ORIGINAL ARTICLE

Utilization and Implementation of Sports Medical Screening Examinations

Survey of More Than 10 000 Long-Distance Runners

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SUMMARY

Introduction: Preventive medical checkups may help to lower the health risks incurred by participation in sporting activity. However, there are no epidemiologically relevant data on either utilization or implementation of such checkups.

Methods: An internet questionnaire (www.dshs-koeln.de/pace) and personal interviews of long-distance runners were used to obtain information on the acceptance and realization of medical checkups.

Results: Only 50% of 10 025 runners had undergone preventive medical screening. Beginners and returnees to long-distance running are significantly less likely to have themselves checked than performance-oriented athletes (42.0% vs. 59.9%; $p < 0.01$). Moreover, the survey revealed deficiencies in many sports medical tests; for example, over 15% of runners screened stated that their checkup had not included physical examination. Resting ECG was performed in only 67.4% of cases.

Discussion: The findings underline the need for qualified pre-emptive sports medical screening. If current public health campaigns are successful, higher numbers of overweight, untrained persons of all age groups will have to be examined and advised.

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Key words: pre-emptive sports medical screening, prevention, guidelines, health risks, sudden cardiac death

Cardiac or other potentially fatal incidents during sport are dramatic and unexpected events. In many cases, they can be prevented by sports medical screening examinations (1–4). Many public runs and marathons have now developed into mass events for walkers, skaters, marathon runners and half-marathon runners, with participants including older persons, hobby sportsmen, health sportsmen, beginners and returnees. There have been repeated incidents during these large sporting functions, as reported by the media. These have often led to discussion about the risk to health of sporting activity, even though it is usually forgotten that fatalities during sport are relatively rare (5, 10) and that the benefit of regular physical activity is much greater than the potential risks of acute physical stress (11–14).

Significance of sports medical screening examinations

With the help of sports medical screening examinations, early recognition of risks and diseases is possible. It is perfectly clear that this can contribute towards a considerable reduction in health risk, particularly of sudden cardiac death (1–4). Pre-emptive sports medical screening is of great significance in reducing mortality, as shown by Corrado et al.'s longitudinal epidemiological study from Italy for the period 1979 to 2004 (1). The obligatory introduction of screening tests of this type for athletes aged between 12 and 35 resulted in an almost continuous reduction in the incidence of sudden cardiac death, from initially 3.6 to 0.4 per 100 000 person years. In comparison, mortality was unchanged within this period for the section of the population who did not participate in competitive sport and who were not examined by sport physicians (1). Bearing in mind the growing number of overweight and untrained people who are the target of numerous campaigns on health and exercise, qualified pre-emptive sports medical screening must be urgently recommended for Germany (3, 5, 15). Although regular checkups are obligatory for Olympic athletes and in some types of professional sport, there are no binding regulations for free competitive or popular sports (5, 16).

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Frequency of sports medical examinations (%) among 10 025 long distance runners (men, n = 7810; women, n = 2215)

Frequency of physical examinations during sports medical examinations (%) among 4931 long distance runners (men, n = 3929; women, n = 1002)

Guidelines for sports medical screening examinations

The German Society for Sports Medicine and Prevention (DGSP) has issued a new S1 guideline "Guideline for Sports Medical Screening Examination", which, for the first time, specifies evidence-based recommendations and quality standards for sports medical screening examinations outside professional sport or elite teams. The aim is to detect latent or present disease which might be a risk to the sportsman or sportswoman (17). These checkups are intended for beginners and returnees in all age groups and for ambitious hobby or high performance sportsmen and women. The checkup includes questions on the personal medical history, the family history, sporting activities and internal and orthopedic investigations. The use of instrument-based investigations depends on age, the presence of cardiovascular risk factors and possibly other indications. A resting ECG, with expert evaluation, is an obligatory feature. A stress ECG should be taken if there are any symptoms. This is also indicated for men aged at least 40 and women aged at least 50, if there is a risk factor or before

the start of intensive physical stress. From the age of 65, this investigation should be performed for all subjects. Other instrument-based analyses, such as pulmonary function and echocardiography, are only indicated if there are symptoms or if disease is suspected.

PACE Study: online questionnaire for endurance sportsmen

In spite of the great significance of sports medical screening examinations, there are no data on their use in Germany. There are few quantifiable data on the performance of sports medical screening examinations, so that it is not all clear to what extent the DGSP recommendations have already been implemented. However, a good estimate of the acceptance and use of sports medical screening investigations can be obtained with the current PACE study (PACE: Performance, Age, Competition, Exercise), which has already analyzed the marathon and half-marathon performances of more than 300 000 sportsmen aged between 20 and 80 (18). As part of this project, a scaled online questionnaire has been developed and translated into six languages. This puts questions about performance, training planning, habits and sports medical screening examinations. The present study has evaluated information from about 10 000 long distance runners about the use and performance of sports medical screening examinations.

Method

The online questionnaire (www.dshs-koeln.de/pace) and the procedure for data recording and evaluation have been checked by the Ethics Committee of the German Sports University in Cologne and the Data Protection Office for the State of North Rhine Westphalia, who had no objections. Subjects were recruited through press reports, technical articles, the distribution of flyers at running events and announcements on the Internet pages of sports organizers, societies and associations. The Internet-based data recording was complemented by 512 personal questionnaires, performed at various running functions and meetings. The aim of this procedure was to estimate any bias of the online survey. Individual participants in the survey were recruited and addressed without any systematic selection.

The group of questions on the use and plan for sports medical screening examinations starts with the question: "Have you had a sports medical screening examination during the last two years because of your sporting activity?" (possible answers: yes/no). If the answer was yes, the subjects had to specify which of these examinations were performed in the following text field:

- Physical examination (internal and orthopedic)
- Blood pressure
- Resting ECG
- Stress ECG
- Pulmonary function
- Blood examination.

Aside from the medical questions, more general data are recorded, such as gender, age, height and weight. In addition, the PACE questionnaire determines data on endurance performance and training, the number of

completed marathon and half-marathon runs, the time points and times of the first, last and fastest runs, and the average number and scope of the weekly training units in the last twelve months. The participants should classify themselves as hobby and health sportsmen or as high performance and competitive sportsmen and give their motivation for sport (questionnaire under www.dshs-koeln.de/pace).

Data presentation and statistics

The percentage use of sports medical examinations is expressed relative to the total group. The frequency figures for the individual components of the exam only apply to persons who were given a sports medical examination. The questionnaire data are given in *figures 1 to 3* as frequency distributions. The subjects were classified according to the following 10-year intervals: 20 to 29, 30 to 39, 40 to 49, 50 to 59 and 60 to 69.

The chi-square test was used to test the significance of the frequency distributions. To determine significant correlations between variables, multivariate analysis was performed with binary logistic regression (reverse method with stepwise exclusion), and the corresponding odds ratios (OR) were calculated (*table 2*). The 95% confidence interval (CI) and the probability of error (p) were calculated for each odds ratio. The goodness of the model was described with the Nagelkerkes R square. All data analyses were performed with SPSS 12.1. A level of $p < 0.01$ was taken as significant.

Results

Survey participants

Between November 2006 and February 2008, 10 025 endurance sportsmen (7 810 men and 2 215 women), aged from 20 to 70, took part in the PACE study, which is still running. The age and gender distribution of the group of runners surveyed (*table 1*) largely corresponds to the distribution in German marathon and half-marathon functions (18). 68.6% of the male runners and 50.7% of the female runners reported that they had completed at least one marathon run. However, 21.8% of the men and 29.5% of the women had only completed at least one half-marathon.

More than one third of the male runners (35.7%) and female runners (37.9%) reported that they had not been involved in any regular sport before starting running training. 22.8% of the male subjects and 17.1% of the female subjects described themselves as high performance or competitive sportsmen.

Use of sports medical examinations

The online survey showed that only about 50% of the men and 45% of the women ($p < 0.01$) had had a sports medical examination performed (*table 2*). A similar figure (47.7%) was found for the 512 endurance sportsmen who were directly questioned ($p > 0.01$) (*table 3*). Sports medical examinations were performed more frequently on high performance sportsmen (59.9%) than on hobby or health sportsmen (46.8%) or beginners and returnees who had been training for not more than two

FIGURE 3

Frequency of resting ECGs during sports medical examinations (%) among 4931 long distance runners (men, n = 3929; women, n = 1002)

TABLE 1

Absolute and relative numbers of long-distance runners (n = 10 025) surveyed aged between 20 and 70 years

Age group (years)	Endurance sportsmen interviewed			
	Men		Women	
	(n)	%	(n)	%
20-29	987	12.6	444	20.0
30-39	2082	26.7	621	28.0
40-49	3160	40.5	834	37.7
50-59	1248	16.0	265	12.0
60-69	333	4.3	51	2.3
Total	7810	100	2215	100

years (42.0%) ($p < 0.01$). The proportion of subjects examined is also relatively low for older endurance sportsmen (*figure 1*). About 40% of the subjects over 50 had not had a sports medicine investigation during the previous two years.

With the help of multivariate data analysis, additional characteristics were included in the evaluation. In this way, it could be established which groups have themselves examined relatively frequently (*table 4*). These are mainly sportsmen who have already had performance diagnosis with lactate determination (OR 2.31), who regularly use a heart rate monitor (OR 1.41), who regard themselves as high performance sportsman (OR 1.31) or who complete marathon runs (OR 1.28).

Performance of sports medical examinations

More than 15% of sportsmen with endurance training reported that there was no physical examination during their sports medical checkup (*table 2 and table 3*). In the control group of 512 personally questioned long distance runners, this applied to 16.6% of the sportsmen

TABLE 2

Use of sports medical examinations and frequency of individual components of these examinations. A total of 4 931 persons were given sports medical examinations.

Examination	Men				Women			
	„Yes“		„No“		„Yes“		„No“	
	(n)	%	(n)	%	(n)	%	(n)	%
Sports medical examination	3929	50.3	3881	49.7	1002	45.2	1213	54.8
Physical examination	3372	85.8	557	14.2	794	79.2	208	20.8
Resting ECG	2689	68.4	1240	31.6	634	63.3	368	37.7
Stress ECG	2817	71.7	1112	28.3	637	63.6	365	36.4
Blood pressure	3249	82.7	680	17.3	782	78.0	220	22.0
Pulmonary function	2021	51.4	1908	48.6	409	40.8	593	59.2
Blood examination	3056	77.8	873	22.2	737	73.6	265	26.4

Sample size: N = 10 025 long-distance runners; n = 4931 persons with sports medical examination

who had a sports medical examination (table 3). As figure 2 shows, this also applies to many examinations of older sportsmen with endurance training. The figure was still over 10% for sportsmen of over 60.

Only about 80% of those examined reported blood pressure measurement (table 2). Although the resting ECG is obligatory according to the DGSP, it was only performed in 63% of women and 68% of men. Figure 3 shows that the ECG at rest was performed more frequently in older persons. Nevertheless, more than 10% of the sports medical checks in persons aged over 60 did not include a resting ECG. A stress ECG was performed in just under 64% of women and in 72% of men. Lung function was examined in 49% of sports medical examinations.

Discussion

On the one hand, Internet surveys exhibit methodological traps and limitations which should not be underestimated. Aside from potential faulty entries during the online questions, there is the fundamental question of the extent to which the results are representative. Even though more and more people are using the Internet, it must be assumed that, for example, older persons react relatively rarely to PACE press reports, technical articles, flyers and announcements on Internet pages. It is equally difficult to assume that participants in the PACE questionnaire either forgot to mention physical exams or were unwilling to answer some of the questions.

On the other hand, the personal interviews (n = 512) confirm largely the results of the Internet survey. Moreover, the marathon and half-marathon times from the Internet questionnaire also support the plausibility of the data, as these agree well with the times from the result lists (19). When assessing the value of the present results, it should not be forgotten that the PACE study reached a large proportion of currently active marathon and half-marathon runners. If we assume ca. 200 000 active marathon and half-marathon runners in Germany

(18–21), about 5% of these have completed the PACE questionnaire.

However, the answers of the 10 025 long distance runners to the questions on sports medical screening give cause for concern. Although the subjects are certainly a subpopulation which is particularly health orientated, only about half of endurance sportsmen have had a sports medical examination within the last two years. It is especially worrying that many older hobby and health sportsmen, beginners and returnees do not have a health checkup. This is exactly the group with an increased risk of cardiovascular and motoric diseases (3–5). The survey also indicates deficiencies in sport medical examinations and shows that they often do not correspond to the DGSP recommendations (17). This was found in both the Internet survey and in the personal interviews. About 15% of the sportsmen confirmed their initial answer that their sports medical checkups did not include a physical examination. If the data on the use and execution of sports medical examinations are applied to all endurance sportsmen in the survey, it may be concluded that only about one third of men and one quarter of women had a current ECG. Even though some of our colleagues in sports medicine have dispensed with this examination because of available ECG findings, it cannot be disputed that only a minority of active long distance runners have been given a thorough sports medical examination.

This is certainly an unsatisfactory situation from the point of view of preventive medicine. Bearing in mind the health campaigns on the one hand and the high frequency of lack of exercise and overweight on the other, it will become increasingly important that sports beginners are given a qualified medical examination. However, this assumes that this group of persons demands this.

One possible reason for the lack of use of sports medical examinations could be their cost, which is currently not directly covered by the health insurance funds. In view of the major prophylactic significance of exercise

TABLE 3

Comparison between online surveys and personal interviews with long-distance runners: use of sports medical examinations and frequency of individual components

Examination	Online surveys (N = 9 513)				Personal interviews (N = 512)				p
	„Yes“		„No“		„Yes“		„No“		
	(n)	%	(n)	%	(n)	%	(n)	%	
Sports medical examination	4 690	49.3	4 823	50.7	241	47.7	271	52.9	> 0.01
Physical examination	3 965	84.5	725	15.5	201	83.4	40	16.6	> 0.01
Resting ECG	3 149	67.1	1 541	32.9	174	72.2	67	27.8	> 0.01
Stress ECG	3 262	69.6	1 428	30.4	192	79.7	49	20.3	< 0.001
Blood pressure	3 821	81.5	869	18.5	210	87.1	31	12.9	> 0.01
Pulmonary function	2 282	48.7	2 408	51.3	148	61.4	93	38.6	< 0.001
Blood examination	3 616	77.1	1 074	22.9	177	73.4	64	26.6	> 0.01

Persons surveyed online with sports medical examinations, n = 4690; persons interviewed personally with sports medical examination, n = 241.

and sport, it would be desirable to cover the costs for sports medical screening examinations for people engaged in sport, as used to be the case in the federal states of North Rhine Westphalia, Hesse and Berlin (17). A measure of this sort would certainly be of great advantage for current and future health campaigns, such as the "Fit not Fat" initiative of the Federal Government.

It is nevertheless also necessary that a qualified sports medical health check should be performed. The present data indicate that there is great room for improvement here. We must therefore hope that the DGSP recommendations on "Sports medical screening examinations" will be implemented as soon and as completely as possible (17).

Together with the DGSP, the German Olympic Sport Association (DOSB) recommends qualified examiners for these screening examinations (www.dosb.de/ www.dgsp.de/). A prospective cohort study over several years would be both sensible and necessary to test the effects of these checkups.

Conflict of interest statement

The authors declare that no conflict of interest exists according to the guidelines of the International Committee of Medical Journal Editors.

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Translated from the original German by Rodney A. Yeates, M.A., Ph.D.

TABLE 4

Determination of significant factors for the use of sports medical examinations

Variables	OR (CI)	p
Performance diagnosis – Reference: No	2.31 (2.08; 2.56)	<0.001
Regular use of heart rate monitor – Reference: No	1.41 (1.28; 1.54)	< 0.001
Assessment as hobby or high performance sportsman – Reference: hobby sportsman	1.31 (1.16; 1.47)	< 0.001
Long-distance runners – Reference: not marathon or half-marathon runner	1.28 (1.19; 1.37)	< 0.001
Training frequency – Reference: once weekly	1.12 (1.08; 1.17)	< 0.001
Age when starting running training – Reference: started running training as young adult (classification by years)	1.02 (1.02; 1.03)	< 0.001
Experience in running training – Reference: few training years (classification by years)	1.01 (1.00; 1.02)	< 0.01

The data were analyzed by binary logistic regression ($R^2 = 0.123$). The corresponding odds ratios (OR) were calculated with 95% confidence intervals (CI) (n = 8584).

Only complete data sets, with an answer to each question were used in the calculations (n = 8584).

The significance of the odds ratio may be explained using assessment as hobby or high performance sportsman as example.

Persons who regard themselves as high performance sportsmen have a 1.31-fold greater chance of having used a sports medical examination (see line 3 in the table).

The variables gender, smoking, scope of training and regular sport before starting running training had no significant effect on the goodness of the regression model and were therefore excluded.

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