (NPR).

124

125

Measures of ever and current asthma in the National cohort

127   We defined a 'reported ever asthma' case as a child with a positive answer to the question *'Does he/she*

128   *have, or has he/she had asthma?'* Everyone that replied positive was then directed to other asthma

129   related questions (see Panel 1). 'Reported current asthma' was then defined as reporting positively to

130   the question *'Does he/she still have asthma?'.*

131   The 'register-based ever asthma' algorithm based on SPDR and NPR data has been previously described

132   and validated (21). The age-specific positive predicted value (PPV) from that validation study was 0.89

133   (95% CI: 0.85-0.92) for ages between 4.5-17 years. In brief, the 'register-based ever asthma' is defined as

134   either: 1) asthma medication of ≥ 2 dispenses of ICS (inhaled corticosteroid, ATC code: R03BA) and/or

135   LTRA (leukotriene receptor agonist, ATCcode: R03DC03) and/or β2-ICS (combination of inhaled beta-2

136   agonist and inhaled corticosteroid, ATCcodes: R03AK06 and R03AK07) independent of time between,

137   and/or 2) ≥ 3 dispenses of ICS and/or LTRA and/or β2-ICS and/or β2 (inhaled beta-2 agonist, ATC code:

138   R03AC) within a 12-month period (prior to the date of the interview) or 3) an asthma diagnosis (ICD-10

139   diagnostic codes: J45, and J46) from NPR.

140   To define 'register-based current asthma' from the SPDR we used the same register-based algorithm as

141   for 'register-based ever asthma' (21) in combination with conditions placed on recent time-windows for

142   asthma diagnosis (ICD-10 diagnostic codes: J45, and J46) from NPR respectively in the last 6, 12, 18 and

143   24 months prior to the date of the interview. Instead of a recent diagnosis we also conditioned on at

144   least one dispensed medication (ICS, LTRA, B2, β2-ICS) from the SPDR. We wanted to investigate several

145   time windows to see which one captured the 'reported current asthma' question best and to evaluate if

146   it would be enough using only dispensed medication.

147

148   *Measures of a doctor's diagnosis in the Stockholm cohort*

149   A parental-'reported doctor's diagnosis' was defined as answering 'yes' to the asthma gated question

150   ('reported ever asthma') plus answering 'yes' to: *'You said that he/she has or has had asthma, has*

151   *he/she been given that diagnosis by a doctor or nurse?'*

152   'Register-based doctor's diagnosis' was defined based on at least one primary or secondary diagnosis of

153   asthma up until the time of the interview by ICD-10 codes (J45, and J46) from NPR (inpatient or

154   outpatient) or VAL (primary care).

155

156   *Measures of asthma medications in the National cohort*

157   Parental-'Reported asthma medications' was defined as answering 'yes' to the asthma gated question

158   plus answering 'yes' to the following question: *'Does your child currently take any asthma-medication*

159   *(inhalator, spray or tablets)?'* This question was added in 2010 as an update to the original

160   questionnaire, so not included for everyone (n=9860).

161   'Register-based asthma medications' was defined as at least one dispensed asthma medication (ICS,

162   LTRA, β2, β2-ICS) from SPDR during the last , 6, 12, 18 and 24 months prior to the interview.

163

164   *Statistical analyses*

165 Agreement between register data and questionnaire data was assessed, using Cohen's kappa statistic,

166 with 95% Confidence Interval (CI). The percentage of overall agreement was also estimated. Cohen's

167 kappa is a measure of agreement beyond what would be expected by pure randomness. A kappa over

168 0.75 is characterized as excellent, a kappa of 0.40-0.75 is considered fair to good, and 0.40 and below as

169 poor (27).

170 Statistical Analysis Software 9.4 (SAS Institute, Cary, NC) was used for all analyses.

171

Results

173 Table 1 lists the demographic characteristics of the sub-cohorts of the CATSS study; the National and

174 Stockholm cohorts. In general, the characteristics of the smaller Stockholm cohort were very similar to

175 the much larger National cohort. The prevalence of 'reported ever asthma' was slightly higher in the

176 Stockholm cohort (17.4%), compared to the national cohort (14.5%). However, 'reported current

177 asthma' (7.1%) did not differ substantially between cohorts.

178

179 *'Reported ever asthma'*

180 The kappa statistic of 'reported ever asthma' and 'register-based ever asthma' was 0.69, indicating good

181 agreement. The overall agreement was 92.1% (Table 2).

182

183 *Doctor's diagnosis*

184 The comparison between the parental 'reported doctor's diagnosis' and the 'register-based doctor's

185 diagnosis' from NPR or VAL showed a kappa of 0.57, indicating a fair to good agreement. The overall

186 agreement was 86.3% (Table 2).

187

188 *'Current Asthma'*

7

189   Table 3 shows the agreement between 'reported current asthma' and 'register-based current asthma'

190   with time-specific criteria for at least one dispensed medication or diagnosis within four different time-

191   windows. For 6 months the kappa statistic was 0.59, 0.67 and 0.70 for 12 and 18 months respectively

192   and 0.70 for 24 months. When diagnosis was removed from the 'reported current asthma' definition the

193   agreement just slightly decreased for all of the time-windows with a kappa of 0.56, 0.65, 0.69 and 0.69

194   respectively. At all time-windows the overall agreement was very high (95% to 96%).

195

196   *Taking asthma medications*

197   Table 4 shows the agreement between 'reported asthma medications' by parent and 'register-based

198   asthma medications', any asthma medication dispensed from SPDR in different time-windows. The

199   kappa increased from 0.52 for 6 months before the interview to 0.57 for 12 months and then slightly

200   increased for 18 months before the interview to 0.59. For a time-window of 24 months the kappa

201   decreased to 0.55. The overall agreement ranged between 78-80%.

202

Discussion

204   We found good agreement between 'reported ever asthma' and 'register-based ever asthma'

205   (kappa=0.69) and fair to good agreement (kappa=0.57) between parental-'reported doctor's diagnosis'

206   and 'register-based asthma diagnosis'. We also found good agreement (kappa= 0.70) between 'reported

207   current asthma' and 'register-based current asthma', conditional on at least one dispensed medication

208   or a diagnosis within the last 18-months. Finally, we found the best agreement between 'reported

209   asthma medications' by parents and 'register-based asthma medications' within the last 18 months

210   (kappa=0.59).

211   .

212   Previous and similar studies that assessed the validity of the question on **'reported ever asthma'** against

213   a clinical diagnosis found high sensitivity (i.e., proportion with a diagnosis that are correctly identified as

214   such), 0.87 in one study (7) and good sensitivity, 0.68, in another one (28). Valle et al. used a younger

215   cohort than ours, 6-7 years old children and they used a golden standard (i.e., clinical diagnosis) which

216   could potentially explain why they found a high estimate of sensitivity (0.87) (7). Marco et al.

217   investigated adults and found good validity (sensitivity of 0.68) while we studied children and found

218   good agreement (kappa =0.69) (28). In addition, among university students the question on 'reported

219   ever asthma' was validated against a variable combining physician's interview, methacholine challenge,

220   skin prick test and specific IgE which reported a low sensitivity (0.40) and a good PPV (0.76) (5). Thus,

221   large heterogeneity in terms of sensitivity, PPV and Kappa exists between the different studies (age-

222   groups and comparison variables) when assessing the validity of 'reported ever asthma' from a

223   questionnaire.

224   We have previously validated the register based comparison variable 'register-based ever asthma'

225   against medical records with high positive predictive values (0.89 95% CI: 0.85-0.92) for clinical asthma

226   diagnosis (21). This definition of asthma has been applied in several studies as a proxy for ever/incident

227   asthma (29-33) as well as for current/prevalent asthma (30).. Another study investigating **'reported**

228   **doctor's diagnosis'** found a moderate PPV of 0.57 when the question of parental-reported doctor's

229   diagnosis was validated against asthma medication reimbursement in a younger cohort (6) . The

230   question of doctor's diagnosis has also been validated against a structured interview among 7-8 years old

231   which found excellent PPV (0.98) and good sensitivity (approx. 0.70) (12). There are many reasons to our

232   fairly low kappa estimate, for example asthma diagnosis in low ages is fairly unspecific and those who

233   answered no to the question on 'reported ever asthma' never got the question on doctor's diagnosis

234   (see Figure 1). In addition, the kappa could be due to both over-(the register may not have coverage)

235   and underreporting since a diagnosis given a long time ago may be forgotten if the child has no current

236   asthma symptoms or medication. However, this does not imply per se that our comparison variable is

237   poor.

238   We estimated the agreement between **'reported current asthma'** and 'register-based current asthma'

239   with different time windows. We found the 18-month window to be preferable with a kappa of 0.70,

240   which indicates a good agreement. Interestingly, when only using medication data the resulting kappa

241   just decreased slightly giving us confidence that our 'register-based current asthma' including one

242   recently dispensed medication is almost as good a proxy for 'reported current asthma' as when using

243   both medication and diagnosis. Recall bias has shown not to be influential within the last 12 months in a

244   recent study of self-reported hospital admissions compared to administrative records (34). In light of

245   this, it is not surprising that reported 'current' asthma (with no timeframes in the question) equals 'in the

246   last 18 months'. Possible explanations could be purchasing large amounts of medicines irregularly,

247   having mild asthma which does not require medications or sharing medicines with other family members

248   (14). We were unable to find any other studies that had assessed the validity of 'reported current

249   asthma'. Current wheeze is more common to validate in childhood than current asthma, for example

250   current wheeze (or wheezing symptoms within the last 12 months) is included in the ISAAC

251   questionnaire and applied in other validation studies (6, 7). However, wheeze is a symptom and asthma

252   is a condition/disease and children with wheeze do not necessarily need to have asthma. Therefore

253   those studies using 'current wheeze' are limited in generalizing their findings to asthma.

254   We found a fair agreement between **'reported asthma medications'** and 'register-based asthma

255   medications' with a kappa ranging from 0.52 to 0.59 depending on time-window. Nwaru et al. validated

256   a question on parental-reported asthma medication during the last 12 months against the asthma

257   medication reimbursement and reported excellent sensitivity and perfect NPV (6). One difference

258   between our study and that of Nwaru et al. was that their question included a clear time-window, while

259   ours was vaguer and left it to the parents to interpret the meaning of 'current'. Koster et al., 2010 found

260   substantial agreement between parental reported ICS use and pharmacy register based ICS use (35).

261   Their study also had an explicit time-period (i.e., 12 months) and differences in prevalence compared to

262   our study, which affects the kappa. We rather chose to estimate agreement between the answers and

263   register-based information on dispensed medications within four different time frames and we found 18

264   months to have the best agreement. Importantly, the same time-window of 18 months was found

265   preferable in a previous study on the concordance between register data on dispensed drugs and

266   parental-reported use of asthma drugs in adolescents (14). If all patients had complied with the

267   prescribed treatment, we would probably have an even better register-based measure of asthma, which

268   would be more in agreement with the questionnaire information on whether the child have asthma or

269   not.

270

271   **Strengths and limitations**

272   The CATSS study has nationwide coverage and high response rate which strengthen the generalizability

273   of the findings and decrease possible selection bias. Another strength is that data are retrieved from the

274   Swedish health care registers. Register data enable us to obtain an objective measure based on

275   dispensed medication from the SPDR and diagnoses from the NPR. In addition, in Stockholm County,

276   primary health care centers (PHCC) have reported all diagnostic information (ICD-codes) to VAL since

277   2003. Therefore we restricted the Stockholm cohort to only include those who were born and lived in

278　Stockholm all years (and not just temporary). One could argue that being a twin may affect the

279　generalizability of the findings. However, it has been shown in the age-range between 5 to 18 years that

280　the prevalence of asthma is not higher in twins compared to singletons (30). Therefore, including twins

281　should not affect the generalizability of the findings. Another limitation is the smaller sample size for

282　'reported asthma medications', as this question was added to the interviews in year 2010. In addition,

283　young children with wheeze and shortness of breath might not always end up with an asthma diagnose

284　by a doctor, therefore there may be some under-representation in the parental-reported 'ever asthma'.

285　We were not able to capture those children and their symptoms in the current study. Furthermore,

286　although a binary measure of asthma is very common in registers and questionnaire based-studies, we

287　recognize that a binary outcome does not accurately represent the heterogeneity of asthma phenotypes

288　and persistence. However, since register-based outcomes for asthma are used widely in the Nordic

289　countries and other countries such as Canada, USA and Korea we felt it was important to test the

290　agreements of commonly used binary outcomes. Registers have the advantages of being cost-effective

291　and are population-based therefore improving generalizability and statistical power. In depth

292　questionnaire-based cohort studies can provide more information on the various asthma phenotypes

293　important for clinical applications but can suffer from recall-bias and are often smaller hence providing

294　less power for epidemiological questions, and may be less generalizable.

295

296　Conclusions

297　We found that parent-reported asthma-related questions showed on average good agreement with the

298　Swedish health care registers which can be applied for health care research purposes. Valid screening

299　instruments such as questionnaires, registers, clinical cohorts and patient charts can improve

300　epidemiological research to address various questions on risk factors and consequences of asthma.

301

302　Acknowledgements

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- ***'Reported ever asthma'***: 'Does he/she have or has he/she had asthma'?

  if **'yes'** then:

  - ***'Reported current asthma'***: 'Does he/she still have asthma'?
  - ***'Reported doctor's diagnosis':*** 'You said that he/she has or has had asthma, has he/she been given that diagnosis by a doctor or nurse'?
  - ***'Reported asthma medications':*** 'Does your child currently take any asthma medication (inhalator, spray or tablets)'?

411   Panel 1. Figure of the asthma related questions from the questionnaire

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430 Table 1. Participants' characteristics in the two cohorts

	Category	National Cohort* (n=18725)	Stockholm Cohort # (n=2226)
Age at interview (mean± SD[range]); years		9.4±1.0 [8.5-12.6]	9.2±0.4 [8.5-11.5]
Classified as 9 years old n (%)		16561 (88.4)	2226 (100)
Sex	Male	9495 (50.7)	1158 (52.0)
	Female	9230 (49.3)	1068 (48.0)
'Reported ever asthma' from questionnaire	No	15866 (84.7)	1822 (81.9)
	Yes	2720 (14.5)	388 (17.4)
	Missing	139 (0.7)	16 (0.7)
'Reported current asthma' from questionnaire	No	17324 (92.5)	2059 (92.5)
	Yes	1329 (7.1)	158 (7.1)
	Missing	72 (0.4)	9 (0.4)
'Reported doctor's diagnosis' from questionnaire	No	16071 (85.8)	1846 (82.9)
	Yes	2484 (13.3)	360 (16.2)
	Missing	170 (0.9)	20 (0.9)
'Reported asthma medications' from questionnaire (current)§	No	917 (9.3)	254 (11.4)
	Yes	492 (5.0)	116 (5.2)
	Missing	8451 (85.7)	1856 (83.4)
'Register-based ever asthma' Asthma defined[5] by dispensed medications from SPDR[1] and/or a diagnosis from NPR[2]	No	15398 (82.2)	1731 (77.8)
	Yes	2831 (15.1)	496 (21.1)
	Missing	496 (2.63)	26 (1.2)
'Register-based asthma medications' Any asthma medications dispenses ever from SPDR[1]	No	14752 (78.8)	1655 (74.3)
	Yes	3973 (21.2)	571 (25.7)
Any asthma diagnoses from NPR[2] ever	No	16203 (86.5)	
	Yes	2522 (13.5)	
'Register-based doctor's diagnosis' Any asthma diagnoses from NPR[2] or VAL[3] ever	No		1704 (76.6)
	Yes		522 (23.5)
Age at first diagnose (mean± SD); years		4.0 (3.8)	3.8 (3.6)

SES (Socio Economic Status) from LISA[4]	9 y completed	294 (1.6)	42 (1.9)
	10-12 y completed	7278 (38.9)	554 (24.9)
	>12 y completed	10907 (58.3)	1594 (71.6)
	Missing	246 (1.3)	36 (1.6)
Answered questionnaire (mother/father/other)	Biological mother	15827 (84.5)	1818 (81.7)
Migrant background (Mother or father born outside Scandinavia)	No	16421 (87.70)	1808 (81.22)
	Yes	2188 (12.23)	400 (17.97)
	Missing	116 (0.07)	18 (0.81)
	Biological father	2812 (15.02)	382 (17.2)
	Other	86 (0.5)	26 (1.2)
	Missing	0	0

431 *National cohort included twins in CATSS, whose parents completed the telephone interview since July 1st 2006.
432 #Stockholm cohort included twins in CATSS, born from 2001 in Stockholm and lived all years in Stockholm
433 § This question was added in 2010, in total n=9860 answered the questionnaire after this time-point
434 [1]=Swedish Prescribed Drug Register (SPDR)
435 [2]=National Patient Register (NPR)
436 [3]=Stockholm regional health care data warehouse (VAL)
437 [4]=Longitudinal integration database for health insurance and labor market studies (LISA) at the year when children were 5 years
438 [5]=Asthma medication of ≥ 2 dispenses of ICS and/or LTRA and/or B2-ICS independent of time between and/or ≥ 3 dispenses of
439 ICS and/or LRTA and/or B2-ICS and/or B2 within a 12 month period (prior to the date of the interview) and/or a diagnosis from
440 NPR
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444 Table 2. Agreement between 'reported ever asthma' and 'reported doctor's diagnosis' from the
445 questionnaire against SPDR, NPR and VAL in the National and the Stockholm cohort respectively.

Questionnaire, q	Registers, r	Overall agreement %(n)	q[+]r[-] n	q[-]r[+] n	q[+]r[+] n	q[-]r[-] n	Kappa, (95% CI)
National cohort (n=18725)							
'Reported ever asthma' (questionnaire)	'Register-based ever asthma', Asthma defined by dispensed medications (SPDR) [a] or a diagnosis from NPR	92.09 (16675/18107)	646	786	2003	14672	0.69 (0.68-0.71)
Stockholm Cohort (n=2226)	'Register-based doctor's diagnosis',						

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'Reported doctor's diagnosis' (questionnaire)	Any asthma diagnosis from NPR or VAL	86.31 (1904/2206)	78	224	282	1622	0.57	(0.53-0.61)

446 Table 2 shows the National cohort and the number of participants who were either positive or negative on the questionnaire
447 variable, q+ and q- respectively and positive or negative on the register variable, r+ and r- respectively.
448 a=Asthma medication of ≥ 2 dispenses of ICS and/or LTRA and/or B2-ICS independent of time between and/or ≥ 3 dispenses of
449 ICS and/or LRTA and/or B2-ICS and/or B2 within a 12 month period (prior to the date of the interview)
450 SPDR=Swedish Prescribed Drug Register
451 NPR=National Patient Register
452 VAL=Stockholm regional health care data warehouse
453 CI=Confidence Interval
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456 Table 3. Agreement between 'reported current asthma' from the questionnaire and SPDR and NPR in the
457 National cohort, n=18725

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Questionnaire, q	Registers, r	Overall agreement %(n)	q^+r^- n	q^-r^+ n	q^+r^+ n	q^-r^- n	Kappa (95% CI)	
'Reported current asthma' (questionnaire)	'Register-based current asthma', Asthma defined by dispensed medications (SPDR)a or a diagnosis from NPR with at least one dispensed medication (any) or a diagnosis in the last:							
	6m	95.50 (17814/18653)	671	168	658	17156	0.59	(0.56-0.61)
	12m	95.94 (17896/18653)	472	285	857	17039	0.67	(0.65-0.69)
	18m	96.05 (15873/16526)	314	339	846	15027	0.70	(0.68-0.72)
	24m	95.76 (13946/14563)	225	392	799	13147	0.70	(0.68-0.72)
'Reported current asthma' (questionnaire)	'Register-based current asthma', Asthma defined by dispensed medications (SPDR)a or a diagnosis from NPR with at least one dispensed medication in the last:							
	6m	95.30 (17777/18653)	726	150	603	17174	0.56	(0.53-0.58)
	12m	95.78 (17865/18653)	522	266	807	17058	0.65	(0.63-0.67)

18m	96.00 (15865/16526)	347	314	813	15052	0.69	(0.67-0.71)
24m	95.76 (13945/14563)	249	369	775	13170	0.69	(0.67-0.72)

[a]=Asthma medication of ≥ 2 dispenses of ICS and/or LTRA and/or B2-ICS independent of time between and/or ≥ 3 dispenses of ICS and/or LRTA and/or B2-ICS and/or B2 within a 12 month period (prior to the date of the interview

CI=Confidence Interval

SPDR=Swedish Prescribed Drug Register

Table 4. Agreement between 'reported asthma medications' from the questionnaire and SPDR in the National cohort, n=18725

Questionnaire, q	Registers, r	Overall agreement % (n)	q⁺r⁻ n	q⁻r⁺ n	q⁺r⁺ n	q⁻r⁻ n	Kappa (95% CI)
'Reported asthma medications' (Questionnaire)[a] current	'Register-based asthma medications', At least one asthma medication dispenses (SPDR)[b] in the last:						
	6 m	79.49 (1120/1409)	215	74	277	843	0.52 (0.47-0.56)
	12m	80.48 (1134/1409)	137	138	355	779	0.57 (0.53-0.62)
	18m	80.13 (1129/1409)	83	197	409	720	0.59 (0.54-0.63)
	24m	77.93 (1098/1409)	59	252	433	665	0.55 (0.52-0.60)

[a]=This question was added in 2010, in total n=9860 answered the questionnaire after this timepoint

[b]=Swedish Prescribed Drug Register (SPDR)

CI=Confidence Interval