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Destination specific risks of acquisition of notifiable food- and waterborne infections or sexually transmitted infections among Finnish international travellers, 1995–2015

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ABSTRACT

Background: Overnight international travels made by Finns more than doubled during 1995–2015. To estimate risks and observe trends of travel-related notifiable sexually transmitted and food- and water-borne infections (STIs and FWIs) among travellers, we analysed national reports of gonorrhoea, syphilis, hepatitis A, shigellosis, campylobacteriosis and salmonellosis cases and related them to travel statistics.

Method: Cases notified as travel-related to the Finnish infectious diseases register were used as numerators and overnight stays of Statistics Finland surveys as denominator. We calculated overall risks (per 100,000 travellers) and assessed trends (using regression model) in various geographic regions.

Results: Of all travel-related cases during 1995–2015, 2304 were STIs and 70,929 FWIs. During 2012–2015, Asia-Oceania showed highest risk estimates for gonorrhoea (11.0; 95%CI, 9.5–13), syphilis (1.4; 0.93–2.1), salmonellosis (157; 151–164), and campylobacteriosis (135; 129–141), and Africa for hepatitis A (4.5; 2.5–7.9), and shigellosis (35; 28–43). When evaluating at country level, the highest risks of infections was found in Thailand, except for hepatitis A ranking Hungary the first. During 2000–2011, significantly decreasing trends occurred for most FWIs particularly in the European regions and for STIs in Russia-Baltics.

Conclusions: Our findings can be used in targeting pre-travel advice, which should also cover those visiting Thailand or European hepatitis A risk areas.

1. Introduction

International travel has constantly increased during the last six decades. Arrivals doubled globally during 1995–2014 from 500 million to 1.1 billion, and the trend is set to continue [1]. Recent studies of Finnish travellers abroad have shown that infections outnumber all other health problems [2,3]. Two types of infections are frequent hallmarks of foreign travel: gastro-intestinal infections (traveller's diarrhoea), which represent the most common health problems travellers encounter [3] and sexually-transmitted infections as they easily spread further and may have severe consequences [4,5].

Few studies have described travel-associated faecal-orally transmitted infections in the North-Western European region [6–10]. In Finland, prospective studies with volunteers have focused on travellers' diarrhoea [11], or health problems in general [3], while nation-wide studies have been based on data from an assistance organization, which has been combined with travel statistics [2,12]. Investigations using retrospective study design or conducted on those seeking post-travel medical care are scarce.

To the best of our knowledge, the National Infectious Diseases Register (NIDR) data have only twice been combined with nation-wide travel statistics in scientific publications [13,14], however, Finland represents one of the few countries collecting and publishing their data on annual number of travellers to various destinations [2]. Such an approach allows us to estimate risks of acquiring travel-related infections.

Abbreviations: AR, crude attack rate; FWI, food- and water-borne infection; NIDR, National Infectious Diseases Register; STI, sexually transmitted infection; THL, Finnish National Institute for Health and Welfare

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Table 1
Main characteristics of notifiable travel-related infections. International travellers. Finland, 1995–2015.

Infection	Total number of cases	Number of TRC (% of total)	Average annual number of TRC	Median age of TRC (range)	Sex distribution of TRC (% male)	Finnish-born among TRC (%)
STIs	**8824**	**2304 (26)**				
gonorrhoea	5162	1723 (33)	82	35 (15–76)	88	84
syphilis[a]	3662	581 (16)	28	44 (19–78)	96	100
FWIs	**134,361**	**70,929 (53)**				
hepatitis A	1699	414 (24)	20	34 (0–80)	55	78
shigellosis	2244	1948 (87)	93	37 (0–79)	39	90
typhoid fever	98	90 (92)	4	26 (0–73)	52	56
paratyphoid fever	143	125 (87)	6	28 (1–73)	46	90
Salmonella gastroenteritis[b]	53,115	39,983 (75)	1904	38 (1–87)	55	95
campylobacteriosis	77,062	28,369 (37)	1351	37 (0–91)	51	86

TRC = travel-related cases.
STIs = sexually transmitted infections.
FWIs = food- and waterborne infections.
[a] For syphilis only Finnish-born travel-related cases were included since chronic infections cannot be distinguished from acute infections.
[b] Caused by non-typhoid Salmonellae, i.e. other *Salmonella* subspecies and serovars than *S. enterica* subsp. *enterica* ser. Typhi/Paratyphi.

We performed a retrospective record-based review and analysis of travel-acquired notifiable infections among Finnish travellers with the aim to define risk areas and help to target pre-travel advice.

2. Methods

2.1. Travel-related cases

We selected infections that are frequently associated with international travel and typically transmitted either via sexual transmission route (referred here as sexually transmitted infections – STIs; gonorrhoea and syphilis) or faecal-oral route (referred here as food- and water-borne infections – FWIs; hepatitis A, shigellosis, *Salmonella* gastroenteritis, typhoid fever, paratyphoid fever, and campylobacteriosis). Data were extracted from the NIDR during the defined time period (from 1 January 1995 to 31 December 2015). All these infections are notifiable in Finland according to the Communicable Disease Act and Decree, and the NIDR is maintained by the National Institute for Health and Welfare (THL). *Campylobacter* and non-typhoid Salmonellae infections are laboratory-notifiable only, while the other infections are also notified by the physician. The notification system is based on the unique personal identification number. Laboratory notification includes basic demographics and limited travel information; whereas the physician's notification contains further information about country of infection, date of onset of symptoms, and other relevant epidemiological data.

Total number of cases, number and percentage of travel-related cases, average annual number, median age with range, sex distribution and percentage of Finnish-born travel-related cases were defined for each infection. For syphilis, only Finnish-born travel-related cases were included in further analyses, since chronic infections could not be distinguished from acute infections. *Salmonella* infections were divided in three groups (a) *Salmonella enterica* subsp. *enterica* serovar Typhi (*S.* Typhi), or (b) *Salmonella enterica* subsp. *enterica* serovar Paratyphi (*S.* Paratyphi A, B, C), or (c) all the other *Salmonella* subspecies and serovars (non-typhoid Salmonellae).

2.2. Travel data

Travel statistics, collected by Statistics Finland, were extracted from the pre-existing online Statistics Finland database. The initial data was based on telephone interviews and extrapolated to the Finnish population with the appropriate weights [15]. Travel statistics included the number of travellers by selected countries and geographical regions from 2000 and onwards (destination-specific data only for countries receiving more than 10,000 Finnish travellers per year during 2000–2011, and more than 50,000 per year during 2012–2015).

Travel data from 2012 and onwards were not fully comparable with those of earlier years due to the revised data collection method that came into force in 2012 (the upper age limit was extended from 74 to 84 years). Therefore, the overall time series broke and data had to be analysed separately.

2.3. Risk calculations

Travel statistics were used as denominator when estimating the risks. Crude attack rates (ARs) per 100,000 travellers with 95% confidence intervals (CIs) were calculated by dividing the number of notified travel-associated cases by the estimated total number of travellers to a specific country or region. ARs were only calculated for countries with complete travel data for entire time period. We calculated overall risks during 2012–2015 and trends in risks during 2000–2011. We used binomial regression with log-link for 2000–2011, when yearly statistics were comparable.

Data analysis was performed by Microsoft Office Excel and STATA 14 (StataCorp, College Station, TX).

3. Results

3.1. Descriptive analysis

During the 21-year period, 2304 STIs and 70,929 FWIs were notified as travel-related (26% and 53% of the total, respectively) (Table 1). For the various infections, the total numbers of travel-related cases ranged between 414 (hepatitis A) and 40,198 (salmonellosis together). The lowest proportion (16%) of travel-related cases was scored for syphilis and the highest (92%) for typhoid fever. The proportions of travel-related cases were stable during the whole period for gonorrhoea, syphilis, shigellosis and salmonellosis together. The proportion increased from 2000 to 2004 to 2010–2015 for hepatitis A and campylobacteriosis. The predominance of males was most prominent in STIs. The median age was lowest among typhoid fever and paratyphoid fever cases (26 and 28 years of age, respectively) and highest among travellers who contracted syphilis (44 years of age). Overall, 91% of the cases were born in Finland; in typhoid fever the predominance of Finnish-born cases was less prominent (56%) (Table 1).

The highest case numbers were notified among travellers returning from Egypt (shigellosis), India (typhoid fever), Turkey (paratyphoid fever), Thailand (*Salmonella* gastroenteritis, gonorrhoea, and campylobacteriosis) and Russia (syphilis, hepatitis A). During the 21-year period, 56% of all FWIs cases we studied were notified with *Salmonella* gastroenteritis, followed by campylobacteriosis (40%). The 22% and

Table 2
Distribution of travel-related cases of *Salmonella* gastroenteritis[a] and shigellosis by subspecies/serovar (*S.* gastroenteritis) or serogroup (shigellosis). International travellers. Finland, 1995–2015.

	Number of travel-related cases	Proportion (%)
***Salmonella* gastroenteritis**[a]	39,983	100
S. Enteritidis	16,559	41
S. Typhimurium	2510	6
S. group B (O:4)	1720	4
other	18,482	46
not available	712	2
Shigellosis	1984	100
Shigella sonnei	1313	66
Shigella flexneri	428	22
Shigella boydii	94	5
Shigella disenteriae	60	3
not available	53	3

[a] Caused by non-typhoid Salmonellae, i.e. other *Salmonella* subspecies and serovars than *S. enterica* subsp. *enterica* ser. Typhi/Paratyphi.

17% of them respectively, were returnees from Thailand. India accounted for 50% of typhoid fever and 26% of paratyphoid fever cases. During the 21-year period, 17% of the travel-related hepatitis A cases in the NIDR were notified with travel history to Russia.

For shigellosis, data on serogroup was available for 97% of the travel-related cases (Table 2). The serogroup distribution of isolates was stable over time. Regarding *Salmonella* gastroenteritis cases, data on subspecies and/or serovar was available for 98% of the travel-related cases. For *S.* Enteritidis, Spain was the most frequent country of infection, whereas for *S.* Typhimurium and *S.* group B (O:4), Thailand. Among these serovars, the case number declined with time for *S.* Enteritidis and *S.* Typhimurium and increased for *S.* group B (O:4).

3.2. Trend analysis for 2000–2011

Our analysis showed an increasing (but not significant) trend in risk of campylobacteriosis in all regions, except Africa where the risk peaked in 2005 (data not shown). In other FWIs the trend was mainly declining during the period (Fig. 1).

We found a significant declining trend for STIs among travellers to Russia and the Baltic countries. The risks for STIs remained stable in Asia and Oceania, increased non-significantly in Western Europe, or fluctuated without a clear trend in other European regions (data not shown).

3.3. Overall risks for 2012–2015

During 2012–2015, the overall attack rate was highest for campylobacteriosis (26 per 100,000 travellers) followed by *Salmonella* gastroenteritis (17 per 100,000 travellers), and lowest for typhoid fever and paratyphoid fever (0.050 per 100,000 travellers, each) (Fig. 2).

Among the regions defined by Statistics Finland, Asia and Oceania accounted for the highest overall risk for the STIs, salmonellosis, and campylobacteriosis, while Africa for hepatitis A, and shigellosis (Table 3). At country-level, the highest risk mainly occurred among travellers returning from Thailand. For hepatitis A, Hungary accounted for the highest overall risk during 2012–2015 (Table 4).

Regarding Finnish travellers' risks of being notified with syphilis or gonorrhoea after returning from European countries (including Russia), decreased from 0.78 per 100,000 in 2012 to 0.76 in 2015. The only European country with increasing risks during 2012–2015 was Spain, where risk of gonorrhoea increased from 0.45 to 1.9 per 100,000 travellers, and risk of syphilis changed from 0.30 to 1.2 per 100,000 travellers. The highest overall risk of gonorrhoea among Finnish returnees from Europe during 2012–2015 occurred for Poland, although it was declining from 1.7 to 0.77 per 100,000 travellers, and no syphilis cases were notified with Polish travel history during the period.

4. Discussion

During the last two decades, substantial amount of studies were published on travellers morbidity, and possible risk factors of contracting diseases abroad. However, lacking the data on population at risk and time at risk, networks such as GeoSentinel are unable to provide destination-specific risks or incidence rates, and can calculate only the proportionate morbidity. In our study, we were able to use a travel denominator, therefore destination-specific risks have been provided.

With the exception of campylobacteriosis, we found a decreasing trend for all the studied notifiable infections. In the country-specific analysis, Thailand accounted for the highest overall ARs among countries, except hepatitis A, where travel to Hungary was associated with the highest risk. Among the regions, Asia and Oceania, and Africa were found to show the highest risks. The NIDR and travel data are not available for most countries and, accordingly, investigations combining such nation-wide data for computing risks for different notifiable infections are scarce.

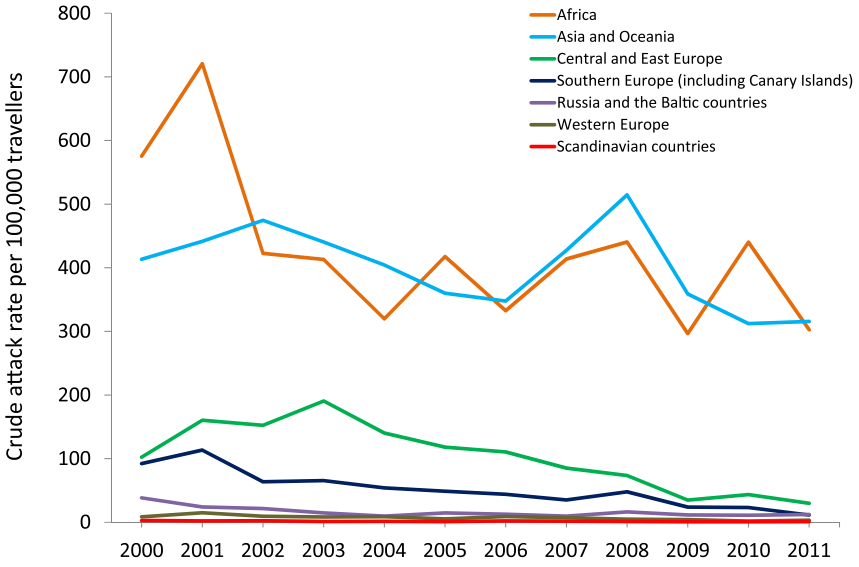

Fig. 1. Significant trends in region-specific attack rates in notifiable food- and waterborne infections. International travellers. Finland, 2000–2011.

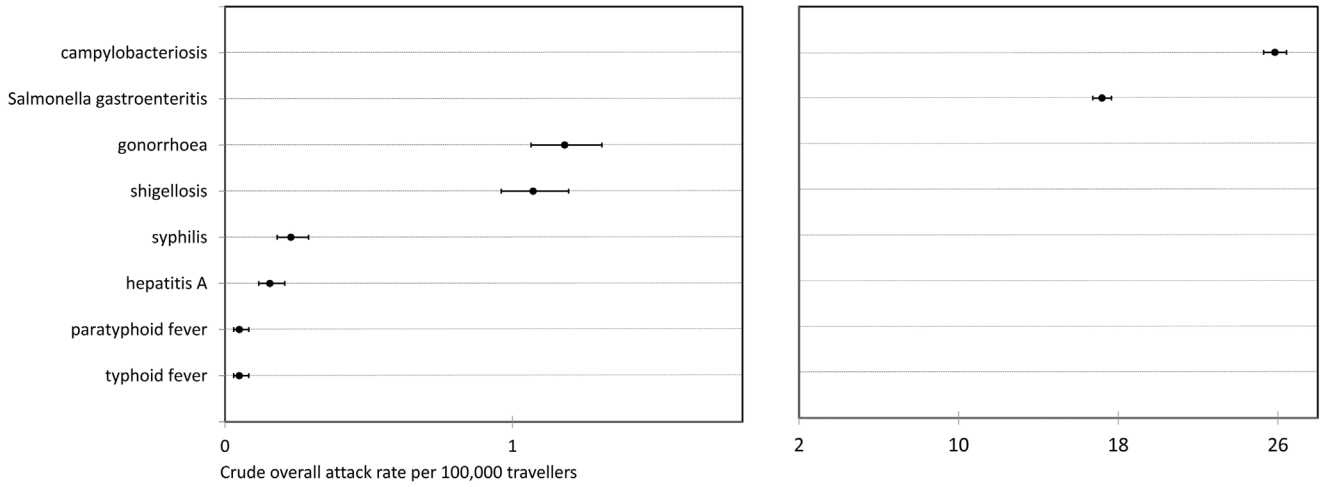

Fig. 2. Overall crude attack rates of infections per 100,000 persons. International travellers. Finland, 2012–2015.
Salmonella gastroenteritis: infections caused by non-typhoid Salmonellae, i.e. other *Salmonella* subspecies and serovars than *S. enterica* subsp. *enterica* ser. Typhi/Paratyphi.
Due to the lack of travel data (denominator) for Africa in 2015, cases with travel history to Africa in that year were excluded from the overall crude attack rates calculations.

Table 3
Overall crude attack rates and the 95% confidence intervals (CI) by regions. International travellers. Finland, 2012–2015.

Infection	Statistics Finland regions						
	Africa[a]	America	Asia and Oceania	Nordic countries[b]	Russia and the Baltic countries	Southern Europe and East Mediterranean countries	Western and Eastern Europe
Sexually transmitted infections							
gonorrhoea	6.7 (4.2–11)	1.5 (0.94–2.5)	11 (9.5–13)	0.24 (0.14–0.41)	0.40 (0.28–0.56)	0.77 (0.58–1.0)	0.77 (0.59–1.0)
syphilis	0	0.58 (0.26–1.28)	1.4 (0.93–2.1)	0.037 (0.0092–0.15)	0.14 (0.082–0.25)	0.24 (0.15–0.39)	0.16 (0.090–0.29)
Food- and waterborne infections							
hepatitis A	4.5 (2.5–7.9)	0	0.96 (0.58–1.6)	0.018 (0.0026–0.13)	0.084 (0.040–0.18)	0.14 (0.070–0.26)	0.044 (0.014–0.14)
shigellosis	35 (28–43)	2.9 (2.0–4.1)	9.6 (8.2–11)	0	0.060 (0.025–0.14)	0.44 (0.30–0.63)	0.22 (0.13–0.37)
salmonellosis	178 (163–195)	17 (14–19)	157 (151–164)	0.48 (0.33–0.71)	4.3 (3.8–4.7)	21 (20–22)	4.0 (3.5–4.5)
campylobacteriosis	99 (88–112)	15 (13–18)	135 (129–141)	2.3 (2.0–2.8)	4.9 (4.5–5.4)	49 (47–50)	22 (21–23)

[a] For Africa ARs were calculated only for the period 2012–2014, since travel denominator was not available in 2015.
[b] Except Finland.

Table 4
Overall crude attack rates and the 95% confidence intervals (CI) in the most common travel destinations. International travellers. Finland, 2012–2015.

Infections	Top three countries with highest overall risks (95% CI)		
	First	Second	Third
Sexually transmitted infections			
gonorrhoea	Thailand, 21.3 (17.8–25.6)	Turkey, 1.4 (0.79–2.5)	Poland, 1.2 (0.52–3.0)
syphilis	Thailand, 3.1 (1.9–5.0)	Russia, 0.84 (0.44–1.6)	Spain, 0.43 (0.24–0.77)
Food- and waterborne infections			
hepatitis A	Hungary, 0.38 (0.10–1.5)	Czech Republic, 0.35 (0.05–2.5) and Turkey, 0.35 (0.11–1.1)	Russia, 0.29 (0.11–0.77)
shigellosis	Thailand, 2.6 (1.5–4.3)	Turkey, 1.9 (1.1–3.0)	USA, 0.73 (0.31–1.8)
salmonellosis	Thailand, 302.8 (288.5–317.7)	Turkey, 90.4 (84.3–97.0)	Latvia, 26.4 (21.2–32.8)
campylobacteriosis	Thailand, 225.6 (213.3–238.5)	Hungary, 120.1 (108.9–132.4)	Turkey, 119.0 (111.9–126.5)

Countries with continuous unique travel data during 2012–2015: Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, USA.

4.1. FWIs findings

Gastro-intestinal infections constitute the vast majority (approximately 80%) of all reported notifiable travel-related diseases as it was showed among Norwegian holiday travellers and Swedish international travellers [10,16]. In a study on cases of campylobacteriosis, salmonellosis, giardiasis and shigellosis notified between 2009 and 2010 to the Norwegian NIDR, 91% of all cases with gastrointestinal infections had information on place of infection, and of those 65% were notified as acquired abroad [8]. In our analysis, the overall proportion of travel-related campylobacteriosis, *Salmonella* gastroenteritis, and shigellosis cases was over the half of the total cases notified with the studied infections. In Norway and Sweden, campylobacteriosis was found to be the most frequent travel-related infection, followed by salmonellosis, giardiasis and shigellosis [8,16].

Regarding the risk of *Salmonella* gastroenteritis, we found an increasing trend among travellers returning from Thailand during 2000–2008, which coincided with a previous Finnish study [14].

However, we also detected a decreasing trend during 2009–2011, which continued during 2012–2015. Similarly, among returnees from Thailand with campylobacteriosis, the risk constantly increased during 2000–2011, then declined during 2012–2015.

For shigellosis, both the number of cases during the 21-year period, and the risk during 2000–2011 were highest among returnees from Egypt. Additionally, we found an increasing risk among travellers returning from Thailand during 2013–2015. Our results on shigellosis serogroups showed the same picture as the few previous studies reporting travel-related shigellosis [17,18]; both the relative importance and the distribution of serogroups were in line with those figures.

In our analysis, Africa accounted for the highest overall risk for hepatitis A during 2012–2015. Among Swedish international travellers, Africa, and especially East Africa was associated with the highest hepatitis A incidence rate [6,16]. The attack rate of hepatitis A among Dutch travellers was calculated for the period 2003–2011 and found to be the highest for returnees from Morocco followed by India and Brazil [7]. The lack of country-level travel data for Africa during 2012–2015 did not allow us to calculate country-specific risks, however, a considerable amount (one out of three) of travel-related cases were notified with travel history to an African country. During the 21-year period, the highest number of the travel-related hepatitis A cases was notified with travel history to Russia, where we found a constantly declining trend in risk during 2000–2011. At country level, the risk of hepatitis A during 2012–2015 was highest among travellers returning from Hungary, the Czech Republic, and Turkey yet our AR calculations for that 4-year-long period were based on low case numbers. Vaccination status of the cases were not available, however; vaccination against hepatitis A for Finnish travellers to these countries is recommended in the in the national travel guidelines.

Due to the low case numbers, trends could not be evaluated at country-level for typhoid fever and paratyphoid fever. In addition, the denominator was not equally available for the most important countries, either because only low number of travellers (< 50.000 per year during 2012–2015) were received, or travel information was not complete for the entire period. Incomplete travel information also affected shigellosis, where we lacked the denominator and could therefore not calculate the risks for Egypt during 2012–2015. However, one out of three *Shigella* infections was contracted in Egypt during the period, suggesting a substantial risk for Egypt.

4.2. STIs findings

The overall STIs trend was declining or stable for all the regions during 2000–2011. During 2012–2015, the risk of contracting syphilis or gonorrhoea remained declining among travellers returning from Thailand, the country with highest risk. A recently published systematic review on trend studies in syphilis described an increasing trend of syphilis among men who have sex with men in the United States and Western Europe after 2000 [19]. Another literature review found a substantially higher incidence of syphilis in Eastern Europe than that observed in the EU-15 countries (member states of the European Union as of 31 December 2003) [20]. ECDC's annual epidemiological reports showed that during 2010–2015, the overall syphilis rates increased across Europe, particularly among men, and the overall rate of reported gonorrhoea infections more than doubled across Europe between 2008 and 2014. These data are somewhat contradictory to our findings; however they are not fully comparable. The highest risk of gonorrhoea among Finnish returnees from Europe during 2012–2015 was recorded for Poland, where it, however decreased from 2012 to 2015. The only European country recorded with increasing risk of acquisition of gonorrhoea or syphilis during 2012–2015 was Spain.

A Norwegian register-based study focused on STI cases with travel history to Thailand found that 5% of gonorrhoea cases and 3% of syphilis cases were connected to Thailand during 1993–1998 [21]. In Sweden, 34% of all the gonorrhoea cases had acquired the infection abroad during 2001–2008 [22]. During 2007–2011, 50% of the Swedish cases in the 35 years or older age groups were travel-related [23] and during 2009–2013, Thailand was found as the country with the highest incidence of sexually transmitted diseases [16]. Consistent with these studies, also in our data Thailand ranked the first in attack rates.

Although acute and chronic syphilis could not be differentiated from the NIDR data, we decided to include syphilis in our analysis, as the importance of travel-related infections has been documented in Finland [24]. We assumed, that country of infection is more inaccurate in foreign-born cases therefore we excluded all the foreign-born travel-related cases from the analysis. The majority of them were born in the same country in which their infections were reported to be acquired.

4.3. Why do trends in risks change?

The experienced decrease in FWIs might be related to better hygienic measures introduced in the destination, having proper pre-travel advice, or increased awareness of travellers. *Salmonella* gastroenteritis trend has declined possibly because of successful control campaigns in agriculture [25], especially poultry. The increase of group B can be explained by increase of multiresistant monophasic *S.* Typhimurium since 2012 (mostly from Thailand), and has also been detected in other countries [26]. Finnish pre-travel advice on treatment of travellers' diarrhoea has changed during the past decade: antibiotics are no longer recommended for mild or moderate diarrhoea and they are advised only if the patient has high fever or gross blood in stools or if the symptoms are exceptionally vigorous or the patient is in poor condition [27]. These changes were implemented because travellers' diarrhoea is mostly a spontaneously resolving disease and new data showed that its antibiotic treatment increases substantially the risk of contracting multi-drug resistant bacteria while travelling [28–30].

In our data, the majority of STI cases were males. We assume that they adopted, at a significant extent, risky sexual behaviours during their trip. The experienced decline in risk in STIs might be due to positive changes in epidemiology at the relevant destinations, and/or increasing awareness in appropriate preventive strategies (e.g. using condom). Since increase of incidences of syphilis and gonorrhoea have been observed in many countries, while in Finland remained stable in the last 5 years, it is also possible, that among travellers practicing more risky behaviours become less common, especially at destinations known to be attached with higher potential risk (e.g. Thailand, Russia).

Previously, appropriate preventive measures, like vaccination (hepatitis A), improved hygienic standards at travel destination (faecal-orally transmitted infections) and pre-travel health consultation (sexually transmitted infections) have been found to be effective [31,32].

By calculating risks, we considered the changes in travel, although we did not have the possibility to indicate tourism changes neither to evaluate preventive strategies.

4.4. Limitations

Besides the specific limitations mentioned above, a number of general limitations also deserve to be discussed. The information on country of infection was missing in a range of 1% (paratyphoid fever) and 53% (campylobacteriosis) of the reviewed notifications (syphilis 39%, hepatitis A 21%, gonorrhoea 20%, and shigellosis, typhoid fever, and non-typhoid Salmonellae infections each less than 10%). Consequently, a substantial number of cases could not be included in the country-specific analyses. Regarding the proportion of missing country data, all the studied infections are mandatory for physicians to notify in Finland, with the exception of campylobacteriosis, and non-typhoid Salmonellae infections, which are only laboratory notifiable. Differences in the flow of information can possibly explain the numbers of missing travel information between campylobacteriosis (53%) and

non-typhoid Salmonellae infections (< 10%): the reference laboratory at THL had requested this information retrospectively for non-typhoid Salmonellae infections if it had not been initially provided, while such approach had not been applied for campylobacteriosis, since the isolates are not routinely sent to THL.

It is noteworthy that this study does not describe the risk of infections in general but, instead, the risk of notifiable diseases for which travel information was available and thus leaves out the major causative agents of many diseases. An example of this is travellers' diarrhoea: it is most commonly caused by diarrheagenic *E. coli* [11,33] such as ETEC and EAEC, which far outnumber *Campylobacter* and *Salmonella* as causative agents, yet are not notifiable.

Furthermore, our data did not cover travellers who had sought medical care only abroad. In a recent study on Finnish travellers to (sub)tropical regions, 79% had health problems, 69% had travellers' diarrhoea and 10% consulted a doctor during travel [3]. Likewise, in a study using the database of SOS International, an assistance organization covering 95% of Finns requiring aid abroad, acute gastroenteritis was the most common diagnosis during 2010–2012 [12].

We were not able to identify immigrants or their children, who are often visiting friends and relatives in their country of origin, neither foreign tourists to Finland, since information on country of birth and nationality in the NIDR was limited. However, given the size of those groups versus the volume of returning travellers, we believe that our results would not be considerably different if we had been able to exclude those groups.

Travel details such as age distribution of travellers and exact duration of trips were not available and did thus not allow calculation of person-time at risk. Changes in travel statistics methodology limited our analysis and only allowed to perform the trend analysis during 2000–2011. Country-specific data could be given only for countries which had high enough traveller counts to be recorded in the Statistics Finland database separately. Finally, lack of confidence intervals of the denominator did not allow us to take its uncertainty into account when calculating crude attack rates.

5. Conclusions

Combining nation-wide databases of infectious diseases register and travel statistics provided destination-specific risks of contracting notifiable infections abroad and trends in risks. Despite the fact, that we observed positive trends in risks of contracting infections abroad, we recommend to maintain, or regarding high risk destinations, even strengthen public awareness. Travellers should be reminded that visits to Europe and Thailand are not without risk either, and pre-travel counselling is warranted also to these destinations. For Europe, vaccinations and advice are needed especially to areas with risk of hepatitis A. For Thailand, counselling should, in addition to including information on vaccinations and prevention and treatment of travellers' diarrhoea (elevated risks of salmonellosis, campylobacteriosis, shigellosis), increase the awareness of the risk of STIs (not only HIV but also gonorrhoea and others) and encourage the use of condoms. Our data can be helpful for health care professionals providing travel advice.

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Authors' contributions

Study concept and design JS, OL; analysis VZ, JS; interpretation of data VZ, JS, AK, RRF, SS, OL; drafting of the manuscript VZ, JS; critical comments on the manuscript JS, AK, RRF, SS, OL; final approval of the version submitted VZ, JS, AK, RRF, SS, OL.

Conflict of interest

The authors declare that there are no conflicts of interest.

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Software

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