

CZECH MOUNTAINEERING ASSOCIATION

MEDICAL COMMISSION

MEDICAL ASPECTS IN MOUNTAINEERING

PROCEEDINGS of the UIAA MOUNTAIN MEDICINE CONFERENCE

- I. ACCIDENTS AND INJURIES IN MOUNTAINEERING
- II. ACCIDENTS IN HIGH ALTITUDE MOUNTAINEERING
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EDITED BY

Ivan ROTMAN

Medical Commission of the Czech Mountaineering Association
Section for Mountain Medicine
of the Czech Society of Sports Medicine
Department of Sports Medicine OÚNZ Děčín CS-405 01 Děčín I,
Czechoslovakia

Pavel VESELÝ

Medical Commission of the Czech Mountaineering Association
Section for Mountain Medicine
of the Czech Society of Sports Medicine
Institute of Molecular Genetics -
Czechoslovak Academy of Sciences
Flemingovo nám. CS-160 00 Praha 6, Czechoslovakia

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Ivan Rotman

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ETIOPATHOGENESIS OF OVERUSE INJURIES OF THE HAND IN EXTREME ROCK CLIMBERS

I. Rotman⁽¹⁾, M. Staněk⁽¹⁾, P. Veselý^(1,2), D. Zicha⁽²⁾, T. Havránek⁽³⁾, T. Skříčka⁽¹⁾

⁽¹⁾ Medical Commission of the Czechoslovak Mountaineering Association, Czechoslovakia

⁽²⁾ Institute of Molecular Genetics, Czechoslovak Academy of Sciences, Prague

⁽³⁾ General Computing Centre, Czechoslovak Academy of Sciences, Prague, Czechoslovakia

Abstract

An attempt was made to analyse data on overuse injuries of the hand in 100 Czechoslovak sport climbers taking part in extreme climbing competitions in 1987 (Rotman et al, Davos 1988; see also poster of this Conference – Staněk et al.: Health complaints and finger deformities in Czechoslovak sport climbers) The GUHA⁽¹⁾ method – Package of Programmes for Exploratory Data Analysis, Programme "assoc" was used.

The GUHA programme is an original Czechoslovak approach to uncovering all possible interrelationships in a set of data and defining all significant correlations. GUHA was used with the hope to provide an insight into all possible factors related to the etiopathogenesis of the overuse injuries of the hand. The data collected and used as variables (antecedents and succedents) describe anthropometric parameters, professional and sport activities, modes of training, localization of health complaints, and objective signs of finger damage, e.g. finger deformities, particularly nodes, fusiform swellings, and flexion deformities affecting finger joints in extreme climbers.

The results of this approach will be reported and discussed.

⁽¹⁾Hájek, P. Havránek, T.: Mechanizing hypothesis formation – mathematical foundations for a general theory, Springer Verlag, Heidelberg 1978.

Introduction

The adverse effects of chronic overloading upon sport climber's upper extremities, especially finger tendons and finger joints are already described by many authors (Tab. 1).

Table 1. Literature describing finger injuries in climbers.

CLARKE	1984	England
BARTSCHI & RADLINBER	1986	Switzerland
BURTSCHER & JENNY	1986	Austria
KRAUSE & REIF & FELDMEIER	1986	Germany
LEAL & RANE & HERRERO	1986	Spain
ROTMAN & PELIKÁN	1986	Czechoslovakia
BOLLEN	1988	England
ROTMAN & STANĚK & VESELÝ	1988	Czechoslovakia

Methods

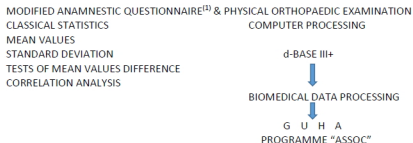
Data on overuse injuries of the hand in 100 Czechoslovak sport climbers taking part in extreme climbing competitions and examined in 1987 were analysed first by means of classical statistical methods. Then an attempt was made to analyse these data applying the Package of Programmes for Exploratory Data Analysis (GUHA) to the evaluation of the data collected and used as variables

– antecedents and succedents – in regard to presumable role of the antecedents as causes of the overuse injuries, factors involved in the etiopathogenesis respectively (Table 2, Table 3)

Table 2. Variables recorded in 100 sports climbers

A N T E C E D E N T S	S U C C E D E N T S
SEX	LOCALIZATION OF LONGLASTING PAIN
AGE	– SHOULDER
BODY HEIGHT	– ELBOW
BODY WEIGHT	– FOREARM
BROCA INDEX	– WRIST
OCCUPATION	RIGHT HAND
OTHER WORK AND SPORT ACTIVITIES	1st – 5th FINGER
	– FINGERS
DURATION OF CLIMBING ACTIVITY	LEFT HAND
CLIMBING DIFFICULTY GRADE REACHED	1st - 5th FINGER
SUMMER AND WINTER TRAINING	LOCALIZATIONKINDS OF DEFORMITIES
STRUCTURE OF TRAINING	
	RIGHT HAND LEFT HAND
COURSE OF THE TREATMENT	
	FINGER 1 st – 5th
MANNER OF GRIP	
	JOINTS – METACARPOPHALANGEAL
PREVIOUS FROSTBITES	– INTERPHALANGEAL – PROXIMAL
	– DISTAL
	FUSIFORM SWELLINGS, NODES, FLEXION DEFORMITIES

Table 3. Data processing



In 100 climbers there were 191 variables recorded and consequently 19,100 data collected. Therefore only a very small part and some examples of results can be presented.

Results

Some of results obtained using classical statistical methods are shown in Tab. 4 and Tab. 5. Only 24 out of 100 climbers had no complaints in the upper extremities, 69% complained long-lasting pain, 51% in fingers only. Fusiform swellings, nodes and flexion deformities of finger joints were present in 44%. The most affected were the 3rd and the 4th finger, especially the proximal

interphalangeal joint of the 3rd finger. However both parameters – pain and/or deformities – were observed in 52 out of 69 climbers (75%) surmounting climbing difficulty-grade from 7* to 10* (UIAA).

Table 4. Characteristics of 100 climbers.

MALE : FEMALE	84 : 16	
AGE <years>	23.6 ± 5.1	range: 15 – 38
BODY HEIGHT <cm>	175.4 ± 7.9	154 – 194
BODY WEIGHT <kg>	66.6 ± 9.3	40 – 89
BROCA index	88.2 ± 7.3	72 – 110
UIAA max	8* ± 1.0	4* to 10*

LONGLASTING PAIN in UPPER EXTREMITIES 69%

in FINGERS ONLY 51%

FINGER DEFORMITIES 44%

PAIN and/or DEFORMITIES in 52 out of 69 climbers (75%)
surmounting climbing difficulty grade (UIAAmax)
from 7* to 10*

The climbers with painful fingers and/or finger deformities were slightly older, climbed less frequently, but practised specialized strength training more frequently than climbers without these symptoms and decreased or stopped climbing during their health complaints less frequently.

GUHA method evaluates the significance of hypotheses about association between two logical expressions – antecedent and succedent, each of them having in general the form of logical conjunction.

Table 5. Presumable factors involved in the etiopathogenesis.

CLIMBERS		pain and/or deformities	without symptoms	P
AGE	Years	23.9 ± 5.1	20.9 ± 3.5	0.05
PERFORMANCE	UIAAmax	8 ± 0.8	8* ± 0.9	n.s.
SUMMER CLIMBING	Days a week	3.0 ± 1.6	3.5 ± 1.5	n.s.
WINTER CLIMBING	Days a week	1.2 ± 0.9	1.8 ± 1.3	0.05
SPECIALIZED TRAINING	Days a week	2.8 ± 1.8	1.4 ± 1.1	0.01

Table 6. G U H A – PROGRAMME "ASSOC" (Language: Fortran IV<H>)

SEARCH FOR POSITIVE ASSOCIATIONS
BETWEEN DERIVED TWO – VALUED
QUANTITIES

FOUR-FOLD CONTINGENCY TABLE

	S1	S0
A1	A	B
A0	C	D

e.g. is the number of objects satisfying antecedent <A>
and not satisfying succedent <S>

Table 7. Hypothesis 1:

NO WINTER CLIMBING 1 DAY A WEEK AND LESS FREQUENTLY <-----> FROSTBITE

	S1	S0	
A1	15	26	41
A0	13	46	59
	28	72	100

Hypothesis 2:

WINTER CLIMBING 1 DAY OR 2 DAYS A WEEK ←-----> FROSTBITE

	S1	S0	
A1	14	17	31
A0	14	55	59
	28	72	100

Hypothesis 3:

WINTER CLIMBING 3 DAY A WEEK AND MORE OFTEN <-----> FROSTBITE

	S1	S0	
A1	27	63	90
A0	1	9	10
	28	72	100

To become acquainted with results obtained by means of the programme GUHA – "ASSOC", the relationship between training frequency in winter and frostbite incidence in fingers can be studied (Table 7). There were three hypotheses printed showing significant positive association between winter climbing frequency one or two days a week and frostbite incidence in these climbers (hypothesis 2). The hypothesis 2 states: there are 31 climbers climbing one or two days a week in winter, 14 of them have suffered from frostbites and 17 climbers not. On the other side, there are 69 climbers who do winter climbing either more or less frequently but the incidence of frostbite in their past history is twice smaller: only 14 of 69 have suffered from frostbites. Hypotheses 1 and 2 state that there is significant frostbite incidence when the climber do not winter climbing both once a week and less frequently or three days a week and more often, respectively.

GUHA RESULTS

BESIDES CONFIRMING SOME NOTORIOUSLY KNOWN TRUTHS LIKE CLIMBERS WHO

– ARE OLDER & HEAVY

> HAVE TROUBLES

– ARE OLDER & CLIMB HARD & TRAIN HARD

SHOWED RATHER INTERESTING NONTRIVIAL AND STIMULATING ASSOCIATIONS, E.G. THAT CLIMBERS WHO ARE

– OLDER & CLIMB MODERATELY IN WINTER & DON'T CLIMB ABOVE 9' UIAA

– OLDER & CLIMB FREQUENTLY IN SUMMER & TRAIN HARD

DO NOT HAVE SUBJECTIVE TROUBLES (P A I N)

BUT DO HAVE OBJECTIVE FINDINGS AT MEDICAL EXAMINATION

WHAT DOES THIS MEAN?

DISSIMULATION or INBORN ANATOMY or SHORTCOMINGS IN EXAMINATION?

Summary

1. The reported results of an investigation of Czechoslovak sport climbers conform to data in the literature, showing that the prevalence of overuse injuries of the hand in sport climbers is extremely high.
2. Any joint which has been subjected to constant strenuous usage is apt to develop degenerative (osteoarthritic) changes.
3. Using the GUHA programme for the statistical analysis of data gathered about climbers and their overuse injuries has revealed a necessity of restructuring data collection and redefining both antecedents and succedents. This together with new data could ensure exploitation of the full potential of GUHA. Up to the present, the use of GUHA has confirmed a preliminary statistical evaluation of the data and has provided some insight into the problems studied that would otherwise not have been obtained. GUHA will therefore guide us in future work.
4. The present style of uncontrolled and unqualified training does not lead to a rise in climbing performance; on the contrary, it leads to finger injuries and finger deformities.
5. There are certainly also other factors than training, especially genetic ones, that determine a climber's biotype and thus predispose him/her to high climbing performance or that are responsible for susceptibility to damage resulting from chronic overloading in extremely difficult climbing.
6. More detailed studies on the role of biotype and other predisposing factors are required.
7. Because of very difficult treatment of finger overuse injuries, prevention is of paramount importance to sport climbers. This especially concerns the structure, frequency, and intensity of training.
8. Prevention has at least two facets:
 - a) on the climber's side
 - education in self-knowledge,
 - education and training in self-control,
 - creation of a system of training respecting the climber's individual potential and including adaptation of the climber's life style to the purpose.
 - b) on the health-care side
 - development and verification of criteria for biotypology of climbers,
 - development of a new training-system scheme
 - organization adequate education and training courses.

Conclusions

1. Current results indicate close association between a climber's top performance, absence of overuse injuries, and "optimal biotype".
2. Further research is needed to define the "optimal biotype" for top sport climbing.
3. A system of education and training for sport climbers based on the above guidelines should be developed.

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