EFFECT OF MODERATE RUNNING ON SPORTS INJURY REHABILITATION

EFEITO DA CORRIDA MODERADA NA REABILITAÇÃO DE LESÕES ESPORTIVAS

EFECTO DE LA CORRIDA MODERADA EN LA REHABILITACIÓN DE LESIONES DEPORTIVAS

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ABSTRACT

Introduction: Running has become one of the most popular sports and fitness methods for low cost, convenience, and easy adherence. This has made the characteristics and rules of running-related sports injuries a key research issue in sports medicine and public health. Objective: Evaluate the effects of moderate running on sports injuries rehabilitation. Methods: This paper uses mathematical statistics to study some groups that have been running for a long time (n=369). The causes of sports injuries analyses and risks are performed by questionnaire. Results: Relaxation after exercise is a protective factor for sports injuries. The time of maintenance of the running habit and the previous sport's history are factors influencing the risk for a sport's injury. Conclusion: Amateur runners have a high rate of running injuries. The knee is the area with the highest injury incidence. Weight-loss running increases the risk of injury. An individually moderate running training plan can reduce the risk of running injuries. ***Evidence level II; Therapeutic Studies - Investigating the results.***

Keywords: Athletic injuries; Running; Risk Factors; Recovery of function.

RESUMO

Introdução: A corrida tornou-se um dos esportes e métodos de aptidão física mais populares devido ao seu baixo custo, conveniência e fácil adesão. Isso fez com que as características e regras das lesões esportivas relacionadas à corrida tornaram-se uma questão-chave de pesquisa em medicina esportiva e saúde pública. Objetivo: Avaliar os efeitos da corrida moderada sobre a reabilitação de lesões esportivas. Métodos: Este artigo utiliza a estatística matemática para estudar alguns grupos que já praticam corrida há muito tempo (n=369). A análise das causas de lesões e riscos desportivos é feita por questionário. Resultados: O relaxamento após o exercício é um fator de proteção para lesões esportivas. O tempo de manutenção do hábito da corrida bem como o histórico esportivo pregresso são fatores que influenciam no risco para uma lesão esportiva. Conclusão: Corredores amadores têm uma alta taxa de lesões na corrida. O joelho é a área de maior incidência das lesões. Correr para perder peso aumenta o risco de lesões. Um plano de treinamento de corrida moderado planejado individualmente pode reduzir os riscos das lesões durante as corridas. ***Nível de evidência II; Estudos terapêuticos - Investigação de resultados.***

Descritores: *Traumatismos em Atletas; Corrida; Fatores de Risco; Recuperação de Função Fisiológica.*

RESUMEN

Introducción: La corrida se ha convertido en uno de los deportes y métodos de acondicionamiento físico más populares debido a su bajo coste, comodidad y fácil adherencia. Esto ha hecho que las características y las reglas de las lesiones deportivas relacionadas con la corrida sean un tema de investigación clave en la medicina deportiva y la salud pública. Objetivo: Evaluar los efectos de la corrida moderada en la rehabilitación de las lesiones deportivas. Métodos: Este trabajo utiliza la estadística matemática para estudiar algunos grupos que llevan mucho tiempo corriendo (n=369). El análisis de las causas de las lesiones deportivas y los riesgos se realiza mediante un cuestionario. Resultados: La relajación después del ejercicio es un factor de protección para las lesiones deportivas. El tiempo de mantenimiento del hábito de correr, así como el historial deportivo previo son factores que influyen en el riesgo de sufrir una lesión deportiva. Conclusión: Los corredores aficionados tienen un alto índice de lesiones al correr. La rodilla es la zona de mayor incidencia de lesiones. Correr para perder peso aumenta el riesgo de lesiones. Un plan de entrenamiento moderado para correr, planificado individualmente, puede reducir el riesgo de lesiones al correr. ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

Descriptores: *Traumatismos en Atletas; Corrida; Factores de Riesgo; Recuperación de la Función.*

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INTRODUCTION

With the improvement of people's lifestyles, exercise has become one of the important ways of health promotion. Running has become one of the most popular sports and fitness methods due to its economy, convenience, and low threshold.[1] The characteristics and rules of running-related sports injuries (RRI) have become a key research issue in sports medicine and public health.

RRI mostly occurs in the weight-bearing joints of the knees, ankles, and hips. However, the influence of different exercise habits on the occurrence of running-related sports injuries is still controversial.[2] This research will analyze the different exercise habits of amateur runners. Identify the protective factors that may reduce the probability of RRI and the risk factors that cause it to increase.

METHOD

Object

For amateurs of running sports. We selected two running group members with 200 people or more and established for 2 years or more for research.

Method

Questionnaire design

The questionnaire was designed according to related research, and 9 experts were invited to evaluate the content validity of the questionnaire.[3] The CVI value of each entry is 0.89-1. The CVI value of the total table is 0.94. The internal consistency reliability of the questionnaire Cronbach'sα coefficient is 0.90.

Investigation method

We were introduced and assisted by the person in charge of the running team. The uniformly trained investigators entered its WeChat group. Based on sufficient publicity, members register with investigators in a one-to-one manner. The investigator verifies the relevant conditions of the applicants according to the inclusion and exclusion criteria.[4] One-to-one electronic questionnaires were distributed to those who met, and the investigator answered the questions that the respondent encountered while filling out the questionnaire. A total of 388 questionnaires were collected, of which 369 were effective, with an effective rate of 95.10%.

Biomechanical modeling of human motion

The skeletal dynamics equation if the human musculoskeletal system under consideration has n degrees of freedom (DoF). The corresponding joint angle is the generalized displacement $\overline{q}$. The relationship between movement and muscle force in the musculoskeletal system can be expressed by the following matrix equation (1):

$$M(\overline{q})\ddot{\overline{q}} + C(\overline{q})\dot{\overline{q}}^2 + \overline{C}(\overline{q}) + R(\overline{q})F_{MT} + \overline{E}(\overline{q},\dot{\overline{q}}) = 0 \quad (1)$$

Where: $M(\overline{q})$ is the mass matrix $(n \times n)$ of the system. $M(\overline{q})\ddot{\overline{q}}$ is the inertia force and moment vector. $C(\overline{q})\dot{\overline{q}}^2$ is the centrifugal force, Coriolis force and moment vector. $\overline{C}(\overline{q})$ is the gravity and moment vector $(n \times 1)$. $R(\overline{q})$ is the moment arm matrix of muscle strength $(n \times m, m)$ is the number of muscles). F_{MT} is the muscle-tendon contraction force vector $(m \times 1)$. $R(\overline{q})\ F_{MT}$ is the net torque vector of muscle--tendon contraction. $\overline{E}(\overline{q},\dot{\overline{q}})$ is the force and moment vector of the external force environment on the human body.

The size of muscle contractility depends on the degree of muscle excitement and the characteristics of muscle contraction ability.[5] We can use 2 differential equations to represent the Hill-type muscle model that is currently widely used:

$$\left.\begin{aligned} \dot{a} &= f_1(u,a) \\ \dot{l}_M &= f_2(l_M, l_{MT}, a) \end{aligned}\right\} \quad (2)$$

u is the level of muscle excitement. a is the degree of muscle activity ($0 \leqq a \leqq 1$). l_M is the length of muscle fiber. l_{MT} is the total length of the muscle-tendon complex. Muscle strength F_{MT} can be obtained by solving the above two differential equations and then integrating the following equations:

$$\dot{F}_{MT} = f(F_{MT}, l_{MT}, \dot{l}_{MT}, a) \quad (3)$$

Statistical analysis

Use SPSS21.0 software for data analysis. The mean ± standard deviation represents the measurement data conforming to the normal distribution. The t-test was used for comparison between groups. The median and interquartile range represents the measurement data that does not conform to the normal distribution $[M(P_{25} \sim P_{75})]$. The rank-sum test was used for comparison between groups.[6] The classification data adoption rate or composition ratio is expressed. The χ2 test was used to compare the rates between two categorical variables and unordered multi-categorical variables. The rank-sum test was used for comparison between groups of ordered multi-categorical variables. The multivariate analysis adopts two-category Logistic regression analysis.

RESULTS

Basic situation

In the 369 valid questionnaires, 226 males (61.25%) and 143 females (38.75%). A total of 106 respondents did not have any sports system injuries.[7] Two hundred sixty-three respondents had sports system injuries, which accounted for 71.27% of all respondents.

The relationship between injury and exercise habits

Single-factor analysis

Compared with the healthy group, the injury group has statistically significant differences in running habit maintenance time, weekly running volume, running frequency, marathon history, running venue, warm-up, and relaxation habits ($P<0.05$). We perform chi-square split pairwise comparisons on the running habit maintenance time and the running venue. Inspection level $\acute{\alpha} = \alpha / [k(k\text{-}1) / 2 + 1]$. Where k=4 and α'=0.007. Comparing health and injury respondents: the composition ratio of the number of people who maintained the running habit for "<6 months" and that of participants "13-24 months (inclusive)" were statistically significant.[8] There was a statistically significant difference in the ratio of the number of persons. Who participated in the ratio of "<6 months" and the ratio of participants in ">24 months." However, the difference between other times was not statistically significant; there was no statistically significant difference in the number of road injuries between healthy and injured people among the surveyed persons.

Binary Logistic Regression

We incorporated the eight variables of weekly running volume (km), whether the running is regular, warm up, relax, participation time, marathon history, and running venue, into the binary logistic regression.[9] Seven categorical variables are assigned values. (Table 1)

Multi-factor analysis

Relaxation after exercise is a protective factor for sports injuries. The maintenance time of running habits and the history of participating in the marathon are the risk factors of sports injury. (Table 2)

Table 1. Multivariate regression variables and assignments.

Variable	Assignment	variable	Assignment
Is running regular	1=No, 2=Yes	Running habit maintenance time	1≤6 months, 2=6~12 months (inclusive), 3=13~24 months (inclusive), 4≥24 months
Whether to warm up before exercise	1=No, 2=Yes	Marathon history	1=Never participated, 2=Yes (including half marathon or full marathon)
Whether to relax after exercise	1=No, 2=Yes	site	1=Rubber track, 2=Road, 3=Mixed, 4=Treadmill

Table 2. Multi-factor regression results of sports injuries and exercise habits of amateurs in running sports.

Variable	Reference group	β	SE	Waldχ2	P	OR	OR 95% CI
Relax	Yes	-0.761	0.312	5.969	0.015	0.467	(0.254-0.860)
Marathon history	no	0.63	0.307	4.201	0.04	1.877	(1.017-3.412)
Running habit maintenance time	<6 months	0.272	0.125	4.773	0.029	1.313	(1.028-1.676)
pavement				3.906	0.272	1	
highway	Treadmill	0.51	0.494	1.734	0.188	1.917	(0.718-4.795)
Rubber track		0.027	0.519	0.003	0.958	1.028	(0.403-3.009)
Mixed pavement		0.446	0.502	0.79	0.374	1.562	(0.601-4.165)
Constant		0.046	0.637	0.005	0.943	1.047	

DISCUSSION

There is no significant difference in gender, age, and running speed between amateurs who have not experienced sports injuries and those who have suffered at least one injury.[10] These factors also have a limited impact on the occurrence of RRI. And relaxation after exercise or otherwise is the most important factor affecting the occurrence of injury. There is about 0.5 times the possibility of injury when there is a habit of relaxation. Relaxation can reduce the risk of sports injuries by nearly 50%. This is similar to the results of previous studies. Relaxation after exercise is a protective factor for the occurrence of RRI. It can effectively reduce the incidence of sports injuries such as RRI. Among them, post-exercise relaxation is mainly based on training such as static stretching.

Respondents who have completed marathon races (including half-marathons) have a risk of injury that is nearly twice that of those who have not participated in the race. Because half marathon (21km) and full marathon (42km) require participants to complete the ultra-long distance run at one time, participants may need to repeat a one-time high-volume training during the preparation period. Therefore, one-time running too much is a risk factor for injury.[11] Although in the univariate analysis, there are statistically significant differences in the two variables of marathon completion history and weekly running volume between healthy and injured people. The weekly running volume has less influence on injury than other factors. It was corrected during the multivariate regression process, and the regression equation only retained the variable of marathon race history. Therefore, it can be inferred that the impact of one-time overload on injury is greater than the cumulative load in a certain period. This is consistent with the results of other studies.

Running habit maintenance time is also an important factor affecting the occurrence of RRI. For each level increase during this time, the risk of damage increases by 1.336 times. The longer the running habit is maintained, the longer the exposure time and the more cumulative injury events. Participation time may not be a risk factor for a new RRI. Therefore, if we want to study this situation, we need to use the incidence rate instead of the injury component ratio for analysis. However, this study was a cross-sectional survey and could not accurately obtain the exercise time before the injury. Therefore, we cannot make relevant statistics.[12] If the participation time is proportional to the incidence of injury, the accumulation of exercise load exceeding the body's acceptable threshold will cause injury. This is related to the excessive accumulation of exercise load or the relatively insufficient exercise capacity of the runner. If participation time is inversely proportional to injury incidence, participation time itself is not a risk factor for injury. Whether the injury occurs is more related to the runner's athletic ability and running proficiency.

The difference in the composition ratio of the number of healthy and injured respondents who exercise on the road and the treadmill is statistically significant. The risk of RRI when exercising on the road is 1.9 times that of the treadmill. Similar results also exist on treadmills and crossroads. The risk of injury between the treadmill and the rubber track is almost equal. It is inferred that the higher risk of damage on mixed roads also comes from road running. Therefore, the overall result of the running roads is not statistically significant. It has a certain clinical significance. It is not recommended for amateurs to run on the road. Because compared with treadmills and rubber tracks, the cushioning of asphalt or cement roads is weaker. The ground reaction force generated by it is greater. Asphalt or cement roads will harm the body and lead to an increase in the incidence of injury.

CONCLUSION

Amateur runners first recommend that they fully relax after exercise. At the same time, they should try their best to develop sports on treadmills or rubber tracks. It is not recommended to exercise excessively at one time. The training plan should be a small number of times.

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