Health problems and risks encountered among healthy and vulnerable Dutch travelers

Vlot, J.A.

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Predicting morbidity in older travelers during a short-term stay in the tropics: the ELDEST study

Jessica A. Vlot, Marissa G.D. Vive, Heinrich J. Brockhoff,
Perry J.J. van Genderen, Marie-Christine E. Trompenaars,
Jim E. van Steenbergen, Leo G. Visser

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Abstract

Background Older persons may suffer more from travel-related health problems because of ageing and underlying chronic disorders. Knowledge on who is more likely to have these health problems helps to tailor travel health advice more specifically. This study aimed to determine predictors of travel-related morbidity in older travelers by assessing their pre-travel characteristics and performance using physical and cognitive functioning tests.

Methods Multicentre prospective cohort study among older travelers (≥ 60 years) who consulted one of the participating Dutch travel clinics. Handgrip strength and cognitive performance were measured pre-travel. Participants completed questionnaires before departure and one and four weeks after return. A diary recorded health complaints during travel until two-week post-travel.

Results In total, 477 travelers completed the study (follow-up rate of 97%). Participants' median age was 66 years. The most visited regions were South-East Asia (34%) and South Asia (14%). Median travel duration was 19 days. Polypharmacy (≥5 medications per day) was not uncommon (16%). The median Charlson Comorbidity Index (CCI) score was 0. Self-reported travel-related infectious diseases concerned primarily respiratory tract infections (21%) and gastroenteritis (10%), whereas non-infectious complaints were injuries (13%), peripheral edema (12%), and dehydration (3%). Medical assistance was sought by 18%, mostly post-travel from their general practitioner (87%). Self-reported physical and mental health-related quality of life significantly improved during and after travel. Predictors for an increased risk of travel-related morbidity were higher CCI score, more travel experience, longer travel duration, higher number of daily medications, visiting northern Africa or South-East and East Asia, and phone and social media use.

Conclusion Older Dutch travelers are generally fit, well-prepared and suffer not only from common infectious health problems, but also from injuries. Travel improved their self-perceived health. The predictors could be used to identify the more at-risk older traveler and to decrease travel-related morbidity by optimizing pre-travel advice.

Introduction

Over the past decades, increase in life expectancy and vitality has led to a growing older population travelling internationally.[1] In previous studies 15-30% of all international travelers were older adults.[2-4] Between 1995 and 2017, the percentage of Dutch travelers to tropical destinations has almost doubled from 8% to 16%.[5] It is conceivable that this also holds true for older travelers.

The travel-related morbidity of older travelers is expected to differ from that of younger travelers due to physiological, medical and behavioural differences.[6-9] Due to their altered homeostasis older persons may suffer more from exposure to extreme climate and environmental conditions, potentially resulting in increased susceptibility to dehydration and hyper- or hypothermia.[10-13] In addition, older persons are more susceptible to infections due to impaired immune responses, waning immunity, and limited effectiveness of pre-travel vaccinations.[4, 14-17] Moreover, polypharmacy and underlying chronic disorders, including cardiovascular disease, diabetes mellitus (DM), and chronic respiratory diseases are more prevalent among older persons.[18-23] This poses a risk of decreased physical functioning, drug-related side effects and drug-drug interactions or exacerbations of pre-existing illnesses during travel.[10, 21, 24-26] Yet, older travelers choose different, possibly lower-risk destinations and travel modes and show less risky behaviour, which may diminish their travel-related health risks.[7, 27]

A case-control study by Gautret et al. revealed that the observed proportion of illnesses, such as lower respiratory tract infections (RTIs), trauma and injuries, urinary tract infections, and heart disease, was higher in the older travelers visiting a travel clinic post-travel compared with younger travelers.[6] Illnesses such as acute diarrhoea, upper RTIs, mild malaria, and dengue, were less frequently observed. However, the generalizability of these findings may be limited due to confounding by indication as only ill older travelers presenting themselves at the clinic post-travel were included.

Our aim was to identify predictors related to the occurrence of morbidity in older travelers during their tropical travel and shortly thereafter. To that end we evaluated their pre-travel performance using physical and cognitive functioning tests and

determined the incidence, duration and inconvenience of travel-related morbidity in a prospective cohort.

Methods

Design and participants

We conducted a multicentre prospective observational cohort study among older adults travelling to tropical destinations (ELDEST study, morbidity in ELDErly travelers during a Short-Term stay abroad). Travelers were informed and recruited during their regular visit at four Dutch travel clinics between July 2016 and November 2017 [LUMC in Leiden (coordinating centre), Harbor Hospital Rotterdam and Municipal Health Services (MHSs) Rotterdam-Rijnmond and Haaglanden]. Inclusion criteria were: age ≥ 60 years, a scheduled travel to a tropical destination, and a travel duration of ≤ 35 days. Exclusion criteria were inability to complete diary and questionnaires because of foreign language, or cognitive disability (i.e. suffering from memory disorders) or visiting the clinic less than two weeks prior to departure.

The study consisted of two parts. Part A collected pre-travel basic demographic information, and travelers completed physical and cognitive functioning tests. For logistical reasons, the cognitive test could not be performed at the MHSs sites. In part B, travelers completed pre- and post-travel questionnaires. In addition, a diary on travel-related health complaints was kept starting 1 week pre-travel, during travel until 2-week post-travel. Depending on their willingness to participate, travelers were included solely in part A or in both parts. This study was approved by the Medical Ethical Committee of the LUMC (registry number P16.056). All participants signed an informed consent. We followed the strengthening the reporting of observational studies in epidemiology (STROBE) reporting guideline.

Functional tests (part A)

Hand grip strength is correlated with physical functioning and several important health outcomes.[28] Grip strength was defined as the maximum strength from three attempts, measured with the Jamar Hydraulic hand dynamometer.[29, 30] The six item cognitive impairment test (6CIT) was conducted to assess the level of cognitive deficits.[31, 32] This test can be completed within 3-4 minutes and consists of six

weighted items including one memory, two attention and three orientation questions. The 6CIT is not influenced by education level.[32] A higher score is associated with more cognitive impairment (Supplementary Appendix 1).

Questionnaires (part B)

Questionnaires were pre-tested among older adults for clarity and comprehensibility before start of the study. Travelers completed questionnaires at different time points: one week pre-travel, one week post-travel and four week post-travel. If travelers reported health complaints in the third questionnaire, an additional questionnaire was filled out eight weeks post-travel.

Questionnaire 1 captured demographic data, medical history, medication and travel characteristics. In addition, three standardized tests were included to identify potential risk profiles based on health status, independence and (co)morbidity. Self-reported health status was assessed by the Short Form 36 health survey (SF-36) measuring eight health domains: physical functioning, social functioning, role limitations due to physical or emotional problems, mental health, vitality, bodily pain and general health perception.[33] A higher SF-36 score is associated with a better health status (range 0-100). The level of independence of performing daily activities (e.g. dressing) was measured using the Katz activities of daily living (Katz-ADL).[34, 35] A higher Katz-ADL score is associated with more dependence (range 0-26). The comorbidity burden was assessed with the Charlson Comorbidity Index (CCI), a tool to measure comorbidity and to estimate 10-year survival (Supplementary Appendix 2).[36, 37] Questionnaire 2 concerned travel preparation, risk behaviour, health complaints and treatment. Post-travel health complaints and (possible) medical treatment were evaluated in questionnaire 3 and 4. The SF-36 was repeated twice to measure changes in self-reported health.

Diary (part B)

Health complaints and experienced inconvenience were reported daily in a paper diary, starting one week pre-travel until two weeks post-travel. Every traveler received a digital thermometer for measuring body temperature in case of illness.

Definitions

Polypharmacy was defined as the use of five or more medications per day (not including malaria prophylaxis.[38] Diarrhoea was defined as the passage of three or more unformed stools during a 24-h period (WHO definition).[39] Fever was defined as body temperature ≥ 38°C. Travel destinations were categorized according to geographical regions of the United Nations Statistics Division.[40] Travel-related morbidity was categorized by evaluating the presence, duration, inconvenience, and treatment of predefined symptom clusters using the diaries (Supplementary Appendix 3). Symptom clusters were defined on the presence of health complaints, matching the Dutch General Practitioners guidelines as closely as possible.[41]

Sample size

We estimated that ~20% of older travelers would experience some kind of health problem during their foreign stay, but data for Dutch older travelers are lacking. Therefore, a formal power calculation was not performed. As many travelers as feasible were included within the timeframe of the project with the intention to collect complete data of at least 100 travelers aged between 70 and 79 years old, which would result in at least 20 travelers with health problems in this age group. Based on the age distribution of the participating centres in the past years and an attrition rate of 25%, a total of 625 inclusions were estimated to be required for this study to achieve this goal.

Statistical analysis

Statistical analyses were conducted using SPSS software, version 23 (IBM Corp). Firstly, descriptive analyses and univariable analysis were used for demographical, (physical) health status and travel characteristics of travelers participating in A and B. Travelers aged 60-69 years were compared with travelers 70 years or older in our cohort regarding the pre-travel health characteristics. Secondly, incidence, duration, experienced inconvenience and treatment of travel-related morbidity were determined. SF-36 scores were compared using Wilcoxon signed rank test. Thirdly, logistic regression analyses were performed to identify predictors for travel-related morbidity using univariable and multivariable analysis. Without preselection from the univariable analysis, variables were entered in a multivariable logistic regression

using backward elimination until the Akaike information criterion ($P < 0.157$) was minimized. In accordance with the guidelines for establishing prediction models, we selected the Akaike information criterion above the classic method of statistical significance with a *P*-value < 0.05 because otherwise important variables could be indicated as 'non predictive' due to the relatively small sample size.[42] The Nagelkerke R^2, Hosmer and Lemeshow test, Brier score and c-index of the model were assessed to determine the performance of the model. The 6CIT total score could not be included in the model, as it was unavailable for travelers which were included at the MHSs. Associations were reported as odds ratios, 95% confidence intervals (CI) and *P*-values.

Results

Study population and travel characteristics

In total, 1003 travelers were invited, of whom 649 were included in part A (35% non-participation). Of these, 477 travelers (73%) were available for case analysis (Part A and B, follow-up rate questionnaires 97%) (Figure 1). Demographic and travel characteristics are shown in Supplementary Table S1. The median age was 66 years (interquartily range [IQR] 63-70); 132 (28%) were aged 70 years and over.

Travelers were generally fit with an overall median 6CIT total score of 0 (IQR 0-2) and a median grip strength of 34 kg (IQR 28-45) (Table 1). The most visited regions were South-Eastern Asia (34%), and Southern Asia (14%) (Supplementary Figure S1). The median time spent abroad was 19 days (IQR 14-23). Almost all travelers owned a mobile phone (98%) and many used social media (60%) (Supplementary Table S1).

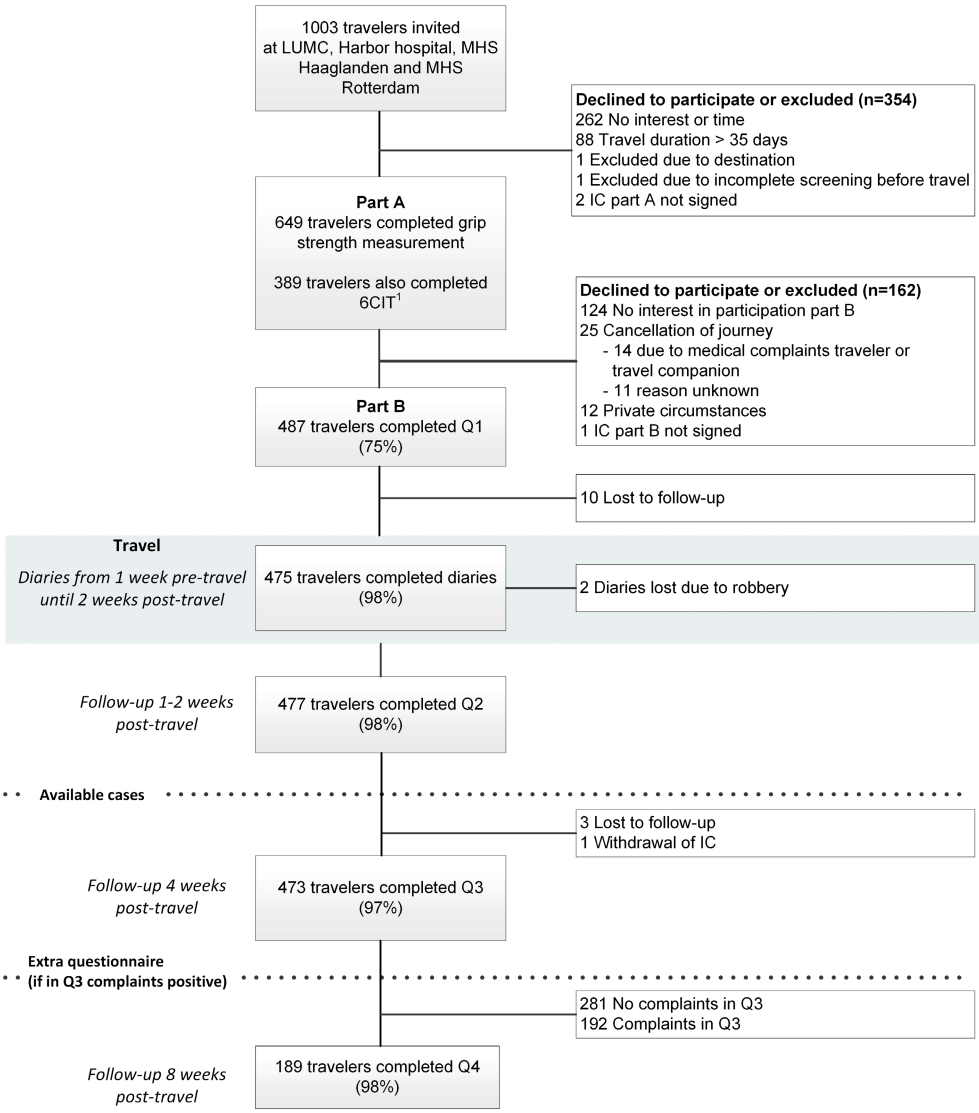

Figure 1. Flowchart of participants in the ELDEST study. [1] Only performed by participating travelers at two of the four clinics. 6CIT, Six Item Cognitive Impairment Test; IC, Informed Consent; LUMC, Leiden University Medical Centre; MHS, Municipal Health Service; Q, Questionnaire.

Pre-travel health characteristics

Polypharmacy was not uncommon among participants. One third of all travelers did not use any medication at all; 16% used five or more daily medications. In travelers aged 70 years and over polypharmacy occurred more frequently (P = 0.003). Katz-ADL revealed that 97% of travelers could be classified as independent. The median CCI was 0 (IQR 0-1), corresponding with an estimated 10-year survival of 92%.[36] Pre-travel performance scores, particularly grip strength, 6CIT, and CCI, were significantly worse in travelers aged ≥70 years. Overall, the three most observed pre-existing conditions were cardiovascular diseases (44%, mainly hypertension), malignancies (16%), and skin diseases (10%) (Table 1).

Travel preparation

The majority of travelers booked their travel online (60%). They frequently consulted sources for advice, such as the general practitioner (GP, 91%) and the internet (18%). Nearly all travelers had a travel insurance (97%). Travelers often carried self-medication for diarrhoea such as loperamide (73%), and oral rehydration solution (ORS, 60%) (Supplementary Table S2). Also hand-hygiene products, such as hand sanitizers (58%), were brought along of which 75% (207/275) used these regularly (Supplementary Table S3).

Risk behaviour

Travelers showed various kinds of risk behaviour such as consuming unpeeled fruit (76%), raw food products (27%, i.e. crustaceans or shellfish) or eating at street vendors (19%). Regular hand washing before a meal was practiced by 84% of travelers. About 20% reported contact with animals that mostly involved monkeys (91%) or dogs (48%) (Supplementary Table S3).

Malaria prophylaxis

If malaria prophylaxis was indicated (n=147), chemoprophylaxis and mosquito nets were used in 82% and 80% of travelers, respectively. Atovaquone/proguanil was mostly used (93%); only one traveler used mefloquine (1%). Most travelers were fully compliant (92%). Side effects are listed in Supplementary Table S4. No cases of malaria were reported.

Table 1. Pre-travel health characteristics of 477 older travelers to the tropics.

	Available cases All ages[a] N=477	Available cases 60-69y N=345	Available cases ≥70y N=132	Comparison p-value[h]
BMI, *kg/m², median (IQR)*	25.4 (23-28)	25.4 (23-28)	24.9 (23-28)	*P*=0.514[i]
Sensory function				
Wearing glasses or contact lenses[b]	366 (77)	261 (77)	105 (80)	*P*=0.395
Wearing hearing aid[b]	53 (11)	25 (7)	28 (21)	*P*<0.001
Influenza vaccination received in the past year[b]	265 (56)	167 (48)	98 (74)	*P*<0.001
Katz-ADL score, *median (IQR)*[bc]	0 (0-0)	0 (0-0)	0 (0-0)	*P*=0.138
0	461 (97)	336 (98)	125 (95)	
1	15 (3)	8 (2)	7 (5)	
Grip strength, *kg, median (IQR)*[d]	34 (28-45)	35 (28-46)	32 (25-42)	*P*<0.001[i]
6CIT total score, *median (IQR)*[e]	*N=303* 0 (0-2)	*N=225* 0 (0-2)	*N=78* 2 (0-4)	*P*=0.017
CCI score, *median (IQR)*	0 (0-1)	0 (0-1)	1 (0-2)	*P*<0.001
0	287 (60)	226 (66)	61 (46)	
1	79 (17)	58 (17)	21 (16)	
2	66 (14)	37 (11)	29 (22)	
3	23 (5)	13 (4)	10 (8)	
4	8 (2)	3 (1)	5 (4)	
≥5	14 (3)	8 (2)	6 (4)	
Number of medication per day, *median (IQR)*	1 (0-3)	1 (0-3)	1 (0-4)	*P*=0.011
None	159 (33)	125 (36)	34 (26)	
1-5	271 (57)	195 (57)	76 (58)	
6-10	42 (9)	23 (7)	19 (14)	
11-13	5 (1)	2 (1)	3 (2)	
Polypharmacy (≥5 medications per day)	77 (16)	45 (13)	32 (24)	*P*=0.003
Medical history				
Any cardiovascular disease[f]	212 (44)	131 (38)	81 (61)	-
Hypertension	134	88 (26)	46 (36)	*P*=0.039
Cardiac arrhythmia	32	16 (5)	16 (12)	*P*=0.003
Myocardial infarct	13	7	6	*P*=0.204
Angina pectoris	5	3	2	*P*=0.620
Cardiac failure	3	2	1	-

	Available cases All ages[a] N=477	Available cases 60-69y N=345	Available cases ≥70y N=132	Comparison p-value[h]
Malignancy	76 (16)	41 (12)	35 (27)	*P*<0.001
With metastases	8	5	3	
Skin disease	49 (10)	34	15	*P*=0.627
Urinary tract infection(s) <12 months pre-travel[b]	36 (8)	26	10	*P*=0.995
Pulmonary disease	39 (8)	29	10	*P*=0.767
Asthma	22	19	3	
COPD	14	9	5	
Auto-immune disorder[b]	32 (7)	18	14	*P*=0.036
Diabetes mellitus	30 (6)	19 (6)	11 (8)	*P*=0.259
With complications	7	5	2	
Gastric disease	22 (5)	17	5	*P*=0.808
Intestinal disease	16 (3)	10	6	*P*=0.397
Ulcerative colitis/Crohn's disease	3	2	1	
Renal disease	15 (3)	8	7	*P*=0.138
Kidney transplant	5	3	2	
Liver disease	6 (1)	4	2	*P*=0.671
HIV	1 (0)	0	1	-
Dementia[g]	1 (0)	0	1	-

Data represent absolute numbers (N) and percentages (%), unless otherwise specified. Abbreviations: BMI, body mass index; IQR, interquartile range; Katz-ADL, Katz activities of daily living; 6CIT, Six Item Cognitive Impairment Test; CCI, Charlson comorbidity index; COPD, Chronic obstructive pulmonary disease; HIV, human immunodeficiency virus.

[a] Available cases are eligible travelers that participated in part A and B.

[b] Percentages were calculated over the total number of travelers that answered the concerning question. Some travelers did not fill in the questions concerning these items, resulting in a maximum of three missing values.

[c] Katz-ADL: range 0-26.

[d] Grip strength: range 0-90 kg. For procedure, see Supplementary Appendix 1.

[e] 6CIT: range 0-28 . For procedure, see Supplementary Appendix 1. Measurements were unavailable for travelers included at the Municipal Health Services.

[f] This group variable represents the number of cardiovascular events including hypertension (n=134), cardiac arrhythmia (n=32), myocardial infarct (n=13), angina pectoris (n=5), cardiac failure (n=3), transient ischemic attack (n=8), cerebral infarction (n=3) peripheral vascular disease (n=14). Some travelers had multiple cardiovascular events therefore no comparison could be calculated between both age groups.

[g] Early vascular dementia; researchers decided that participating partner was allowed to help filling in the questionnaires and diary.

[h] Pearson's Chi-Square test or Fisher Exact test was used, unless otherwise specified.

[i] Unpaired t-test was used.

Morbidity during and shortly after travel

One out of five travelers (21%) suffered from a RTI, of which one in ten travelers had a pre-existent pulmonary disease [e.g. asthma or chronic obstructive pulmonary disease (COPD)]. Almost one third of the RTIs (27%) were complicated (Table 2). One in six travelers with an uncomplicated RTI also reported these complaints pre-travel. Among all 98 travelers with an RTI, 30% experienced inconvenience, 16% used an antibiotic and 12% consulted a doctor.

Gastroenteritis (GE) was observed in 47 travelers (10%), of which six (13%) were complicated (Table 2). One in five travelers had a gastrointestinal disease in their medical history, mostly gastroesophageal reflux or irritable bowel syndrome. Almost half of the travelers (46%) with uncomplicated and all complicated GE experienced inconvenience and altered their program or stayed in their accommodation. Eight travelers (20%) consulted a doctor and many used self-medication. The relative risk (RR) of contracting GE appeared to be higher for travelers using a proton-pump inhibitor, but was not significant (RR = 1.75, 95% CI 0.97 to 3.18, P = 0.07). Dehydration occurred in 18 travelers (4%), of whom six had GE, and four were taking diuretics. Two dehydrated travelers (11%) used ORS.

Despite the presence of comorbidities in 40% of travelers, exacerbations of pre-existent conditions were reported in only 5% of the travelers (Supplementary Table S5). Eight travelers (2%) experienced cardiovascular complaints; 88% had a pre-existing cardiovascular disease such as hypertension or cardiac arrhythmias (Table 2). One traveler with cardiac arrhythmia consulted a doctor. In 59 travelers (12%) with peripheral edema, 47% had a medical history of cardiovascular disease (mostly hypertension). A higher comorbidity burden (CCI) and the use of more daily medication was associated with a higher travel-related morbidity (P = 0.04 and P = 0.14 respectively, data not shown).

A total of 61 travelers (13%) suffered mostly minor injuries, such as cuts, abrasions or spraining (Supplementary Table S5) often caused by accidental falling (30%). No fractures were reported. One traveler reported a dog bite (WHO category II) in Malawi.

Medical assistance

Medical assistance for health complaints possibly related to their travel was primarily sought between the first week to two months after return (81%), mostly at the GP (87%). Respiratory (27%) and gastrointestinal complaints (21%) were the main reasons of consultation. Only seven travelers consulted a GP (57%) or an emergency room (43%) during travel, mostly for gastrointestinal complaints, wounds or altitude sickness. Five travelers were hospitalized post-travel, none during travel. No mortality was observed (Table 3).

Self-reported health

There was a significant improvement in mental health sum score and associated domains during travel (all $P < 0.001$). Improvement in self-perceived physical health was observed within the bodily pain domain ($P < 0.001$, data not shown). After travel, there were still significant improvements noticeable in the mental health sum score, vitality and general mental health (all $P < 0.001$) in comparison with pre-travel. In addition, a significant improvement in the physical health sum score ($P = 0.01$) and bodily pain ($P < 0.001$) were observed (Supplementary Table S6).

Predictors for travel-related morbidity

Multivariable analysis demonstrated that travelling to Northern Africa or South-East and East Asia, phone and social media use, higher CCI score, higher number of medications per day, more tropical travel experience and longer travel duration seemed to be associated with increasing odds for travel-related morbidity. Travelers with a better SF-36 mental health sum score pre-travel, travelling with family and travelers with higher education appeared to have reduced odds for travel-related morbidity. Grip strength and Katz-ADL were not identified as predictors (Table 4).

Table 2. Self-reported morbidity in 475 older travelers travelling during and up to 2 weeks after travel to the tropics[a]

	Cumulative incidence	Incidence density (cases/100 travel months)	Mean duration of complaints in days (range)[f]		Number of travelers with symptoms in the week before travel	Number of travelers forced to alter program or confined to accommodation	Medication used				Medical assistance[g]
							Antibiotic	Loperamide	Activated carbon	ORS	
Symptom clusters[b]	N (%)	Travel months: 512	Mean	Range	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Infections (general)[c]	21 (4)	4.1	2.4	(1-7)	0	12 (57)	3 (14)	0	0	0	4 (19)
Gastroenteritis											
Uncomplicated	41 (9)	8.0	1.8	(1-5)	3 (7)	19 (46)	3 (7)	16 (39)	3 (7)	13 (32)	8 (20)
Complicated	6 (1)	1.2	3.5	(1-7)	1 (17)	6 (100)	2 (33)	3 (50)	2 (33)	2 (33)	
Dehydration[d]	18 (4)	3.5	4.9	(1-18)	1 (6)	8 (44)	0	0	0	2 (11)	1 (6)
Respiratory tract infection											
Uncomplicated	72 (15)	14.1	3.1	(1-7)	12 (17)	23 (32)	10 (14)	0	0	0	12 (17)
Complicated	26 (6)	5.1	12.2	(4-21)	0	6 (23)	6 (23)	0	0	0	
Urinary tract infection											
Uncomplicated	2 (1)	0.4	1.0	(1-1)	0	0	1 (50)	0	0	0	0
Complicated	2 (1)	0.4	28.0	(20-36)	1 (5)	0	1 (50)	0	0	0	0
Cardiovascular complaint											
Angina pectoris	5 (1)	1.0	5.4	(1-21)	2 (40)	1 (20)	0	0	0	0	1 (20)
Cardiac failure	3 (1)	0.6	4.0	(2-6)	1 (33)	1 (33)	0	0	0	0	
Peripheral edema	59 (12)	11.5	9.8	(3-25)	2 (3)	9 (15)	0	0	0	0	2 (3)
Musculoskeletal complaints[e]	11 (2)	2.1	6.6	(1-14)	0	5 (45)	0	0	0	0	2 (18)
Total	**266 (56)**	**52.0**			**23 (9)**	**90 (34)**	**26 (10)**	**19 (7)**	**5 (2)**	**17 (6)**	**30 (11)**

Data represent absolute numbers (N) and percentages (%), unless otherwise specified. Abbreviation: ORS oral rehydration solution

[a] Two diaries were robbed, resulting in 475 diaries.

[b] Data represent the number of cases fulfilling criteria of defined symptom clusters, see Supplementary Appendix 3. Some travelers fulfilled the criteria for multiple symptom clusters.

[c] Infections that did not fulfil criteria of another symptom cluster.

[d] Dehydration was observed in 18 travelers, of whom six travelers also experienced gastroenteritis.

[e] Three travelers reported pre-travel 'stiffness' and one was known with rheumatoid arthritis.

[f] Duration of complaints meeting symptom cluster criteria.

[g] Represents medical assistance needed for same symptom cluster, as indicated in questionnaire or diary.

Table 3. Medical consultations due to possible travel-related illnesses during the travel and post-travel period.

	During travel N=7	1-2 weeks post-travel N=33	2-4 weeks post-travel N=34 [a]	4-8 weeks post-travel N=22[a]	Subtotal post-travel N=79	Total study period N=84
Type of medical assistance [b]						
General practitioner	4 (57)	28 (85)[d]	27 (79)	14 (61)	69 (87)	73 (87)
Medical specialist	0	2 (6)	6 (18)[e]	7 (30)	15 (19)	15 (18)
Emergency room	3 (43)	0	0	0	0	3 (4)
Hospital admission	0	3 (9)[f]	1 (3)[g]	1 (4)[h]	5 (6)	5 (6)
Reason for seeking medical assistance						
Infections (general)	0	2 (6)	2 (6)	0	4 (5)	4 (5)
Gastrointestinal complaints	3 (43)	6 (18)	4 (12)	5 (22)	15 (19)	18 (21)
Dehydration	0	1 (3)	0	0	1 (1)	1 (1)
Respiratory complaints	0	7 (21)	10 (29)	6 (26)	23 (29)	23 (27)
Urinary tract complaints	0	1 (3)	2 (6)	3 (13)	6 (8)	6 (7)
Cardiovascular complaints	0	1 (3)	3 (9)	0	4 (5)	4 (5)
Peripheral edema	0	3 (9)	0	0	3 (4)	3 (4)
Musculoskeletal complaints	0	3 (9)	6 (18)	3 (13)	12 (15)	12 (14)
Ear nose throat complaints	1 (14)	6 (18)	2 (6)	3 (13)	11 (14)	12 (14)
Other	3 (43)	3 (9)	5 (15)	2 (9)	10 (13)	13 (15)
Total medical consultations [c]	7 (100)	33 (100)	34 (100)	22 (96)	89 (113)	97 (115)

Data represent absolute numbers (N) and percentages (%). Medical support for complaints that were (possibly) travel-related, as was judged by a clinician. Regular medical appointments such as annual influenza vaccination of measuring blood pressure were excluded.

[a] In the period of 2-4 weeks post-travel, three travelers were lost to follow-up. In the period 4-8 weeks post-travel, an additional three travelers who did reported medical complaints in questionnaire 3 did not fill in questionnaire 4.

[b] Travelers that received multiple types of medical assistance were only indicated once in the table at the highest level of care that was received.

[c] Totals may exceed 100% since some travelers sought medical support multiple times (10 travelers twice, one traveler thrice).

[d] Among which one traveler with African tick bite fever.

[e] Among which one traveler with scabies.

[f] Dehydration due to gastroenteritis, acute cardiac failure and arthritis.

[g] Sepsis.

[h] Acute cholecystitis.

Table 4. Best predicting characteristics for developing travel-related morbidity in 475 older travellers to the tropics.

	No morbidity	Morbidity	Univariable analysis		Multivariable analysis	
	N=281	N=194	OR [95% CI]	*P* value	OR [95% CI]	*P* value
Gender, female	131 (47)	100 (52)	1.22 [0.84 - 1.78]	0.29		
Age, *years, median (IQR)*	66 (62-70)	66 (63-71)	1.02 [0.98 - 1.05]	0.30		
Educational level						
Primary education (=ref)	19 (7)	19 (10)	1.00	0.04	1.00	0.03
Secondary education	85 (30)	75 (39)	0.88 [0.44-1.79]		0.80 [0.37 - 1.74]	
Higher education	177 (63)	100 (52)	0.57 [0.27 - 1.12]		0.48 [0.23 - 1.02]	
Immigrant	23 (8)	15 (8%)	0.94 [0.48 - 1.85]	0.86		
Travel advice obtained at MHS	101 (36)	71 (37)	1.03 [0.70 - 1.50]	0.88		
Travel experience to tropics: number of journeys in preceding 5 years, *median (IQR)*	2 (1-5)	2 (1-5)	1.00 [0.98 - 1.02]	0.95	1.05 [0.985 – 1.13]	0.13
Tropical travel destination						
Caribbean, Central and South America (=ref)	44 (16)	36 (19)	1.00	0.03	1.00	0.02
Northern Africa	4 (1)	7 (4)	2.14 [0.58 - 7.88]		3.8 [0.91 - 15.82]	
Sub Saharan Africa	88 (31)	37 (19)	0.51 [0.29 - 0.92]		0.63 [0.34 - 1.20]	
Central, South and Western Asia/Middle East	102 (36)	76 (39)	0.91 [0.54 - 1.55]		0.87 [0.49 - 1.56]	
South-East and East Asia	42 (15)	38 (20)	1.11 [0.59 - 2.06]		1.56 [0.78 - 3.11]	
Travel duration, *days, median (IQR)*	18 (14-23)	20 (15-24)	1.03 [1.01 – 1.06]	0.02	1.04 [1.004 - 1.070]	0.03
Duration between pre-travel consult and departure, *days, median (IQR)*	38 (21-52)	37 (22-50)	1.00 [0.99 – 1.00]	0.44		

	No morbidity	Morbidity	Univariable analysis		Multivariable analysis	
	N=281	N=194	OR [95% CI]	*P* value	OR [95% CI]	*P* value
Purpose of travel						
Business (=ref)	10 (4)	5 (3)	1.00	0.79		
Visiting friends or relatives	40 (14)	30 (15)	1.50 [0.46 - 4.85]			
All other	231 (82)	159 (82)	1.38 [0.46 - 4.10]			
Travel group composition						
With an organized group travel (=ref)	50 (18)	46 (24)	1.00	0.17	1.00	0.12
With family	191 (68)	116 (60)	0.66 [0.42 - 1.05]		0.63 [0.38-1.04]	
All other	40 (14)	32 (16)	0.87 [0.47 - 1.61]		0.94 [0.47-1.85]	
Type of accommodation during travel						
Accommodation owned by participant/family/friends (=ref)	26 (9)	20 (10)	1.00	0.43		
Luxurious rented accomodation	241 (86)	159 (82)	0.86 [0.47 - 1.60]			
Nonluxurious accomodation	13 (5)	15 (8)	1.39 [0.55 - 3.54]			
Phone use						
No phone (=ref)	7 (2)	4 (2)	1.00	0.16	1.00	0.11
Regular mobile phone	33 (12)	35 (18)	1.86 [0.50 - 6.93]		2.24 [0.53-9.44]	
Smartphone	241 (86)	155 (80)	1.13 [0.32 - 3.91]		1.21 [0.31-4.77]	
Social media use	166 (59)	119 (61)	1.08 [0.74 - 1.57]	0.69	1.55 [0.996-2.42]	0.05
BMI, *kg/m*^{2}, *median, (IQR)*	25 (23-27)	25 (23-28)	1.02 [0.97 - 1.07]	0.51		
Sensory function						
Wearing hearing aid	30 (11)	23 (12)	1.13 [0.63 - 2.01]	0.67		
Wearing glasses or contact lenses	220 (78)	144 (74)	0.82 [0.53 - 1.25]	0.35		

	No morbidity	Morbidity	Univariable analysis		Multivariable analysis	
	N=281	N=194	OR [95% CI]	*P* value	OR [95% CI]	*P* value
Katz-ADL score, *median (IQR)*	0 (0-0)	0 (0-0)	1.23 [0.46 - 3.60]	0.63		
6CIT total score, *median (IQR)*[a]	0 (0-2)	2 (2-2)	1.13 [1.01 - 1.27]	0.04		
Grip strength, *kg, median (IQR)*	36 (28-46)	32 (28-44)	0.99 [0.97 – 1.01]	0.15		
Influenza vaccination received <1 year	147 (53)	116 (60)	1.13 [0.91 - 1.92]	0.14		
Number of daily medications, *median (IQR)*	1 (0-3)	2 (0-4)	1.13 [1.05 - 1.22]	0.001	1.07 [0.977-1.17]	0.14
CCI score, *median (IQR)*	0 (0-1)	0 (0-2)	1.20 [1.06 - 1.35]	0.003	1.15 [1.006-1.31]	0.04
SF-36 sum scores pre-travel, *median (IQR)*						
Physical health	92 (85-95)	87 (77-93)	0.97 [0.95 - 0.98]	<0.001		
Mental health	90 (86-94)	87 (79-91)	0.96 [0.94 - 0.98]	<0.001	0.96 [0.944-0.981]	<0.001

Data represent absolute numbers (N) and percentages per category (%), unless otherwise specified. Variables were selected for the multivariable regression analysis using backward selection until the Akaike information criterion ($P \leq 0.157$) was satisfied. Abbreviations: OR, odds ratio; IQR, interquartile range; ref, reference; MHS, Municipal Health Service; BMI, body mass index; Katz-ADL, Katz activities of daily living; 6CIT, Six Item Cognitive Impairment Test; CCI, Charlson comorbidity index; SF-36, Short-Form 36 survey.

[a] Not included in the multivariable regression analyses since measurements were unavailable for travelers included at the Municipal Health Services. Model: constant = 9.02, Nagelkerke R^2=0.18, Hosmer and Lemeshow test $P = 0.53$, c-index=0.71, Brier score=0.2087.

Discussion

In this multicentre prospective study we assessed whether physical and cognitive performance tests could predict travel-related morbidity in Dutch older travelers during a short-term stay in the tropics. We found that a higher CCI score and higher number of daily medications, but also more tropical experience, longer travel duration, travelling to Northern Africa or South-East and East Asia, and phone and social media use were associated with higher odds for travel-related morbidity. The participants were generally experienced and well-educated, physically and mentally fit with little (co)morbidity or polypharmacy and well-connected to the digital world of internet, social media and smartphones. As expected, travelers in higher age groups scored worse on performance measurements although these groups were not identified as predictors.

Our cohort had considerable travel experience, was well-prepared for their tropical trip, and showed limited risk-seeking behaviour. This last aspect is in line with the retrospective study of Alon et al. who demonstrated that older travelers practiced less risky eating and drinking habits and were more compliant with anti-malarial chemoprophylaxis than younger travellers.[7] Most older travelers in our cohort were fully compliant (92%). It is noteworthy that a substantial number of our travelers used a smartphone and social media. This could imply that these methods of communication could be used for future (intervention) strategies as mobile technology will impact travel medicine more and more.[43-45]

In accordance with previous literature[6, 7], older travelers frequently experienced 'classic' travel-related morbidities, such as gastrointestinal and respiratory infections, but they also reported complaints which are more likely to occur in older people such as dehydration (4%), cardiovascular complaints (2%), peripheral edema (12%) and accidental falls (4%). Unexpectedly, exacerbations of pre-existing illness were only rarely reported. In the post-travel questionnaire 141 travelers (30%) reported to have experienced diarrhoea, of whom 12 travelers did not temporarily stop their diuretics. Since older persons are more prone to complications such as hypotension or renal failure following dehydration, it is important to discuss during the pre-travel consult in which situations diuretics should be discontinued (e.g. during periods of vomiting and/or diarrhoea).[46] Less anticipated complaints were injuries (13%), skin (12%) and musculoskeletal complaints (2%). Especially falling deserves further

investigation, as falls are a major determinant of morbidity and mortality in older adults.[47, 48]

Medical assistance was frequently sought, but mostly post-travel. Underlying reasons for late medical consultation were not studied. Possible explanations are previous experience with similar complaints that appear to be self-limiting, preference for own GP, or unexpected longer duration of complaints after travel.[49]

Our findings that older travelers experienced significant improvement in the self-reported mental- and physical health during and after travel extend earlier findings.[50-52] This kind of effects of travel appears to have a positive effect on the perceived health of the traveler and could therefore outweigh the impact of health problems. Although this positive effect decreased on return, travelers still experienced improved health as compared with before travel.[50] A survey study on the well-being and health among employees of German companies after a, mostly European, holiday revealed that enough leisure time, warmer destinations, being physically active, good sleep and making new social contacts facilitate improved health whereas dealing with a greater time-zone difference (i.e. jetlag) was associated with a decreased health.[52] Most of our study participants travelled to warmer tropical destinations, whereby they frequently cross different time-zones. Interestingly, in the employee study an older subgroup aged 50-62 (18%) was analysed, and they found that age was associated with differences in holiday organization (e.g. duration and travel time), but did not affect the positive health changes on its own.[52] The findings in our study cohort underline that travelling to the tropics does not only entail morbidity for the older traveler, but could positively affect both their mental and physical health. We did not address possible improvements on existing co-morbidities.

We hypothesized that pre-travel, validated physical and mental health performance measures might identify older travelers more at risk for travel-related morbidity. Grip strength was chosen as an objective measure of physical performance, but no association was found. The same holds for the level of independence measured with the Katz-ADL. A possible explanation for these findings could be that most included travelers are fit and living an active and independent life, what enables them to undertake tropical journeys.

Finally, we identified several demographic (phone and social media use), travel (duration, destination, experience) and health characteristics (CCI and medication)

as predictors of travel-related morbidity. We used the Akaike information criterion in order not to overlook any important associations. In line with our findings, previous research also identified travel duration and destination as predictors, but not specifically in the older traveller.[50, 53] Interestingly, age was not found to be an independent predictor for morbidity, even though pre-travel characteristics were found to be significantly different when comparing age groups (Table 1). The direction of some effect sizes seems counterintuitive (e.g. more travel experience seems to be associated with higher morbidity rates). It is therefore important to note that this model aimed to identify prognostic and not etiologic relationships between characteristics and travel-related morbidity. This relationship might be confounded by other characteristics, such as risk behaviour.[12, 53] Risk behaviour was not included in the multivariable regression model, since this cannot validly be measured pre-travel.[54] The identified predictors could be used to identify older travelers with a relatively high risk for travel-related morbidity. Most of them could be easily assessed since they are part of the current pre-travel consultation (destination, duration, and travel experience) or could easily be assessed at that moment (educational level, phone and social media use and CCI score). Future research should be conducted to confirm the association between the identified predictors and travel-related morbidity.

The strengths of this study are the multicentre approach, the large sample size of > 100 travelers aged 70 and over, the high follow-up rate of 97%, the limitation of recall bias using a diary during travel and questionnaire shortly after return, the use of validated measurement tools, the use of well-defined symptom clusters to quantify reported morbidity and the collection of baseline data before departure which limits selection bias and offers the opportunity to compare health status pre- and post-travel.

The study also has some limitations that need to be discussed. This study population might not be completely representative for the older population in general (‘healthy traveler bias’). Compared with travelers who participated only in part A or partly in B, travelers who participated in A and B were slightly younger, had a higher grip strength and were less cognitively impaired (Supplementary TableS7). Also, when other aspects are taken into account, our travelers appeared to be fitter than the average age-matched Dutch population. A pre-existing illness was reported by

40% of our travelers, which is lower than the anticipated 50% in the general non-travelling Dutch population of 65 years and older[55], but comparable with the 43% in Swiss travelers who also visited non-tropical destionations.[56] Also polypharmacy was somewhat lower in our study population (16%) than the 20% rate in the Dutch population aged 55 years and older.[57] Therefore, the true incidence of morbidity in the older traveller might be higher. For that reason, we also compared the data of our group travelers aged between 70 and 79 years (n=117) with the data from individuals of the same age group of the AT-AGE study (n=303) in which an identical measurement procedure had been used in different primary care practices. [58] Linear regression demonstrated no significant mean difference in the maximal grip strength between both cohorts, after correcting for age and gender (mean difference 1.3, 95% CI -0.2 to 2.8, $P = 0.096$). This implied that the older travelers visiting the clinic pre-travel physically did not differ (much) from the older adults visiting primary care practices. Of interest, a recent retrospective study among older travelers visiting an Irish travel health clinic pre-travel demonstrated similar health (e.g. about one third used no medication, majority had a medical condition) and travel characteristics (e.g. South Eastern Asia and South America as popular destinations, travel duration of 3 weeks, mostly travelling for leisure or visiting friends or family) as in this ELDEST cohort.[59]

In practice

This study demonstrates that older Dutch travelers to the tropics are generally fit, well-prepared and experienced relatively low rates of morbidity. Although several travelers encountered travel-related morbidity, these travelers did not solely entail illness, as the participants perceived both improved mental- and physical health after travel. Special attention should be given to travelers with the identified predictors (e.g. long travel duration, destinations in Northern Africa or South-East and East Asia, high CCI score, multiple daily medications, using a mobile phone and media use). Furthermore, extensive travel experience should not reassure the travel advisor.

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Author contributions

Concept and design: Vlot, Brockhoff, van Genderen, Trompenaars, van Steenbergen, Visser

Acquisition of data*:* All authors

Statistical analysis: Vlot, Vive

Drafting of the manuscript*:* Vlot, Vive, van Steenbergen, Visser

Critical revision of the manuscript: All authors

Obtained funding: Vlot, Visser

Abbreviations

DM (Diabetes Mellitus), ELDEST (morbidity in ELDErly travelers during a Short-Term stay abroad), LUMC (Leiden University Medical Centre), MHSs (Municipal Health Services), STROBE (Strengthening the Reporting of Observational studies in Epidemiology), 6CIT (Six item Cognitive Impairment Test), SF-36 (Short Form 36 health survey), Katz-ADL (Katz Activities of Daily Living), CCI (Charlson Comorbidity Index), WHO (World Health Organization), SPSS (Statistical Package for the Social

Sciences), IQR (interquartile range), GP (General Practitioner), RTI (Respiratory Tract Infection), COPD (Chronic Obstructive Pulmonary Disease), GE (Gastroenteritis), RR (Relative Risk), CI (confidence interval), ORS (Oral Rehydration Solution), AT-AGE (Age and Thrombosis: Acquired and Genetic risk factors in the Elderly).

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Supplementary data

Supplementary Table S1. Demographic and travel characteristics of a cohort of 477 older travelers to the tropics.

	Available cases[a] N=477
Age, *years, median (IQR)*	66 (63-70)
Age group	
60-69 y	345 (72)
70-79 y	117 (25)
≥80 y	15 (3)
Gender, *female*	232 (49)
60-69y	174/345 (50)
70-79y	53/117 (45)
≥80y	5/15 (33)
Education level[b]	
Primary education	38 (8)
Secondary education	162 (34)
Higher education	277 (58)
Immigrant	39 (8)
Travel experience to tropical destinations[c]	437 (92)
If travel experience, number of journeys in preceding 5 years	
0	99 (21)
1-5	280 (59)
6-10	28 (6)
>10	28 (6)
Most visited tropical destinations[de]	
South-Eastern Asia	163 (34)
Southern Asia	68 (14)
South America	58 (12)
Eastern Africa	51 (11)
Southern Africa	45 (9)
Western Africa	31 (6)
Central America	22 (5)
Travel duration, days, *median (IQR)*	19 (14-23)
<1 week	6 (1)
1-2 weeks	117 (25)
2-3 weeks	181 (38)

	Available cases[a] N=477
3-4 weeks	113 (24)
4-5 weeks	60 (13)
Purpose of travel	
Holiday	380 (80)
Visiting friends or relatives	70 (15)
Business	15 (3)
Volunteering	12 (3)
Most frequent travel group composition	
With partner	237 (50)
With an organized group travel	96 (20)
With friends	36 (8)
Solo	30 (6)
With children	23 (5)
Most frequent type of accommodation during travel[e]	
Hotel	346 (73)
Lodge	66 (14)
With friends/family	48 (10)
Guesthouse	29 (6)
Cruiseship	18 (4)
Used a mobile phone	466 (98)
Smartphone[c]	397 (85)
Social media use[ce]	285 (60)
Most frequently used	
Facebook	221 (47)
LinkedIn	136 (29)
YouTube	51 (11)

Data represent absolute numbers (no.) and percentages per category (%), unless otherwise specified.

[a] All eligible travelers that participated in part B and were not lost to follow-up before questionnaire 2 were designated available cases, while all other eligible travelers were designated unavailable cases.

[b] Education level: according to classification Central Bureau for Statistics, the Netherlands.

[c] Percentages were calculated over the total number of travelers that answered the concerning question. Some travelers did not fill in the questions concerning these items, resulting in a maximum of 3 missing values.

[d] Travel destination: categorized according to geographical regions described by the United Nations Statistics Division.

[e] Totals may exceed 100% since multiple options per participant can apply

Supplementary Table S2. Travel preparation of a cohort of 477 older travelers to the tropics.

	Available cases N=477
Method of booking	
Online	287 (60)
Travel agency	165 (35)
Telephone	17 (4)
Duration between pre-travel consult and departure, *days, median (IQR)*	37 (21-51)
Most frequent additional pre-travel advice sought [a]	
General practitioner	432 (91)
Internet	84 (18)
Travel bureau	38 (8)
Pharmacy	36 (8)
Medical specialist	17 (4)
Insurance status	
Travel insurance	464 (97)
Including medical costs	413 (87)
Including repatriation	417 (89)
Health insurance covers medical costs abroad	416 (89)
Medicines and travel (n=318)[b]	
Took extra supply of regular medication	257 (81)
Travelled with personal prescription information sheet	248 (78)
Medication against GI complaints in carry-on bag[a]	
Loperamide	347 (73)
ORS	284 (60)
Activated carbon	89 (19)
Antibiotics	62 (13)
Hand hygiene products in carry-on bag[a]	
Hand sanitizer	275 (58)
Wet wipes	187 (39)
Soap	127 (27)

Data represent absolute numbers (no.) and percentages (%), unless otherwise specified. GI, gastrointestinal complaints. Percentages were calculated over the total number of travelers that answered the concerning question. Some travelers did not fill in the questions concerning these items, resulting in a maximum of 10 missing values. Abbreviations: ORS, Oral Rehydration Solution.

[a] Total may exceed 100% since multiple options per participant can apply.

[b] Within group of travelers that used medication.

Supplementary Table S3. Risk behavior in a cohort of 477 older travelers to the tropics.

	Available cases N=477	
Washing hands regularly[a]		
After using the toilet	459	(96)
Before meal	400	(84)
Using hand sanitizer regularly[◊]	207	(43)
Using tap water for toothbrushing	251	(53)
Using bottled water from sealed bottle for toothbrushing	254	(53)
Hand contact with animals (e.g. stroking or holding)[a]	97	(20)
Monkey	88	(91)
Dog	47	(48)
Cat	28	(29)
Elephant	14	(14)
Snake	6	(6)
Camel/dromedary	5	(5)
Drinking/eating[a]		
Food from hotel buffay	381	(80)
Fruit that was not cleaned by participant	362	(76)
Freshly squeezed juices	311	(65)
Salad prepared by others	302	(63)
Drinks with icecubes	216	(45)
Soft ice	126	(26)
Food from food stands	92	(19)
Raw crustaceans	43	(9)
Products containing raw eggs	37	(8)
Leftovers from previous meal	32	(7)
Raw shellfish	27	(6)
Non pasteurized cheese	21	(4)
Raw or medium rare meat	18	(4)
Pasteurized milk	7	(1)
Barefoot walking[a]		
Only at the beach	204	(43)
On the street	34	(7)
Swimming in the sea	146	(31)
Had contact with mud or soil	165	(35)
Visited a local market	369	(78)

Data represent absolute numbers (no.) and percentages (%). Percentages were calculated over the total number of travelers that answered the concerning question. Some travelers did not fill in the questions concerning these items, resulting in a maximum of four missing values. Percentages were calculated over the total number of travelers that answered the question.

[a] Total may exceed 100% since multiple options per participant can apply.

[◊] 20 travelers used a hand sanitizer they did not brought themselves.

Supplementary Table S4. Malaria prophylaxis in a cohort of 477 older travelers to the tropics.

	Available cases N=477
Malaria chemoprophylaxis started	
No, it was not recommended by the clinic	330 (69)
No, but it was recommended by the clinic*	27 (6)
Yes	120 (25)
Type of chemoprophylaxis	
Atovaquone/proguanil	112 (93)
Mefloquine	1 (1)
Proguanil	7 (6)
Side effects	
Atovaquone/proguanil	18 (15)
Mefloquine	0
Proguanil	0
Type of side effects from atovaquone/proguanil[a]	
Gastrointestinal complaints	9 (50)
Abdominal pain	3
Nausea	3
Diarrhoea	3
Sleeping complaints	7 (39)
Sleeplessness	3
Strange/vivid dreams	4
Dizziness	6 (33)
Headache	1 (6)
Compliance malaria chemoprophylaxis	
Full compliance	110 (92)
Reasons for non compliance	
Side effects	4 (30)
Too few tablets brought	2 (20)
Other**	4 (40)
Bed net used[b] ***	
No, it was not recommended by the clinic	329 (69)
No, but it was recommended by the clinic	29 (6)
Yes	117 (25)

Data represent absolute numbers (no.) and percentages (%).

[a] Total may exceed 100% since patients could report multiple side effects.

[b] Percentages were calculated over the total number of travelers that answered the concerning question. Some travelers did not fill in the questions concerning these items, resulting in a maximum of two missing values.

*One traveler got robbed of personal belongings, including the chemoprophylaxis. One traveler brought the chemoprophylaxis as standby emergency treatment. Another traveler did so due to low temperatures and no mosquitos were noticed.

**Only in specific areas (n=2), staying on altitude (n=1), unknown reason (n=1).

***Main reason for not using a bed net was the presence of a functioning air-conditioning.

Supplementary Table S5. Morbidity documented in questionnaires during and up to two weeks after returning home in 477 older travelers to the tropics.

	Available cases N=477
Injury	61 (13)
Fallen	18
Cut	10
Bitten, licked or scratched by animal	1
Other minor injuries	32
Exacerbation of chronic health complaints	22 (5)
Travelers' diarrhea (subjective)[a]	141 (30)
Medication temporariliy discontinued	10 (2)
Diuretics (n=19)	3
Antihypertensives (n=49)	2
Statins (n=40)	5
Obstipation[b]	34 (7)
Skin complaints[b]	59 (12)
Exacerbation of chronic skin disease	10 (17)

Data represent absolute numbers (no.) and percentages (%).

[a] Travelers' diarrhea was defined as the passage of three or more unformed stools during a 24-hour period.

[b] Percentages were calculated over the total number of travelers that answered the concerning question. Some travelers did not fill in the questions concerning these items, resulting in a maximum of two missing values.

Supplementary Table S6. Changes in self-perceived health after vs pre-travel versus using SF-36 in 477 older travelers to the tropics.

	Post-travel (median, IQR)	**Pre-travel** (median, IQR)	**p value**[b]	**Individual difference**[c] (median, IQR)	**Interpretation** Change in self-perceived health (S/NS)
Mental health sum score	**91 (86; 95)**	**89 (83; 93)**	**0.00**	**+3 (-2; 6)**	**Improved mental health** (S)
Vitality (energy/fatigue)	85 (75; 90)	80 (70; 90)	0.00	+5 (-5; 10)	Improved vitality (S)
Social functioning	100 (100; 100)	100 (100; 100)	0.15	+13 (-13; 13)	Improved social functioning (NS)
Role emotional	100 (100; 100)	100 (100; 100)	0.86	-33 (-33; 33)	More impairment due to emotional problems (NS)
General mental health[a]	92 (84; 96)	88 (80; 92)	0.00	+4 (-4;8)	Improved mental health (S)
Physical health sum score	**91 (82; 95)**	**89 (82; 94)**	**0.01**	**+1 (-4; 5)**	**Improved physical health** (S)
Physical functioning	95 (85; 100)	95 (85; 100)	0.23	+5 (-5; 5)	Improved physical functioning (NS)
Role physical	100 (100; 100)	100 (100; 100)	0.83	+25 (-50; 50)	Less impairment due to physical problems (NS)
Bodily pain	100 (87; 100)	88 (75; 100)	0.00	+13 (13; 25)	Less bodily pain (S)
General health perceptions	75 (65; 85)	75 (65; 85)	0.58	+5 (-10; 10)	Improved general health (NS)

Data represent median SF-36 scores (range 0-100). Abbreviations: SF-36, Short-Form 36 survey; S, significant; NS, not significant.

[a] One participant did not answer the question concerning this item, resulting in one missing value.

[b] Analysis of differences between post and pre-travel SF-36 scores was performed by Wilcoxon signed rank test.

[c] Positive values correspond with an health improvement within travelers, while negative values correspond with a decrease in health.

Supplementary Table S7. Comparison of available and partly available cases of 649 older travelers to the tropics.

	Available cases[a]		Partly available cases[a]		Comparison[b]
	N = 477		N = 172		p value
Gender, female	232	(49)	87	(51)	0.72
Age, median, *years (IQR)*	66	(63-70)	67	(63-71)	0.06
Age groups					
60-69 y	345	(72)	112	(65)	
70-79 y	117	(25)	52	(30)	
≥80 y	15	(3)	8	(5)	
Grip strength, *kg, median (IQR)*[c]	34	(28-45)	33	(26-42)	0.046
6CIT total score, *median (IQR)*[d]	0	(0-2)	2	(0-4)	0.001
Most visited tropical destinations[ef]					
South-Eastern Asia	163	(34)	40	(23)	
South America	58	(12)	36	(21)	
Southern Asia	68	(14)	22	(13)	
Eastern Africa	51	(11)	15	(9)	
Southern Africa	45	(9)	20	(12)	
Western Africa	31	(6)	7	(4)	
Central America	22	(5)	3	(2)	
Western Asia and Middle East	14	(3)	7	(4)	
Northern Africa	13	(3)	7	(4)	
Eastern Asia	14	(3)	4	(2)	
Carribean	12	(3)	6	(3)	
Central and Middle Africa	10	(2)	1	(1)	
Central Asia	5	(1)	0	(0)	
Eastern Europe	1	(0)	1	(1)	

Data represent absolute numbers (n) and percentages per category (%), unless otherwise specified.

Abbreviations: 6CIT, Six Item Cognitive Impairment Test.

[a] All eligible travelers that participated in part A only or were lost to follow-up before questionnaire 2 were designated partly available cases, while all other eligible travelers were designated available cases.

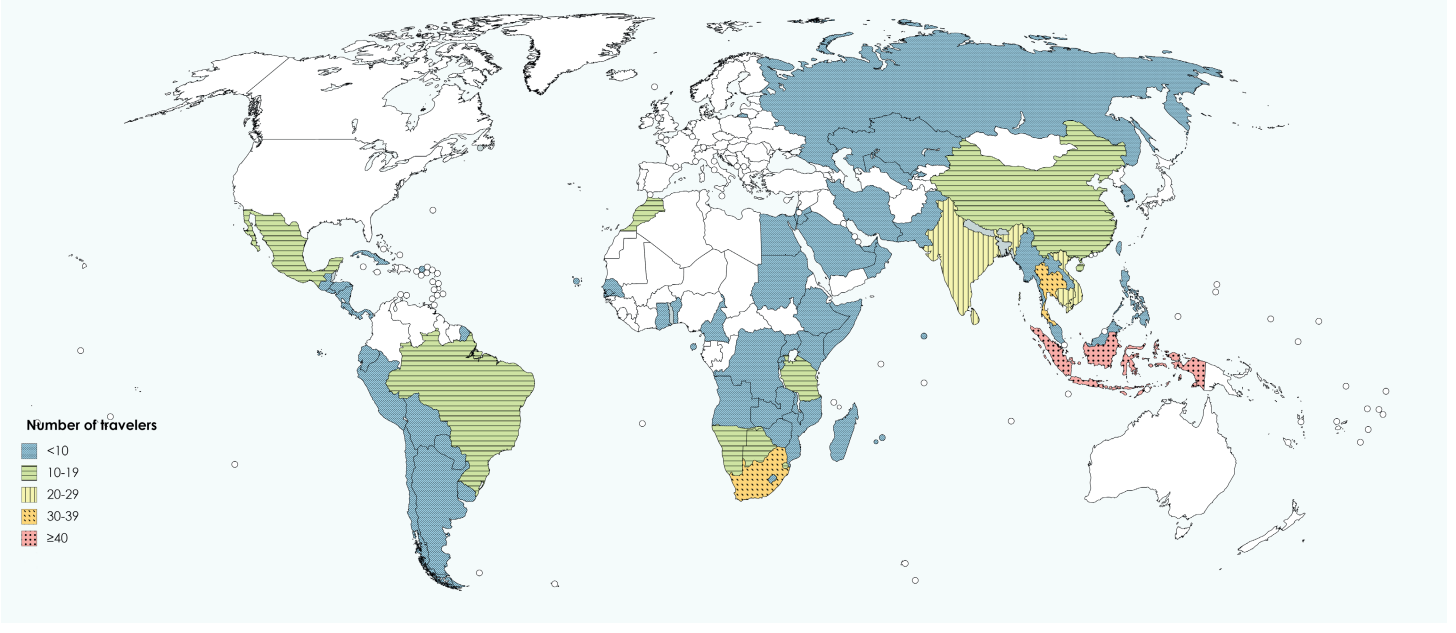
[b] Mann Whitney U test was used for analysis of continuous variables. Pearson's Chi-square test was used for analysis of categorical variables.

[c] Grip strength: Range 0-90 kg, see eAppendix 1.

[d] 6CIT: Range 0-28, see eAppendix 1.

[e] Travel destination: categorized according to geographical regions described by the United Nations Statistics Division.

[f] Totals may exceed 100% since some travelers visited multiple destinations.



Supplementary Figure S1. Most visited destinations of 477 older Dutch travelers (≥60 years) traveling to the tropics for a short-term stay.

Supplementary Appendix 1. Protocol functional tests measurements

Hand grip strength measurement protocol

1. Participant sit in a chair with back support and without arm rests.
2. The arm/elbow of the participant should be at 90˚, thumbs facing upwards (Figure 1)
3. Measurement is taken by the dominant hand (participant is asked 'which hand do you use to write'). If the participant is not able to use the dominant hand, the non-dominant hand is used. The reason for not using the dominant hand is noted. For all measurements, the dynamometer was set to the second handle position from the inside, as most people squeeze on their maximum power in this position.[1]
4. The participant is encouraged to squeeze the Jamar hand dynamometer (Figure 2) as tightly as possible for 2-3 seconds.
5. Grip strength in kilograms is read from the outside dial and recorded on the data entry form (range of 0-90 kg).
6. In total four measurements are performed of which the first one is a test measurement and is not noted on the form.
7. In order to interfere as little as possible with regular practice in the travel clinics, hand grip strength was measured after travel consultation and administration of vaccinations.

Figure 1

Figure 2

Six Item Cognitive Impairment Test (6CIT, range 0-28 points)

Question	Score range	Score
1. What year is it?	Correct – 0 points Incorrect – 4 points	
2. What month is it?	Correct – 0 points Incorrect – 3 points	
Give the patient an address phrase to remember *e.g. Jan, de Vries, Molenstraat 12, Groningen*		
3. What time is it (without looking at the clock) *4. A margin of 1 hour*	Correct – 0 points Incorrect – 3 points	
4. Count backwards from 20 to 1	Correct – 0 points 1 error – 2 points >1 error – 4 points	
5. Say the months of the year in reverse *6. Dec, Nov, Oct, Sep, Aug, Jul, Jun, May, Apr, Mar, Feb, Jan*	Correct – 0 points 1 error – 2 points >1 error – 4 points	
6. Repeat address phrase *7. Score: [Jan] [de Vries] [Molenstraat] [12] [Groningen]*	Correct – 0 points 1 error – 2 points 2 errors – 4 points 3 errors – 6 points 4 errors – 8 points All wrong – 10 points	
Total score	**0 - 28**	**___ / 28**

Supplementary Appendix 2. Standardized tests to identify potential risk profiles

SF-36 health survey including eight health concepts[2]:

Physical health sum score

- Physical functioning;
- Role limitations because of physical health problems;
- Bodily pain; and
- General health perceptions.

Mental health sum score

- Vitality (energy/fatigue);
- Social functioning;
- Role limitations because of emotional problems
- General mental health;

Katz-ADL[3,4]

Question	Answers (score)
Receiving assistance in bathing?	yes (1) / no (0)
Receiving assistance getting dressed?	yes (1) / no (0)
Receiving assistance in going to the toilet?	yes (1) / no (0)
Using incontinence pads?	yes (1) / no (0)
Receiving assistance moving from bed to chair?	yes (1) / no (0)
Receiving assistance in feeding?	yes (1) / no (0)

Charlson Comorbidity Index (CCI), a tool to measure comorbidity which has been used previously to estimate 10-year survival.[5,6]

Item	CCI Score
Myocardial infarction	1
Congestive heart failure	1
Peripheral vascular disease	1
Cerebrovascular disease	1
Dementia	1
Chronic pulmonary disease	1
Connective tissue disease	1
Ulcer disease	1
Mild liver disease	1
Diabetes mellitus	1
Hemiplegia	2
Moderate or severe renal disease	2
Diabetes mellitus with end organ damage	2
Any tumor	2
Leukemia	2
Lymphoma	2
Moderate or severe liver disease	3
Metastatic solid tumor	6
Acquired immunodeficiency syndrome	6

Supplementary Appendix 3. Symptom clusters for health complaints in diaries.[7]

Symptom cluster	Criteria	Restriction	Duration
General infections	Fever (temperature ≥ 38.0°C).	Not fulfilling criteria of another symptom cluster	
Uncomplicated gastroenteritis	Watery or unformed stools more than three times per 24 hours and one or more of the following complaints; nausea, vomiting, abdominal cramps and fecal incontinence.	No fever or bloody stools.	Maximum: 14 days
Complicated gastroenteritis	Watery or unformed stools more than three times per 24 hours and one or more of the following complaints; fever and bloody stools. Or Uncomplicated gastroenteritis that lasted longer than 14 days.		
Dehydration	Two or more of the following; urination less than four times per 24 hours, dark urine, thirst, dry mucosae and orthostatic dizziness.		
Uncomplicated respiratory tract infection	Cough and one or more of the following complaints: nasal constipation, sore throat and coughing up sputum.	No dyspnea, pain on the chest or heart palpitations	Maximum: 7 days
Complicated respiratory tract infection	Cough and fever and one or more of the following complaints; dyspnea at rest or pain on the chest related to respiration Or Uncomplicated respiratory tract infection that lasted longer than 7 days	No heart palpitations and the pain on the chest was not elicited by exercise	
Uncomplicated urinary tract infection	Painful urination	No fever	Maximum: 7 days
Complicated urinary tract infection	Two or more of the following; painful urination, fever and flank pain Or Uncomplicated urinary tract infection that lasted longer than 7 days		

Symptom cluster	Criteria	Restriction	Duration
Angina pectoris	Pain on the chest elicited by exercise	No fever or pain on the chest related to respiration	
Cardiac failure	Swollen ankles or lower legs and dyspnea at rest		
Peripheral edema	Swollen ankles or lower legs	No dyspnea	Minimum: 3 days
Musculoskeletal complaints	Knee-, neck/shoulder- or back pain		

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