Risk of renal disease in patients with both type 1 diabetes and coeliac disease

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Abstract
Aims/hypothesis Our aim was to study the risk of renal disease in patients with type 1 diabetes (T1D) and coexisting coeliac disease (CD).
Methods Individuals with T1D were defined as having a diagnosis of diabetes recorded at ≤30 years of age in the Swedish Patient Register between 1964 and 2009. Individuals with CD were identified through biopsy reports with villous atrophy (Marsh stage 3) from 28 pathology departments in Sweden between 1969 and 2008. We identified 954 patients with both T1D and CD. For each patient with T1D + CD, we selected five age- and sex-matched reference individuals with T1D only (n=4,579). Cox regression was used to estimate the following risks: (1) chronic renal disease and (2) end-stage renal disease in patients with CD + T1D compared with T1D patients only.

Results Forty-one (4.3%) patients with CD + T1D and 143 (3.1%) patients with T1D only developed chronic renal disease. This corresponded to an HR of 1.43 for chronic renal disease (95% CI 0.94, 2.17) in patients with CD + T1D compared with T1D patients only. In addition, for end-stage renal disease there was a positive (albeit statistically non-significant) HR of 2.54 (95% CI 0.45, 14.2). For chronic renal disease, the excess risk was more pronounced after >10 years of CD (HR 2.03, 95% CI 1.08, 3.79). Risk estimates were similar when we restricted our cohort to the following T1D patients: (1) those who had an inpatient diagnosis of T1D; (2) those who had never received oral glucose-lowering medication; and (3) those who had not received their first diabetes diagnosis during pregnancy.

Conclusions/interpretation Overall this study found no excess risk of chronic renal disease in patients with T1D and CD. However, in a subanalysis we noted a positive association between longstanding CD and chronic renal disease in T1D.

Keywords Coeliac disease · Cohort studies · Renal disease · Type 1 diabetes

Abbreviations CD Coeliac disease · ESRD End-stage renal disease · GFD Gluten-free diet · T1D Type 1 diabetes · VA Villous atrophy
Introduction

Coeliac disease (CD) is a chronic immune-mediated enteropathy with a worldwide prevalence approaching 1% [1]. CD is associated with type 1 diabetes (T1D), and the prevalence of CD in T1D ranges from 3% to 12% [2, 3]. Most individuals with these two diseases are first diagnosed with T1D [4] but there is also a positive association with T1D among individuals with an initial diagnosis of CD [5]. The impact of a concomitant diagnosis of CD on morbidity in T1D has not been thoroughly studied. Although both CD and T1D are associated with an increased risk of renal disease [6–8], few studies have examined the risk of renal disease in patients with both T1D and CD.

The incidence of T1D has increased in recent decades [9, 10]. Chronic renal failure due to diabetic nephropathy is a feared complication of T1D and is one of the leading causes of end-stage renal disease (ESRD). Intensive treatment with good metabolic control can decrease the risk of diabetic nephropathy [11], and severe kidney disease has become less common [12]. Nevertheless, late complications, not least nephropathy, are serious problems and we need more knowledge about why some T1D patients develop renal disease.

In a recent cross-sectional study from the Netherlands, including 31 patients with both T1D and CD, the authors found no difference in the prevalence of diabetic nephropathy between cases (T1D + CD) and controls (T1D only) [13]. Another study from the UK found a higher prevalence of nephropathy in patients with T1D and CD compared with controls (T1D only) [14]. Skovbjerg et al examined the prevalence of CD in 467 patients with T1D and nephropathy and compared it with the prevalence of CD in 505 patients with T1D without nephropathy [15]. The prevalence of CD was 2.6% among T1D patients with nephropathy and 1.0% in T1D patients without nephropathy; the difference was not statistically significant ($p=0.17$). A recent Australian study [16] examined urinary albumin excretion as a marker of renal dysfunction in children with T1D and biopsy-proven CD as compared with children with T1D only. The authors found that the children with T1D and CD had a lower urinary albumin–creatinine ratio than children with T1D only but pointed out that larger studies are needed to confirm these findings [16].

Based on recent findings of an increased risk of ESRD in patients with CD, we investigated the role of CD for the risk of renal disease in T1D [6, 17] by comparing 954 patients with both T1D and CD vs 4,579 patients with T1D only.

Methods

Study population Data linkage between the Swedish National Patient Register, the Total Population Register and nationwide histopathology data on CD allowed us to estimate the risk of chronic and severe renal disease in patients with both CD and T1D.

Individuals with T1D were identified from the Swedish National Patient Register [18] from 1964 to 2009 according to appropriate International Classification of Disease codes (ICD-7 260 [www.wolfbane.com/icd/icd7.htm]; ICD-8 250 [www.wolfbane.com/icd/icd8.htm]; ICD-9 250 [www.icd9data.com/2007/Volume1/240-279/250-259/250/default.htm] and ICD-10 E10 [www.who.int/classifications/icd/en/]). Early Swedish versions of the ICD (7th, 8th and 9th editions) did not distinguish between type 1 and type 2 diabetes. Consequently, we defined T1D as a diabetes diagnosis at ≤ 30 years of age, as type 2 diabetes is rare in Swedish individuals below the age of 30 years [19, 20]. Earlier research has shown that this definition has a 95% positive predictive value for insulin-dependent diabetes mellitus in Sweden [21].

We collected biopsy reports between 2006 and 2008 from all 28 pathology departments in Sweden and identified 29,096 individuals with biopsy-verified CD [22]. The biopsies were performed between 1969 and 2008 and CD was defined as the presence of duodenal/jejunal villous atrophy (VA; Marsh stage 3) [23]. VA has a high specificity for CD in Swedish patients [24]; 95% of those with VA have CD according to an earlier validation of this CD dataset [24].

Data on renal disease were obtained from the Swedish Patient Register (both inpatient and hospital-based outpatient data) according to appropriate ICD codes (see electronic supplementary material [ESM] text). In this paper, the term ‘severe renal disease’ denominates chronic renal disease and ESRD, which was defined by treatment with dialysis or a renal transplant according to procedure codes.

Some 42,806 individuals with a diagnosis of T1D were identified by the Swedish National Board of Health and Welfare. The government agency Statistics Sweden could confirm the identity of 42,578 (99%) of these individuals. Thirty-five individuals were excluded because of having a diagnosis of any renal disease before the first recorded diagnosis of T1D. Of the remaining 42,543 individuals with T1D, 954 (2.2%) had a diagnosis of CD before 31 December 2009. From the remaining 41,589 individuals with T1D without a record of CD, we selected 4,579 matched reference individuals (five reference individuals per CD-T1D case).

In summary, this paper was based on 954 individuals with T1D and CD and 4,579 reference individuals with T1D only.

Statistical analyses We used Cox regression with CD modelled as a time-dependent variable to estimate the risk of chronic renal disease in patients with T1D and coexisting CD compared with patients with T1D only. Follow-up time began on the date of the first T1D diagnosis and ended with a diagnosis of chronic renal disease, ESRD, death, emigration
or the end of the study period (31 December 2009), whichever occurred first. Data in the Cox model were internally stratified for sex, age and calendar period at T1D diagnosis, to reduce the influence of the matching variables on the risk of renal disease.

We evaluated chronic renal disease in pre-defined subgroups according to sex, calendar year during which T1D was diagnosed (1964–1975, 1976–1987, 1988–1999 and 2000–2009) and age at T1D diagnosis (0–9, 10–19 and 20–30 years). The age groups were chosen because the onset of puberty in Swedish children seldom occurs before the age of 10 [25]. Incidence rates were calculated by dividing the number of incident events (diagnoses of chronic renal disease) with person-years at risk. We also tested the interaction between CD and sex, age, and calendar period with regards to the risk of chronic renal disease.

All subgroup analyses were divided into two time strata, <10 years since CD diagnosis and ≥10 years since CD diagnosis, because the proportional hazards assumption was not fulfilled in this model. Because the prevalence of CD [26] and T1D [27] can vary in different countries, this was considered by adjusting for country of birth in separate analyses.

**Sensitivity analyses** To increase the specificity of T1D we performed sensitivity analyses in three steps. First, we excluded individuals with a record of having received oral glucose-lowering medication as listed in the Prescribed Drug Register according to relevant Anatomical Therapeutic Chemical Classification System (ATC) codes (A10B and A10X). This was to avoid including patients who may have had type 2 diabetes despite being assigned an ICD code consistent with insulin-dependent diabetes (E10). Second, we excluded women who received their T1D diagnosis during pregnancy (0–9 months before delivery) to reduce the possibility of including women with gestational diabetes rather than T1D. Data on pregnancy were retrieved through linkage with the Swedish Medical Birth Registry. Finally, in a third sensitivity analysis we only included individuals with an inpatient diagnosis of T1D (n=5,360, 96.9%).

**Post hoc analysis** In a post hoc analysis we examined the distribution of clinical diagnoses registered in patients with chronic renal disease according to ICD codes in the Patient Register. In addition, we estimated the risk of the most frequently registered diagnosis, ‘T1D with renal complications’, in patients with T1D + CD as compared with patients with T1D only according to CD duration (< or ≥10 years). This analysis was adjusted for sex, age at T1D diagnosis and calendar period.

Further, we also examined the cumulative proportion of individuals with chronic renal disease according to their CD status, where the exposed group consisted of T1D individuals who at some stage of life had a diagnosis of CD. Results were plotted as a Kaplan–Meier curve.

A post hoc analysis showed that we had 80% power (significance level 0.05) to detect a 66% increased risk (HR 1.66) of chronic renal disease in T1D + CD patients compared with T1D only patients.

**Ethics** This project (2011/841-31/3) was approved on 15 June 2011 by the Ethics Review board, Stockholm, Sweden.

**Results**

**Population characteristics** The median age attained at chronic renal disease was 21 years (range 6–29 years) in patients with both T1D and CD and 20 years (range 3–30 years) in patients with T1D only. We identified 41 (4.3%) events of chronic renal disease in patients with T1D and CD during follow-up (of which 29 occurred after CD diagnosis) and 143 (3.1%) in patients with T1D only (Table 1). Of the individuals with both CD and T1D, 18% (172/954) had a diagnosis of CD preceding the T1D diagnosis.

**Overall risk of renal disease** The absolute risk of chronic renal disease in the T1D + CD population was 343/100,000 person-years and that for ESRD was 23/100,000 person-years. CD may be a risk factor for chronic renal disease (HR 1.43, 95% CI 0.94, 2.17) as well as for ESRD (HR 2.54, 95% CI, 0.45, 14.2) in T1D.

Also a post hoc Kaplan–Meier curve found a higher risk of chronic renal disease in T1D individuals who at some stage had a diagnosis of CD (ESM Fig. 1).

**Risk of renal disease in relation to CD duration** There was an increased risk of chronic renal disease in patients with T1D who had CD of ≥10 years duration (HR 2.03, 95% CI 1.08, 3.79) (Table 2). In addition, CD may influence the risk for ESRD (HR 3.18, 95% CI 0.68, 14.9) in T1D in the first 10 years after CD diagnosis. Due to the small number of events we were unable to calculate the risk for ESRD in patients with T1D who had CD for ≥10 years.

**Subgroup analyses** In age-, sex- and calendar-period-specific strata we assessed the risk of chronic renal disease in patients with T1D and CD (Table 2). In a formal interaction analysis, we found no interaction between CD and age, sex, calendar period of T1D diagnosis or the risk of chronic renal disease in T1D (see ESM text).

Adjustment for country of birth did not change the risk estimates (data not shown).

**Sensitivity analyses** The risk estimates for chronic renal disease did not change more than marginally after excluding individuals with a record of oral glucose-lowering medication.
or having potential gestational diabetes (T1D diagnosis 0–9 months before delivery) or by restricting the study participants to those with an inpatient diagnosis of T1D (Table 3).

Post hoc analysis The most common clinical diagnosis registered in patients with chronic renal disease was ‘T1D with renal complications’, in both patients with T1D + CD and T1D only (Table 4). CD may be associated with an increased risk of ‘T1D with renal complications’ in the first 10 years following CD diagnosis (HR 1.41, 95% CI 0.85, 2.35). The risk of ‘T1D with renal complications’ was higher in T1D patients with CD duration ≥10 years (HR 2.09, 95% CI 1.08, 4.03).

Discussion

In this population-based cohort study we found that CD may be associated with an excess risk of chronic renal disease and ESRD in patients with T1D, as compared with patients with T1D and no CD diagnosis. However, the association with chronic renal disease was only statistically significant in individuals with CD for more than 10 years.

A major strength of this study is its large number of subjects in conjunction with the independent identification of cases through national healthcare registers. The Swedish National Patient Register has been thoroughly validated and the majority of diagnoses have a high positive predictive value (85–95%) [18]. The sensitivity of T1D is expected to be 100% because hospital admission is almost mandatory at T1D diagnosis in younger individuals, and it has been reported that the negative predictive value of diabetes is 100% in patients admitted to hospital (872/872) [28]. Other strengths in this study include the sensitivity analyses using data on pregnancy and glucose-lowering medication, thereby further increasing the specificity for the T1D diagnosis.

Defining CD based on nationwide biopsy reports with Marsh stage 3, obtained from all pathology departments in Sweden, is another strength of this study, since 96% of Swedish paediatric gastroenterologists performed a biopsy in at least 9/10 patients with suspected CD during the study period [24]. In addition, our validation study showed that 95% of patients with VA had CD and that, in patients with available CD serology, 88% had positive serology before biopsy; this percentage is similar to that in coeliac patient cohorts from other countries [29]. VA may be explained by diagnoses other than CD (e.g. giardiasis, Helicobacter pylori infection, inflammatory bowel disease) but according to our validation study diagnoses other than CD rarely explain VA [24], with only 0.3% of patients with VA having inflammatory bowel disease, which was the most

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>T1D and CD</th>
<th>T1D</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>954</td>
<td>4,579</td>
</tr>
<tr>
<td>Age at T1D diagnosis, years, median (range)</td>
<td>9 (0–30)</td>
<td>9 (0–30)</td>
</tr>
<tr>
<td>Age at T1D diagnosis</td>
<td>565 (59.2)</td>
<td>2,650 (57.9)</td>
</tr>
<tr>
<td>0–9 years</td>
<td>261 (27.4)</td>
<td>1,290 (28.2)</td>
</tr>
<tr>
<td>10–19 years</td>
<td>128 (13.4)</td>
<td>639 (14.0)</td>
</tr>
<tr>
<td>20–30 years</td>
<td>21 (4–71)</td>
<td>22 (2–71)</td>
</tr>
<tr>
<td>Entry year (median range)a</td>
<td>12 (0–46)</td>
<td>12 (0–46)</td>
</tr>
<tr>
<td>Follow-up, years, median (range)b</td>
<td>12 (1–63)</td>
<td>No data</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>526 (55.1)</td>
<td>2,495 (54.5)</td>
</tr>
<tr>
<td>Male</td>
<td>428 (44.9)</td>
<td>2,084 (45.5)</td>
</tr>
<tr>
<td>Calendar periodc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1964–1975</td>
<td>100 (10.5)</td>
<td>471 (10.3)</td>
</tr>
<tr>
<td>1976–1987</td>
<td>151 (15.8)</td>
<td>738 (16.1)</td>
</tr>
<tr>
<td>1988–1999</td>
<td>344 (36.1)</td>
<td>1,604 (35.0)</td>
</tr>
<tr>
<td>2000–2009</td>
<td>359 (37.6)</td>
<td>1,766 (38.6)</td>
</tr>
<tr>
<td>Nordic country of birth</td>
<td>946 (99.2)</td>
<td>4,444 (97.4)</td>
</tr>
<tr>
<td>Gestational diabetes</td>
<td>15 (1.6)</td>
<td>93 (2.0)</td>
</tr>
<tr>
<td>Oral glucose-lowering medication</td>
<td>19 (2.0)</td>
<td>139 (3.0)</td>
</tr>
<tr>
<td>Ever chronic renal disease</td>
<td>41 (4.3)d</td>
<td>143 (3.1)</td>
</tr>
</tbody>
</table>
A common differential diagnosis in VA in our dataset [24]. Obviously, the prevalence of other diagnoses explaining VA may be different in other parts of the world.

The large number of subjects allowed for important stratified analyses and sensitivity analyses. We identified an increased risk of chronic renal disease in patients with T1D and CD ≥10 years. Testing for interaction revealed no difference in chronic renal disease risk in relation to sex. Additional interaction testing found no difference in chronic renal disease risk according to age or calendar period. Unfortunately, we were unable to estimate HRs in some subgroup analyses (age 20–30 years and first/last calendar period ≥10 years) due to few observed events.

A few limitations should be considered. First of all, we had limited power to detect excess risks for renal disease. Despite the inclusion of more than 900 individuals with both CD and T1D, a post hoc analysis showed that we had 80% power to detect a 1.66-fold increased risk of chronic renal disease. The main HR in this study (HR 1.43) did not reach that level and was therefore not statistically significant. Future studies should aim at longer follow-up of patients, and preferably identify an older population of CD + T1D patients where chronic renal failure may be more prevalent.

We lacked individual data on HbA1c levels, insulin therapy, BMI, albuminuria, glomerular filtration rate and gluten-free diet (GFD). In earlier screening studies the prevalence of CD

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**Table 2** Subgroup analyses of CD in patients with T1D and risk of chronic renal disease

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>0–9 years after CD diagnosis</th>
<th>≥10 years after CD diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed events (n)</td>
<td>HR (95% CI adjusted)</td>
</tr>
<tr>
<td>Overall</td>
<td>18</td>
<td>1.31 (0.80, 2.14)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>7</td>
<td>1.27 (0.58, 2.79)</td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>1.37 (0.73, 2.57)</td>
</tr>
<tr>
<td>Age at T1D diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–9 years</td>
<td>9</td>
<td>0.88 (0.44, 1.74)</td>
</tr>
<tr>
<td>10–19 years</td>
<td>9</td>
<td>2.88 (1.37, 6.06)</td>
</tr>
<tr>
<td>Calendar periodb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1964–1975</td>
<td>2</td>
<td>3.83 (0.87, 16.8)</td>
</tr>
<tr>
<td>1976–1987</td>
<td>7</td>
<td>1.37 (0.63, 2.99)</td>
</tr>
<tr>
<td>1988–1999</td>
<td>6</td>
<td>1.02 (0.44, 2.39)</td>
</tr>
<tr>
<td>2000–2009</td>
<td>3</td>
<td>1.24 (0.36, 4.28)</td>
</tr>
</tbody>
</table>

**a** No individual with T1D diagnosed between 20 and 30 years of age had a later diagnosis of chronic renal disease, hence no risk estimates were calculated for this age group

**b** Calendar year during which T1D was diagnosed

**c** Not calculated; because few events occurred in these categories, we were unable to calculate HRs

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**Table 3** Sensitivity analyses of the risk of chronic renal disease in patients with T1D and CD

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>CD duration &lt;10 years</th>
<th>CD duration ≥10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>First T1D diagnosis not during pregnancy</td>
<td>1.30 (0.80, 2.13)</td>
<td>2.01 (1.07, 3.75)</td>
</tr>
<tr>
<td>No oral glucose-lowering medication</td>
<td>1.28 (0.77, 2.12)</td>
<td>1.69 (0.85, 3.36)</td>
</tr>
<tr>
<td>Inpatients with T1D</td>
<td>1.32 (0.81, 2.16)</td>
<td>2.04 (1.09, 3.81)</td>
</tr>
</tbody>
</table>

Data are presented as HR (95% CI)

All sensitivity analyses are adjusted for sex, age at diagnosis of T1D and calendar period

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**Table 4** Distribution of clinical diagnoses according to ICD codes among patients with chronic renal disease

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>T1D and CD</th>
<th>T1D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>41</td>
<td>143</td>
</tr>
<tr>
<td>T1D with renal complications</td>
<td>39 (95)</td>
<td>126 (88.1)</td>
</tr>
<tr>
<td>T1D with glomerular disease</td>
<td>1 (2)</td>
<td>8 (5.6)</td>
</tr>
<tr>
<td>Renal failure</td>
<td>1 (2)</td>
<td>5 (3.5)</td>
</tr>
<tr>
<td>Renal dialysis</td>
<td>0</td>
<td>3 (2.1)</td>
</tr>
<tr>
<td>Renal transplantation</td>
<td>0</td>
<td>1 (1.4)</td>
</tr>
</tbody>
</table>

Data are presented as n (%)
in T1D has been reported as 3–12% [1, 2]. In Sweden, patients
with T1D are routinely screened for CD; however, this may
not have been the case during the early period of this study so
we cannot rule out the possibility that reference individuals
(T1D only) may have coexisting CD in the current study. However, this type of misclassification should not affect our
results more than marginally, because T1D patients with un-
diagnosed CD are unlikely to make up more than a small
percentage of the control population [30].

In this nationwide cohort study we found a non-significant
positive association between CD and chronic renal disease
and ESRD in patients with T1D. However, the increased HR
after more than 10 years of CD suggests that there may be a
dose–response relationship where longstanding CD could
have a detrimental effect on T1D complications. Previous
studies regarding diabetic complications in patients with
T1D and CD as compared with T1D-only patients are limited
by small study samples and report conflicting results [13, 14,
16, 31]. Some studies report that either CD itself or a GFD
might have a renoprotective effect [16, 31]. However, the
exact role that CD and GFD play in metabolic control in
patients with T1D is still not known [32, 33].

We can only speculate about the reason for the increased
risk of severe renal disease: difficulty in keeping to a strict
GFD as well as a diet recommended for patients with diabetes,
together with the demands of managing T1D therapy over
time are among the potential explanations [34, 35]. However,
it cannot be ruled out that T1D patients with poor metabolic
control are more likely to be screened for CD (and their CD
then diagnosed) and later develop chronic renal disease due to
underlying poor metabolic control. Nevertheless, considering
that CD per se is associated with an almost threefold increased
risk of ESRD [6], we find it plausible that CD has contributed
to the increased risk of renal disease in T1D patients in the
current study.

Even if symptoms decrease after the initiation of a GFD in
CD, intestinal inflammation may persist despite adherence to
a strict GFD [36, 37]. This could explain an increased risk of
complications in T1D with long duration of CD. Earlier
studies have reported an association between diabetic nephropathy and low-grade inflammation [38, 39].

This study, through its design, is however limited in
explaining the underlying mechanisms of an increased risk
for chronic renal disease in T1D + CD patients. The increased
risk of chronic renal disease might be due to subjects being
first included in the study during the early period, when the
management and diagnosis of chronic renal disease might
have been different from what it is today or during the
1990s. Another limitation is that we did not consider competing
risks when estimating our HRs. Although we studied a
young population where mortality is limited, we cannot rule
out that the lack of competing risk analysis has influenced our
HRs.

The diagnosis of chronic renal disease entered in the Pa-
tient Register is heterogeneous. For this reason we performed
a post hoc analysis to examine the distribution of clinical
diagnoses underlying a diagnosis of chronic renal disease in
the Patient Register (Table 4). The majority of patients with
T1D, either with or without concomitant CD, had renal dis-
ease related to their T1D diagnosis, referred to as ‘T1D with
renal complications’. In T1D patients with longstanding CD
(≥10 years) the HR for ‘T1D with renal complications’ was
doubled (HR 2.09) compared with that in patients with T1D
only.

The lack of other clinical data supporting the diagnosis of
chronic renal disease is a weakness in this study.

Due to the small number of events of ESRD in this study
population we were unable to calculate HRs for ESRD in
patients with T1D and longstanding CD (≥10 years), although
we found a non-statistically significant increased risk of
ESRD in patients with T1D and CD <10 years. The reasons
for there being few events of ESRD could be the short follow-
up time and the fact that study participants were rather young.
The median age at ESRD diagnosis was 41 years both in
patients with CD and in reference individuals (general popu-
lation without CD) in our previous study [6].

In conclusion, this study found no excess risk of chronic
renal disease in patients with T1D and CD, but in a
subanalysis we noted a positive association between
longstanding CD and chronic renal disease in T1D.

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the Swedish Coeliac Society (JFL).

Duality of interest The authors declare that there is no duality of
interest associated with this manuscript.

Contribution statement All authors made substantial contributions to
the study’s conception and design, acquisition of data and analysis and
interpretation of data. All authors were involved in drafting the article and
revising it critically for important intellectual content and gave final
approval of the version to be published. KM and JFL are responsible
for the integrity of the work as a whole.

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