A prospective cohort study of 7031 distance runners shows that 1 in 13 report systemic symptoms of an acute illness in the 8-12 day period before a race, increasing their risk of not finishing the race 1.9 times for those runners who started the race: SAFER study IV

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Abstract

Background: Data on the prevalence of acute illness in the period prior to a distance running race is limited. Currently, the presence of systemic symptoms (failed "neck check") is used to advise athletes on participation.

Aim: To determine 1) the period prevalence of pre-race acute illness symptoms before a distance running event, 2) if symptomatic runners receiving educational material on acute illness did-not-start (DNS) the race, and 3) if symptomatic runners who start, did-not-finish (DNF) the race.

Methods: 7031 runners completed an online pre-race acute illness questionnaire in the 3-5 day period prior to a race. Symptomatic runners received educational information on exercise and acute illness. Runners were followed prospectively to determine DNS and DNF risk.

Results: 1338 runners (19.0%) reporting symptoms (7.5% reporting systemic symptoms - failed "neck check"), receiving educational information, had a higher DNS frequency (11.0%) compared to controls (6.6%)(p=0.0002). Symptomatic runners, who started the race, had a higher DNF frequency (2.1%) compared to controls (1.3%)(p=0.0346), particularly runners with systemic symptoms (2.4%; RR=1.90).

Conclusion: In summary, 19% (1 in 5) runners reported pre-race acute illness symptoms, with 7.5% (1 in 13) reporting systemic symptoms. Although runner education reduced the percentage symptomatic race starters, the majority of them still chose to race resulting in a two times higher risk of not finishing in those with systemic symptoms. Pre-race acute illness symptoms are common, an educational intervention affects an athlete's decision to compete yet most symptomatic runners still competed, and systemic symptoms negatively affect performance, with possible health implications.

Key words:

running, illness, infection, pre-race, screening, epidemiology

Introduction

It has been well established, that the most common acute illnesses affecting athletes of most sporting codes are upper respiratory tract (URT) illnesses, followed by acute gastrointestinal diseases [1-12]. It has also been documented that during periods of high-intensity, prolonged training or increased competition "load", there is an amplified risk of sub-clinical immunological changes that may increase the risk of both symptomatology or specific diagnosis of acute illness [13, 14]. Similarly, a single high intensity and prolonged duration exercise session is associated with a decreased immunity, which can last 3 to 72 hours, and this period is referred to as the "open window" period where an athlete is particularly vulnerable to contract an acute illness [15-19].

Acute illness is a significant health burden to the athlete [20] and can result in: i) a reduction in exercise performance [11], ii) an interruption to training, iii) missing an important international competition, and iv) increase the risk of serious medical complications and even sudden death during strenuous exercise [11, 15, 16, 21, 22]. It has also been documented that a decrease in exercise performance after full clinical recovery from an URT illness can last for 2 to 4 days [15].

In runners participating in endurance events, such as marathons and ultra-marathons, there is an increased risk of developing an URT illness in the period after the race [15, 17, 18, 23-27]. Runners with a high pre-race training load (>65km per week) [15], faster running times [23] and those who had a recent pre-race illness [28], have the highest risk of developing a post-race URT illness.

However, data on the prevalence of an acute illness in the period prior to a distance running race is very limited. One study indicated that 17% of runners participating in the 2000 Stockholm Marathon had an illness in the 3 weeks prior to the race [28], while another study indicated that 40% of runners participating in the 1987 Los Angeles Marathon reported an URT illness in the 8 week period prior to the marathon [26]. Although limited, these data indicate that a significant number of runners have symptoms

of an acute illness in the period immediately before a race, and are mostly respiratory tract illnesses. This high prevalence of pre-race acute illness is perhaps not surprising, given the fact that most runners train at both high intensity and high volume in the weeks before a race.

One of the most common clinical decisions for the sport and exercise medicine physician is to determine if a runner presenting with an acute illness in the immediate pre-race period can compete in the race. Currently, clinicians use a clinical tool, called the "neck check", to assess and then advise the athlete with respiratory tract illness symptomatology to either participate in an event (or exercise session) or not [29]. The main clinical guideline, according to the "neck check" is that athletes are advised not to participate if there are any systemic symptoms (fever, myalgia, chest-pain, resting tachycardia, excessive shortness of breath, excessive fatigue, or swollen painful lymphadenopathy). This guideline does allow participation at lower exercise intensity, with continuous monitoring of symptoms during exercise, if athletes suffer only from symptoms "localized" to the neck or above (runny nose, blocked nose, sore throat).

However, to the best of our knowledge, there are no data to validate these clinical guidelines. Specifically, we are not aware of data from prospective studies indicating that systemic symptoms and signs are in fact predictive of negative consequences when athletes participate in sport. Furthermore, questions that remain uncertain include 1) the prevalence of acute illness in the 1-2 week pre-race period before participating in an endurance race, 2) if the "neck check" symptom guideline tool is applied, how many runners would adhere to the advice, and 3) whether runners with symptoms of an acute illness prior to the race, but who decide to continue to participate in the race, are in fact able to complete a race.

Aim of the study

The specific aims of this study were to determine 1) the period prevalence of runners with symptoms of an acute illness 8-12 days prior to the 2012 Two Oceans running races

consisting of a 21.1km, 56km ultra-marathon race and trails runs (10km and 22km), 2) the percentage of runners with systemic symptoms of acute illness who "fail" the "neck check", and would therefore be advised not to participate in the race, 3) the percentage of runners with symptoms of an acute illness that did not start the race, after they received educational guidance regarding acute illness and exercise, 4) the percentage of runners with symptoms of an acute illness, who decided against the guidance, to start the race, but who did not finish the race.

Methods

Type of study

This was a prospective cohort study.

Selection of participants

Prior to the onset of the study, the Research Ethics Committee of the Faculty of Health Science at the University of Cape Town approved the protocol (009/2011). The Research Ethics Committee of the Faculty of Health Science at the University of Pretoria (433/2015) also approved the study, including the on-going analysis of the data presented in this manuscript.

All runners who entered for the Two Oceans 21.1km, the 56km ultra-marathon race or the 10km and 22km trail runs (n=26453) were potential participants for this study. All potential participants were informed about the study, and 16492 runners gave informed consent to participate in research. These runners were contacted by email in the 5 days prior to the race to complete an online pre-race acute illness questionnaire, during the 5-day pre-race period. In addition, runners were given an opportunity to complete the online questionnaire at the registration exposition during the 1 to 3-day period prior to the race using Samsung electronic tablets that were provided. Data were submitted electronically and stored in a central database. Runners who reported any symptoms of an

acute pre-race illness then received educational information (via email or a pamphlet given at the time of the interview) with guidelines on exercise and acute illness.

Of the 16492 runners who gave consent to be contacted, 7031 completed the pre-race acute illness questionnaire in the 1-5 day period before the race. The final response rate of the pre-race acute illness questionnaire was therefore 26.6% of all the race entrants (7031/26453) and 42.6% (7031/16492) of all runners who gave consent to be contacted for research. As the response rate was modest, a post-hoc analysis was conducted to ascertain if the participants in this study were representative of all race entrants. The profile (race type, sex, and age) of all race entrants (n=26453), the group that gave consent (n=16492) and final participants in this study (n=7031) is presented in Table 1.

Table 1: The profile by race type, sex, and age groups of all race entrants, runners who gave consent to be contacted for research study, and runners who participated in this study by completing the pre-race acute illness questionnaire

		All race entrants (n=26453)		**Runners who gave consent to be contacted (n=16492)**		**Runners participating in this study (n=7031)**	
		N	**%**	**N**	**%**	**N**	**%**
Race type	21.1km	16284	61.6	10786	65.4	4374	62.2
	56km	9171	34.7	4992	30.3	2397	34.1
	Trail runs	998	3.8	714	4.3	260	3.7
Sex	Males	15369	58.1	9334	56.6	3952	56.2
	Females	11084	41.9	7158	43.4	3079	43.8
Age groups	≤ 30 years	7765	29.4	5174	31.4	1611	22.9 *
	31–40 years	8451	32.0	5225	31.7	2340	33.3
	41–50 years	6366	24.1	3805	23.1	1901	27.0
	> 50 years	3871	14.6	2288	13.9	1179	16.8 *

*: Significantly different from all race entrants ($p<0.05$)

In general, the profile of the participants in this study was very similar for race type and sex to that of all race entrants, as well as all the runners who gave consent to be contacted

for research. The two notable exceptions were that a significantly greater proportion of older runners (>50 years), and a lower proportion of younger runners (<30 years) were participants in the study ($p<0.05$).

Online pre-race acute illness questionnaire and educational information

An online pre-race acute illness questionnaire was developed for the purposes of screening runners for symptoms of acute illness, and to serve as an educational intervention to runners with symptoms of illness. The pre-race acute illness questionnaire was preceded by a paragraph explaining the importance of acute illness prior to a race. This was followed by a brief description of any possible symptoms of an acute infective illness as follows:

"The symptoms of infections vary but include the following: generally not feeling well, fever, general muscle pain, general joint pain, general tiredness, headache, sore throat, blocked or runny nose, sore ears, cough, wheeze, diarrhoea, nausea, vomiting, or abdominal pain".

This description was then followed by a single question to ascertain whether the runner experienced any symptoms of an acute illness in the 7-day period prior to completion of the questionnaire as follows:

Do you have any of these symptoms of acute illness (today or in the last 7 days)? Yes or No

If a runner selected the "No" option they were notified "to enjoy the race". These asymptomatic runners served as a control group for this study. If runners selected the "Yes" option, they were designated as symptomatic runners and additional choices were given. Runners were then asked to select (one or more) symptoms they experienced from a list. These symptoms included: fever; cough, general muscle pain, general joint pains, headache, sore throat, runny nose, blocked nose, sore ears, nausea, vomiting, diarrhoea,

abdominal pain, bladder infection, skin rash and other symptoms. Sub-groups of runners with symptoms were defined as follows: systemic symptoms (fever, cough, general muscle pain, general joint pains, headache), respiratory symptoms (sore throat, runny nose, blocked nose, cough, sore ears, wheezing), gastro-intestinal symptoms (diarrhoea, abdominal pain, nausea, vomiting), and both respiratory and gastro-intestinal symptoms. Runners reporting both respiratory and gastrointestinal symptoms were included in both sub-groups for analysis. However, runners reporting no respiratory and no gastrointestinal symptoms were classified as a sub-group of runners with "Other" symptoms.

Although some authors have listed "general tiredness" (malaise) as a systemic symptom, for the purposes of this study this was not included in the systemic symptom sub-group in this study because, 1) it is common for runners to experience non-specific general tiredness at the peak of their training, particularly in the two week period before a race just before they start a taper, as is the case in this study, 2) this is not a specific systemic symptom of acute illness and many chronic conditions including overreaching and overtraining can cause this symptom, and 3) no runners with symptoms of an acute illness (symptomatic group) reported "general tiredness" as their only symptom, therefore no runner was excluded from the symptomatic group because they reported this symptom.

All participants who indicated symptoms then received an automated email with an educational information leaflet attached to it. The educational information consisted of general information about acute illness, information about the health risks of exercising with illness, and specific guidelines regarding when not to participate, if systemic symptoms are present. Runners were advised to return to running only when all symptoms have disappeared and the runner felt well again. Furthermore, runners were advised, 1) to undergo an evaluation by a qualified medical doctor if they were not sure of their symptoms, and 2) that in mild cases where symptoms were localised to only one system e.g. in the upper respiratory tract, low- to moderate-intensity exercise may be appropriate (Supplementary file). Runners with symptoms received one of three educational leaflets, depending on the symptoms listed in their responses: 1) specific

advice regarding respiratory tract illness and running, 2) specific advice regarding gastro-intestinal illness and running, or 3) general advice regarding running and other non-respiratory or non-gastrointestinal acute symptoms.

Runner follow-up on race day

All the runners in the control group and the symptomatic group were followed during race day. Information about each runner was obtained from a real-time database provided by the race organizers. Data obtained related to runners who actually started the race and which of the athletes who started the race, finished the race. These data were obtainable as each runner was required to wear an electronic chip containing information about the runner ("Champion" chip) strapped to their running shoe. These chips activated a signal when the athletes passed over a mat as they crossed the starting line and finish line. A runner was considered to be a "non-starter" if the start-line mats did not capture a start time on race day. Similarly, a runner was considered a "non-finisher" if the finish-line mats did not capture a finish time on race day. The study protocol did not allow us to contact runners to obtain data on the precise reason/s for not starting or finishing the race.

Statistical analysis of data

All data were entered into an Excel spread sheet (Microsoft 2010) and analysed using the SAS Enterprise Guide (V6.1) statistical package (SAS Institute Inc, Cary, North Carolina, USA). The two main groups of runners (asymptomatic control, symptomatic) and the sub-groups of runners according to body systems affected by illness [respiratory, gastrointestinal, respiratory and gastro-intestinal, and other (non-respiratory and non-gastrointestinal)] and the localisation of symptoms (localized or systemic) were investigated. The main outcome variables were, 1) the period prevalence of symptomatic runners as well as runners with systemic symptoms, 2) the prevalence of different specific symptoms of illness, and 3) whether acute illness is a predictor for those runners that did not start (DNS) the race and, 4) whether acute illness is a predictor for those runners who decided to start the race but did not finish (DNF) the race. All analyses

consisted of modified Poisson regression modelling (delta method), using a robust error estimator (log link function) and an unstructured correlation matrix to estimate the Relative Risk Ratio (RR) and 95% Confidence Intervals (CI). Significant p-values were $p<0.05$. Relative Risks were adjusted for gender and race type for the DNS regressions. However, no runners who started the half marathon did not finish the race, therefore the Relative Risks for the DNF outcome was adjusted for gender only.

Results

Period prevalence (%) of runners with symptoms of an acute illness in the 8-12 days prior to an endurance race

Of the 7031 runners, 5693 runners (81.0%) reported no symptoms, while 1338 runners (19.0%) did experience symptoms of an acute illness in the 8-12 day period prior to the race. Of the 7031 runners, 896 (12.7%; 95% CI: 12.0-13.5) reported respiratory symptoms, 249 (3.5%; 95% CI: 3.1-4.0) reported gastrointestinal symptoms, and 94 runners reported both respiratory and gastrointestinal symptoms (1.3%; 95% CI 1.1-1.6). In addition, 287 runners (4.1%; 95% CI: 3.6-4.5) reported symptoms that were not respiratory or gastrointestinal (Other group).

The prevalence of symptoms in the control and symptomatic group and sub-groups (by system and localization of symptoms) is depicted in Table 2. Of the 7031 runners, 530 runners (7.5% of all runners) reported one or more systemic symptom. Of these runners with systemic symptoms, 402 runners (5.7% of all runners) reported a respiratory tract illness with systemic symptoms, 81 (1.2% of all runners) reported a gastrointestinal illness with systemic symptoms, 46 (0.7%) reported symptoms of both respiratory and gastro-intestinal illness, and 93 (1.3% of all runners) reported other symptoms of acute illness (non-respiratory and non-gastrointestinal) with systemic symptoms.

Table 2. Prevalence of symptoms in the control and symptomatic group and sub-groups (body system and localization of symptoms)

Group	System	Types of symptoms	Participants (n=7031)	% of runners	95%CI
Control			5693	81.0	
Symptomatic	All systems	All	1338	19.0	18.1-19.9
		Localised	808	11.5	10.7-12.2
		Systemic	530	7.5	6.9-8.2
	Respiratory	All	896	12.7	12.0-13.5
		Localised	494	7.0	6.4-7.6
		Systemic	402	5.7	5.2-6.3
	Gastrointestinal	All	249	3.5	3.1-4.0
		Localised	168	2.4	2.0-2.7
		Systemic	81	1.2	0.9-1.4
	Respiratory and gastrointestinal	All	94	1.3	1.1-1.6
		Localised	48	0.7	0.5-0.9
		Systemic	46	0.7	0.5-0.8
	Other *	All	287	4.1	3.6-4.5
		Localised	194	2.8	2.4-3.1
		Systemic	93	1.3	1.1-1.6

*: Non-respiratory and non-gastrointestinal symptom sub-group

The period prevalence (%) of specific symptoms of an acute pre-race illness

The percentage of runners with specific symptoms of an acute pre-race illness in the 8-12 days prior to the endurance race is depicted in Table 3. Runners were allowed to report more than one symptom. The most common (> 20% of runners) specific symptoms experienced by the runners were sore throat (33.8%), runny nose (29.3%), general tiredness (27.3%), a blocked nose (22.8%), headaches (22.1%) and general muscle pain (21.1%). These, and other less frequently reported symptoms, are listed in Table 3.

Table 3. Percentage of the 1338 runners with specific symptoms experienced in the 8-12 days before the endurance race

Symptom Experienced	Number of runners	% runners with the symptom (n=1338)
Sore throat	452	33.8
Runny nose	392	29.3
General tiredness	365	27.3
Blocked nose	305	22.8
Headache *	296	22.1
General muscle pains *	282	21.1
Cough *	243	18.2
Diarrhoea	154	11.5
General joint pains *	149	11.1
Fever *	105	7.9
Sore ears	98	7.3
Abdominal pain	98	7.3
Nausea	65	4.9
Wheezing	48	3.6
Bladder infection	40	3.0
Skin rash	16	1.2
Vomiting	15	1.1
Other symptoms	26	1.9

*: Classified as acute systemic symptoms

Symptoms of acute illness as a predictor for runners not to start the race

Self-reported symptoms of acute illness in the 8-12 days before a race as a predictor for runners not to start the race (adjusted for gender and race type), in different groups and sub-groups, is depicted in Table 4. In the cohort of 7031 runners, 6507 runners (92.5%) started the race and 524 runners (7.5%) did not start the race.

Any symptoms:

Of the 5693 runners in the control group, 377 runners (6.6%) did not start the race on race day. Of the 1338 runners in the symptomatic group, 147 runners (11.0%) did not start the race on race day. The adjusted relative risk not to start the race was 1.1 times higher (95% CI: 1.03-1.10) in the symptomatic, compared to the control group (p=0.0002). It is important to note that the data also indicates that 89% of runners in the symptomatic group still elected to start the race.

Systemic symptoms:

Of the 530 runners in the systemic symptoms sub-group, 80 runners (15.1%) did not start the race on race day. The adjusted relative risk not to start the race was 1.2 times higher (95% CI: 1.02-1.33) in the systemic symptoms sub-group, compared to the control group (p=0.0288). It is important to note that 85% of runners in the systemic symptoms sub-group still elected to start the race. Of the 402 runners in the respiratory systemic symptoms sub-group, 67 runners (16.7%) did not start the race on race day. The adjusted relative risk not to start the race was 1.2 times higher (95 %CI: 1.01-1.31) in the respiratory systemic symptoms sub-group, compared to the control group (p=0.0317). Of the 81 runners in the gastrointestinal systemic symptoms sub-group, 13 runners (16.0%) did not start the race on race day. The adjusted relative risk not to start the race was 2.29 times higher (95% CI: 1.30-3.57) in the gastrointestinal systemic symptoms sub-group, compared to the control group (p=0.0028). Of the 46 runners in the combined respiratory / gastrointestinal systemic symptoms sub-group, 8 runners (17.4%) did not start the race on race day. The adjusted relative risk not to start the race was 2.29 times higher (95% CI: 1.22-4.32) in the combined respiratory / gastrointestinal systemic symptoms sub-group, compared to the control group (p=0.0100). Finally, of the 93 runners in the "Other" symptoms sub-group, who also reported systemic symptoms, 8 runners (8.6%) did not start the race. The adjusted relative risk of not starting the race in this sub-group was not significantly different to that of the control group (p=0.5999).

Localised symptoms:

Runners reporting any localised symptoms localised respiratory or localised gastro-intestinal symptoms had similar DNS frequencies to the control group (Table 4). However, of the 48 runners in the combined respiratory / gastrointestinal localised symptoms sub-group, 7 runners (14.6%) did not start the race on race day and the adjusted relative risk not to start the race was 2.00 times higher (95% CI: 1.22-4.32) in the combined respiratory / gastrointestinal systemic symptoms sub-group, compared to the control group (p=0.0464).

Table 4. The did-not-start (DNS) frequency (% runners) and Relative Risk (RR) Ratio in the control and symptomatic group, and sub-groups by system and localization of symptoms (adjusted for race type and gender)

Group	System	Types of symptoms	Cohort (n=7031)	%	Runners who started	DNS	% DNS	RR **	95% CI	P *
Control			5693	81.0	5316	377	6.6	-	-	-
Symptomatic	Any	All	1338	19.0	1191	147	11.0	1.06	1.03-1.10	0.0002 *
		Localised	808	11.5	741	67	8.3	1.02	1.00-1.04	0.0571
		Systemic	530	7.5	450	80	15.1	1.16	1.02-1.33	0.0288 *
	Respiratory	Localised	494	7.0	455	39	7.9	1.01	0.99-1.03	0.3718
		Systemic	402	5.7	335	67	16.7	1.15	1.01-1.31	0.0317 *
	Gastrointestinal	Localised	168	2.4	150	18	10.7	1.47	0.94-2.30	0.0911
		Systemic	81	1.2	68	13	16.0	2.16	1.30-3.57	0.0028 *
	Resp and GIT	Localised	48	0.7	41	7	14.6	2.00	1.01-3.96	0.0464*
		Systemic	46	0.7	38	8	17.4	2.29	1.22-4.32	0.0100*
	Other #	Localised	194	2.8	177	17	8.8	1.01	0.99-1.04	0.1684
		Systemic	93	1.3	85	8	8.6	1.19	0.62-2.32	0.5999

Resp: Respiratory
GIT: Gastrointestinal
#: Non-respiratory and non-gastrointestinal symptom sub-group
*: Significantly different (pair-wise vs. Control group)
** Relative Risk (RR) Ratio - reference group is Control group

Symptoms of acute illness as a predictor for runners not to finish the race

All symptoms:

Self-reported symptoms of acute illness in the 8-12 days before a race, as a predictor to not finish the race **(**adjusted for gender only), in different groups and sub-groups, are depicted in Table 5. A total of 6507 of the 7031 runners in the cohort (92.5%) started the race, and of the 5316 runners in the control group who started the race, 68 runners (1.3%) did not finish the race on race day. Of the 1191 runners in the symptomatic group who started the race, 25 runners (2.1%) did not finish the race on race day. The adjusted RR not to finish the race was 1.6 times higher (95% CI: 0.99-2.44) in the symptomatic, compared to the control group (p=0.0346).

Systemic symptoms:

Of the 450 runners in the systemic symptoms sub-group who started the race, 11 runners (2.4%) did not finish the race on race day. The adjusted RR not to finish the race was 1.9 times higher (95% CI: 1.01-3.59) in the systemic symptoms sub-group, compared to the control group (p=0.0469). Detailed analyses of the DNF frequencies in the respiratory, gastrointestinal, combined respiratory / gastro-intestinal and "Other" sub-groups were not possible, due to the small sample sizes in these sub-groups.

Table 5. The did-not-finish (DNF) frequency (% runners) and Relative Risk (RR) Ratio in the control and symptomatic group and sub-groups by system and types of symptoms (adjusted for gender)

Group	System	Types of symptoms	All starters (n=6507)	%	Runners who finished	DNF	% DNF	RR **	95% CI	P *
Control			5316	81.7	5248	68	1.3	-	-	-
Symptomatic		All	1191	18.3	1166	25	2.1	1.55	0.99-2.44	0.0346 *
		Localised	741	11.4	727	14	1.9	1.47	0.83-2.61	0.1828
		Systemic	450	6.9	439	11	2.4	1.90	1.01-3.59	0.0469 *
	Respiratory	Localised	455	7.0	448	7	1.5	#	#	#
		Systemic	335	5.1	329	6	1.8	#	#	#
	Gastrointestinal	Localised	150	2.3	147	3	2.0	#	#	#
		Systemic	68	1.0	66	2	2.9	#	#	#
	Resp and GIT	Localised	41	0.6	40	1	2.4	#	#	#
		Systemic	38	0.6	37	1	2.6	#	#	#
	Other ##	Localised	177	2.7	172	5	2.8	#	#	#
		Systemic	85	1.3	81	4	4.7	#	#	#

Resp: Respiratory
GIT: Gastrointestinal
##: Non-respiratory and non-gastrointestinal symptom sub-group
*: Significantly different (pair wise vs. Control group)
#: Sample sizes are too small for analysis
** Relative Risk (RR) Ratio - reference group is Control group

Discussion

The main findings of this study were that: 1) 19.0% of runners in this cohort reported symptoms of an acute illness in the 8-12 day period prior to an endurance race, 2) the most common symptoms of acute illness were sore throat (33.8%), runny nose (29.3%),

general tiredness (27.3%), blocked nose (22.8%) and headaches (22.1%), 3) 7.5% of runners reported acute pre-race systemic symptoms, 4) runners who reported symptoms of acute illness, and who were given educational information, had a significantly higher DNS frequency compared with an asymptomatic control group, 5) the strongest predictors for not starting the race were runners with combined systemic respiratory / gastro-intestinal symptoms (RR=2.29) and runners with systemic gastrointestinal symptoms (RR=2.16), 6) 85% of runners with pre-race symptoms still chose to start the race with, and 7) runners with any pre-race symptoms, but particularly systemic symptoms, who decided to start the race, had a significantly higher DNF frequency compared to asymptomatic control runners.

In this study, 19.0% of runners reported one or more symptoms of an acute illness in the 8-12 day period prior to the race. This period prevalence is lower than the 40% of athletes who reported an episode of an URT illness in the 8 week period prior to the 1987 Los Angeles Marathon [26], but is similar to the 17% of runners who reported symptoms of an infectious episode in the 3 week period prior to the 2000 Stockholm Marathon [28]. However, a comparison between these period prevalence rates is not strictly valid because different definitions of illness were used, and the period over which symptoms were reported differed between studies (1 week, 3 weeks and 8 weeks). Yet, these data indicate that a significant percentage of runners experience symptoms of acute illness in the 1-8 weeks prior to a race.

In our study, the most common reported pre-race symptom was a sore throat followed by a runny nose, general tiredness and a blocked nose. Therefore, symptoms of an acute respiratory illness were most common. These data are consistent with many studies showing that acute respiratory illness is the most common acute illness in athletes before and during competitions and tournaments in a variety of sporting codes [1-12].

An important novel finding in our study is that 7.5% of the runners in our cohort reported systemic symptoms of an acute illness in the 8-12 days before the race. This finding is of concern as these symptoms could indicate an acute systemic infective illness of

potentially serious consequence, which could affect a number of organ systems including skeletal muscle (myositis) and the cardiac muscle (myopericarditis) [11, 15, 16]. Myopericarditis is a known contra-indication to exercise according to established international guidelines, such as those of the American Heart Association (AHA) [30]. Although running is not a contact sport, infective illness such as infectious mononucleosis can result in splenomegaly, which can predispose to splenic rupture [29]. These potential complications of acute illness in the exercising individual are important safety considerations, and it is for this reason that we included an educational intervention program as part of this study, so that runners could be informed of the potential medical complications that may result from exercising while suffering from systemic symptoms of an acute illness.

A further novel approach of this study was that, by following up our cohort, we were able to determine if an educational intervention program can alter the pattern of runners starting the race. We acknowledge that there are many possible reasons for runners to decide whether they choose to start the race. However, in this study we showed that the risk not to start the race was 1.1 times for the symptomatic group compared to the control group (6.6%). On the assumption that all the other possible factors that could influence runners in a decision to not start the race were similar between the symptomatic and control groups, we conclude that the higher DNS frequency in the symptomatic group was, at least in part, as a result of the educational information provided. The observation that runners with systemic symptoms, symptoms in more than one organ system (respiratory and gastro-intestinal), but not those with localized symptoms in one organ system, had the higher DNS rate compared with control runners indicates that the advice not to exercise in the presence of systemic symptoms was, to some extent, applied by runners.

However, we also showed that a high percentage of runners with pre-race symptoms of an acute illness still elected to start the race. Of particular concern is the fact that 89% of all runners with pre-race symptoms and 85% of runners with systemic symptoms still decided to compete in the race. Yet, we recognize that runners, who reported any pre-

race symptoms in the 8-12 day period before the race, could become asymptomatic during the pre-race period, and therefore decide to start the race. This approach would be consistent with the advice in the educational information they received. A limitation of this study was that our protocol did not allow us to contact runners again in the 24-hour period just before the race to determine how many runners became asymptomatic. However, we were able to follow runners during race day in order to document if starting a race with a history of symptoms of pre-race acute illness affected a runner's ability to complete the race. This has to our knowledge, never been investigated or reported.

We are not aware of any studies documenting the relationship between pre-competition symptomatology of acute illness, and the ability to successfully complete a sports event. Therefore, an additional novel finding of this study was that we were able to demonstrate that runners who reported pre-race symptoms of an acute illness were less likely to finish the race. Runners with any acute pre-race (8-12 days) symptoms of illness had a 1.5 times higher risk of not finishing the race, and this increased to 1.9 times higher in runners who reported a history of systemic symptoms. The highest risks of not completing the race were in the sub-groups of runners with either pre-race systemic "other symptoms" (4.7 times higher), or pre-race systemic gastrointestinal illness (2.9 times higher). To our knowledge, these are the first data supporting the clinical guideline that the presence of systemic symptoms is a valid indicator of the potential negative effects of acute illness on athletic performance. Although we did follow-up whether runners with symptoms of pre-race illness developed any medical complications on race day, the sample size was too small to allow meaningful analysis of these data. Therefore, further studies, with larger sample sizes, are in progress to determine the relationship between pre-race symptoms of acute illness and the risk of medical complications.

The main strengths of the present study are its novel nature, that we screened a large number of runners, and that we were able to track the cohort accurately and successfully during the race period. However, our study also had some limitations. Firstly, we were not able to obtain data from all runners who entered the race and had a modest response rate of 26.6% of all race entrants. However, we do report the results of an analysis that

showed that our sample was indeed representative (by race type, gender) of the race registrants. We do however acknowledge that the runners in our sample were older compared with all race entrants, possibly introducing an element of selection bias. The limitation of a modest response rate and possible selection bias would however only potentially affect the validity of the prevalence data, and would not affect the impact of the screening and educational intervention as the follow-up of the final cohort was 100%. Secondly, we acknowledge that there was no clinical diagnosis made on the runners who reported symptoms as the data captured relied solely on self-reported symptoms. It is thus possible that some symptom reporting may have been inaccurate, for example, a sore throat and runny nose could have been due to allergy as opposed to an infection, and generalised body pains and tiredness could have been due to an unstated chronic condition and not due to an acute illness. In future studies, a more precise clinical assessment and laboratory diagnosis would be an important consideration. Thirdly, we acknowledge that in our control group, some runners might not have reported symptoms. Fourthly, as previously discussed we recognize that runners reported symptoms in the 8-12 day period before the race, and that these symptoms may have changed over this period. It is therefore possible that either runners in the symptomatic group may have been become asymptomatic by race day, or that some runners in the asymptomatic (control) group may have become symptomatic by race day. Fifthly, our protocol did not make provision for us to contact runners to determine other possible reasons for runners not starting or not finishing the race. We can therefore not assume that the DNS and DNF frequencies were only as a result of an acute illness, or subsequent advice given to them through the educational intervention. In future studies, data to determine the precise reasons for not starting or not finishing should be obtained from runners. Finally, there is a possibility that the relative risk estimates would be different for the 21km and 56km races, but this could not be assessed due to the limited numbers in the sample. The fact that no 21km runners, who started the race did not finish, is some indication that the relative risk estimates may differ.

In summary, our study shows that 1) an online screening and educational intervention program prior to the race can be successfully implemented, 2) the educational

intervention is effective because it altered the DNS frequency, and that this intervention "filtered" higher risk runners (systemic symptoms, or runners with localised symptoms in more than one organ system), from those at lower risk (localised symptoms confined to one organ system, 3) the majority of runners with acute pre-race symptoms still chose to start the race, and 4) runners with pre-race symptoms of acute illness, particularly systemic symptoms, who chose to compete in the race, are at a higher risk of not finishing the race. Finally, we suggest that further research be conducted in this area, particularly studies that will address the main limitations of this study by 1) verification of the clinical diagnosis, 2) assessment of pre-race symptoms closer to race day, 3) documenting reasons other than illness for not starting or finishing the race, and 4) conducting the study in a larger sample size.

What are the new findings?

- To our knowledge, the SAFER IV study is the first study to report the development of an online pre-race acute illness medical screening and educational intervention program
- We show that 19% runners report symptoms of an acute pre-race illness in the 8-12 day period before an endurance race, with 7.5% runners reporting systemic symptoms
- Runner education reduced the percentage symptomatic race starters, but the majority symptomatic runners still chose to start the race
- Runners with pre-race symptoms of acute illness had a higher risk of not finishing the race, particularly runners with systemic pre-race symptoms (1.9 times higher risk of not finishing)

How might it impact on clinical practice in the near future?

- Clinicians taking care of distance runners need to be aware of the high prevalence (1 in 5) of pre-race symptoms of acute illness in runners competing in an endurance race
- Although a pre-race educational intervention affects a runner's decision to start a race, the majority of symptomatic runners still start the race
- Runners with pre-race systemic symptoms of acute illness, who choose to start the race, have a higher risk of not finishing the race

- Data from this study will form the basis for further clinical studies to determine the relationship between pre-race symptoms of acute illness and the risk of medical complications during a race

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