

# Ski injury epidemiology: The need of speaking the same language

Athanasios Zacharopoulos

Orthopaedic Surgeon

General Hospital of Amfissa

National Secretary for Greece of:  
SITEMSH and ISSS

# Epidemiology:

The study of the frequency and determinants of trauma or disease.

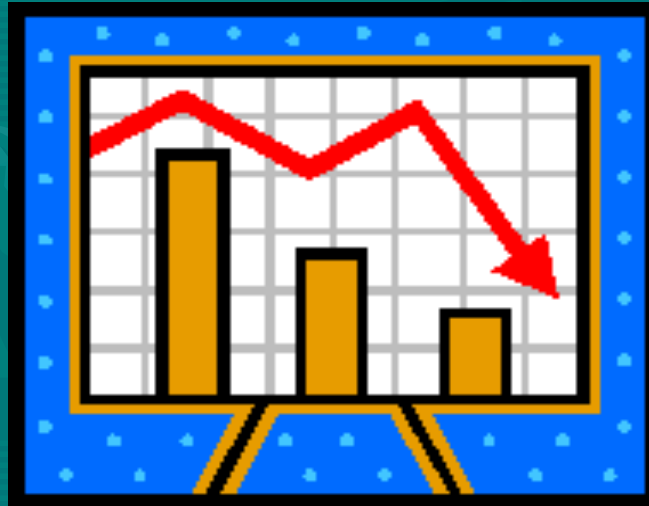


# Epidemiologic Studies

1. Relate the patterns of injury occurrence to causative factors
2. Describe the deleterious patterns of injury or disease
3. Gain insight into the ways of decreasing injury or disease

# Epidemiologic Studies

Also have important applications in determining the effectiveness of the treatment of the injured athlete.



# Why do we need epidemiological studies in skiing?



# Ski Injury Research

Combines epidemiology and clinical medicine to:

- analyze the frequency and determinants of injuries sustained by athletes,
- to alter patterns of participation which contributes to injury and
- to prevent injuries

# Ski Injury Research

But, of course, requires:

- Time by the investigator
- Money
- Knowledge of epidemiological techniques



# Ski Injury Research

Few investigators have, at the moment, the necessary knowledge in the field of ski injury medicine epidemiology to successfully undertake such research.



# Ski Injury Research

The complexity and magnitude of epidemiology research has overwhelmed many inexperienced researchers.



# Ski Injury Research

Don't hesitate to ask for help

- Epidemiology consultant
- Data management professional



# Ski Injury Research

Even before starting the project, seek help to insure that it is based on clearly defined questions and an appropriately structured protocol.

**Καταγραφή Τραυματισμών στα Χειμερινά Αθλήματα**

Περιοχή:  Κελλάρια  Φτερόλαια  Χελμός  3-5 Πηγάδια Νο.....

Ημενία:..... Ημερ:.....  Άνδρας  Skier  
 Ονοματεπώνυμο:.....  Γυναίκα  Snowboarder  
 Διεύθυνση:.....  Snowblades  
 Τηλέφωνο επικοινωνίας:..... Υψος:.....cm  Επισκέπτης  
 Ηλικία:..... Βάρος:.....Kg  Εργαζόμενος  
 Ο τραυματισμός έγινε πριν από ..... λεπτά

Προσέρχεται:  Χωρίς συνοδεία  Συνοδεία διπλάστη  Συνοδεία άλλων

Αριθμός Κακώσεων:  1  2  3  4  5 (Αν > 1, ταξιθέστε γραμμής μετά) αριθμό και κατάσταση)

Αριστερά  Κεφαλή  Πρόσωπο  Αγκώνας  Στήλη  Θώρακας  Κοιλία  
 Δεξιά  Πλυσ  Ηρωσάνας  Αγκώνας  Αντιβράχιο  Κορσός  Αντίχειρας  
 Χέρι  Πόδιος  Πσχο  Μηρός  Επιγονατίδα  ΠΑΚ  
 Ακρος Πόδας  Γόνατο-Εσσο  Γόνατο-Εξσο  Άλλο.....  
 Γόνατο-γρνακά  Γόνατο-ACL  Άλλο.....

Εκδορές  Λύση δέρματος  Εκπόρωση-θλάση  Διάτωση-Διάστρωμμα  
 Ξεφύφημα  Κάταγμα  Αιμόλυα συνείδησης  Φοκταή βλάβη  
 Άλλο.....

Παθολογικό αίτιο:.....

Πριν από τον τραυματισμό προηγήθηκε:  Αντιμετώπιση ασθενούς:.....  
 Λήψη αίμασ  Λήψη φαρμάκων

Εξοπλισμός: <input type="checkbox"/> Ski σμηφιακά <input type="checkbox"/> Ski Carving <input type="checkbox"/> Snowboard <input type="checkbox"/> Snowblades <input type="checkbox"/>	Εξοπλισμός: <input type="checkbox"/> Ενοκίαση <input type="checkbox"/> Ατομικός <input type="checkbox"/> Λενομένα	Ρούχα: <input type="checkbox"/> Κατάλληλα <input type="checkbox"/> Ακατάλληλα	Προστατευτικά: <input type="checkbox"/> Κράνος <input type="checkbox"/> Καρσός <input type="checkbox"/> Γόνατο	Συνθήκες: <input type="checkbox"/> Αίθρας εισρός <input type="checkbox"/> Σύννεφα <input type="checkbox"/> Βροχή <input type="checkbox"/> Ψιόν <input type="checkbox"/> Ομίχλη <input type="checkbox"/> Ισχυροί άνεμοι
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Όση ατυχήματος: <input type="checkbox"/> Εντός πίστας (κούβ?)..... <input type="checkbox"/> Εκτός πίστας <input type="checkbox"/> Lift (κούβ?)..... <input type="checkbox"/> Challe <input type="checkbox"/> Άλλο.....	Κόρυ αιτία ατυχήματος: <input type="checkbox"/> Ίδια πτώση <input type="checkbox"/> Ίδιο λάθος <input type="checkbox"/> Άλλα <input type="checkbox"/> Αποτυχία εξοπλισμού <input type="checkbox"/> Σέγκουση με skier <input type="checkbox"/> Κακή ποιότητα χιονού <input type="checkbox"/> Σέγκουση με Snowboarder <input type="checkbox"/> Άλλα <input type="checkbox"/> Άλλο.....	<input type="checkbox"/> Πατημένο χιόνι <input type="checkbox"/> Σούληρο χιόνι <input type="checkbox"/> Πούδρα <input type="checkbox"/> Απατημένο χιόνι
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Χιονοδρομείτε: <input type="checkbox"/> 1η μέρα <input type="checkbox"/> 1η βδομάδα <input type="checkbox"/> 1ος μήνας <input type="checkbox"/> 1ος χρόνοσ <input type="checkbox"/> 1-3 χρόνια <input type="checkbox"/> 4-6 χρόνια <input type="checkbox"/> > 6 χρόνια	Μαθήματα: <input type="checkbox"/> Κανένα <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> > 10	Χιονοδρομία σήμερα: <input type="checkbox"/> 0-2 ώρες <input type="checkbox"/> 2-4 ώρες <input type="checkbox"/> 4-6 ώρες <input type="checkbox"/> > 6 ώρες	Ημέρες ανά έτος: <input type="checkbox"/> 0-5 <input type="checkbox"/> 5-10 <input type="checkbox"/> > 10	Ημέρες φέτος: <input type="checkbox"/> 0-5 <input type="checkbox"/> 5-10 <input type="checkbox"/> > 10
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Κάκωση στη χιονοδρομία φέτος:  Ναι  Όχι  
 Παλιότερη κάκωση στη χιονοδρομία:  Ναι  Όχι

Θαυμάτε τον εαυτό σας:  Αρχάριο  Μέτριο  Εμπειρο  Αθλητή Εκπαιδευτή  
 Σήμερα χιονοδρομώσασι:  Μόνος  Με φίλους  Με οικογένεια  Με εκπαιδευτή  
 Το επίπεδο τους ήταν:  Ίσιο με το δικό σας  Καλύτερο  Χειρότερο

# Study Design

- Define the question
- Determine method of data collection
- Valid measurement tools
- Outside review of study design before initiation
- Appropriate statistical procedures

*Wade, Sports Injury Research, AJSM Suppl S-38, 1988*

# Study Design

## What is the question?

- A major problem in ski injury studies is establishing the hypothesis.
- The question must be finite and be answerable with the methods available to the author.

# Study Design

Hypothesis = Goal

- Investigations must have a goal
- A goal that is simple and well defined leads to identifiable results
- Research without goals (or with goals that are unlimited) likely to fail

*Wade, Sports Injury Research, AJSM Suppl S-38, 1988*

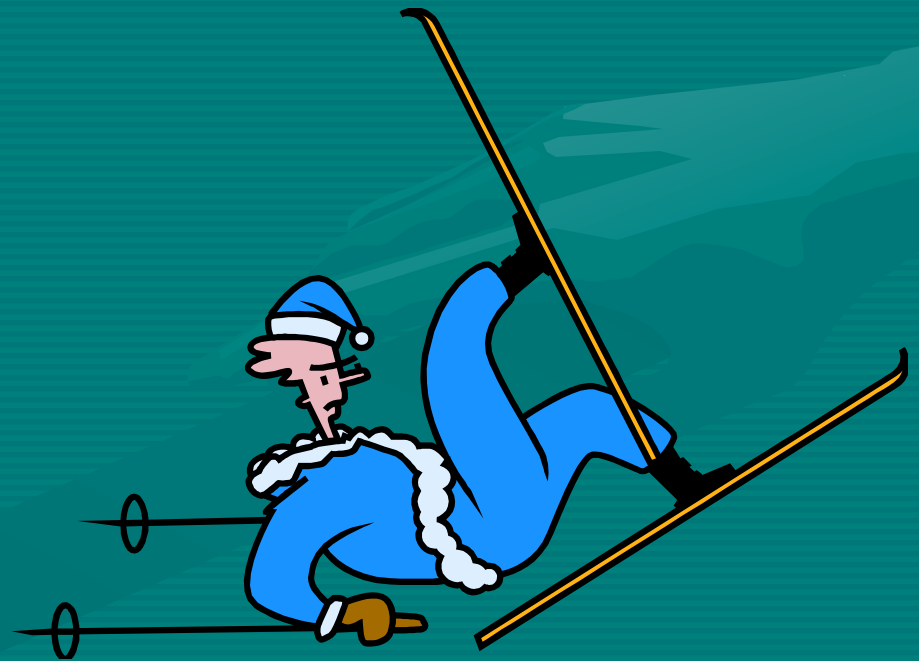
# Methods to Evaluate Problems in Skiing Injuries and Skiing Safety

## Observational studies

1. Case studies
2. Case series
3. Case control studies
4. Cohort studies

## Experimental studies

1. Non randomized clinical trial
2. Randomized clinical trial



# Case Studies

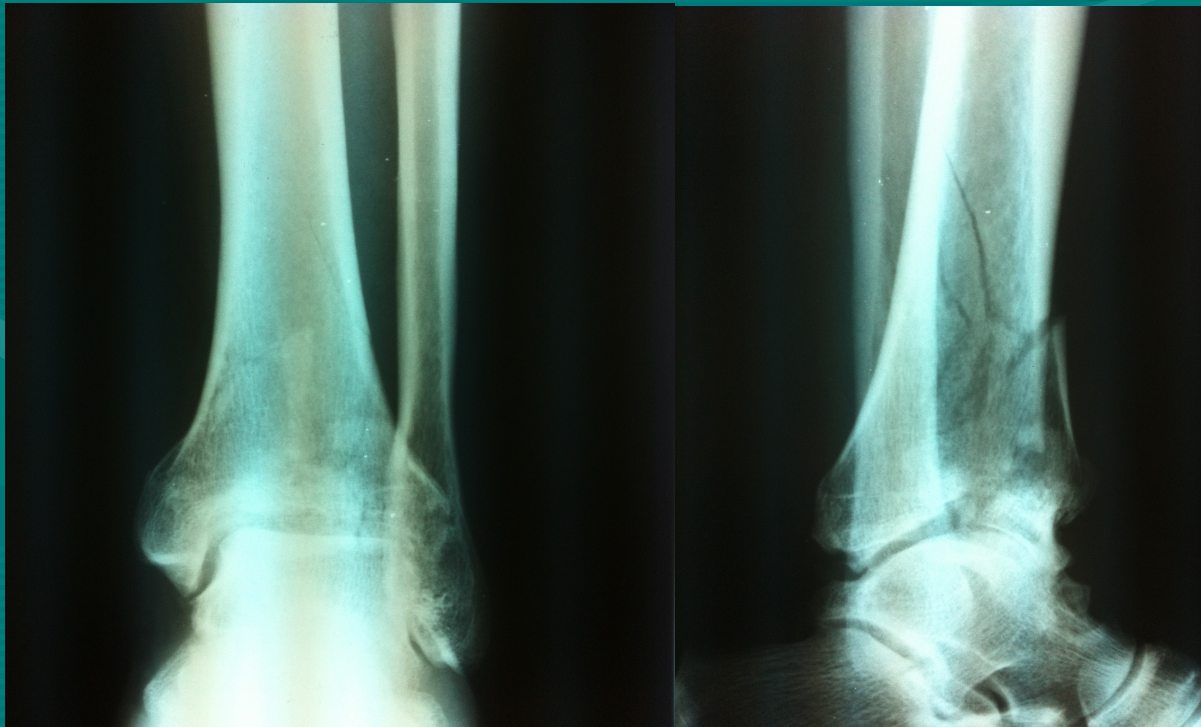
Observes a few items in great detail, but generally in an isolated manner.

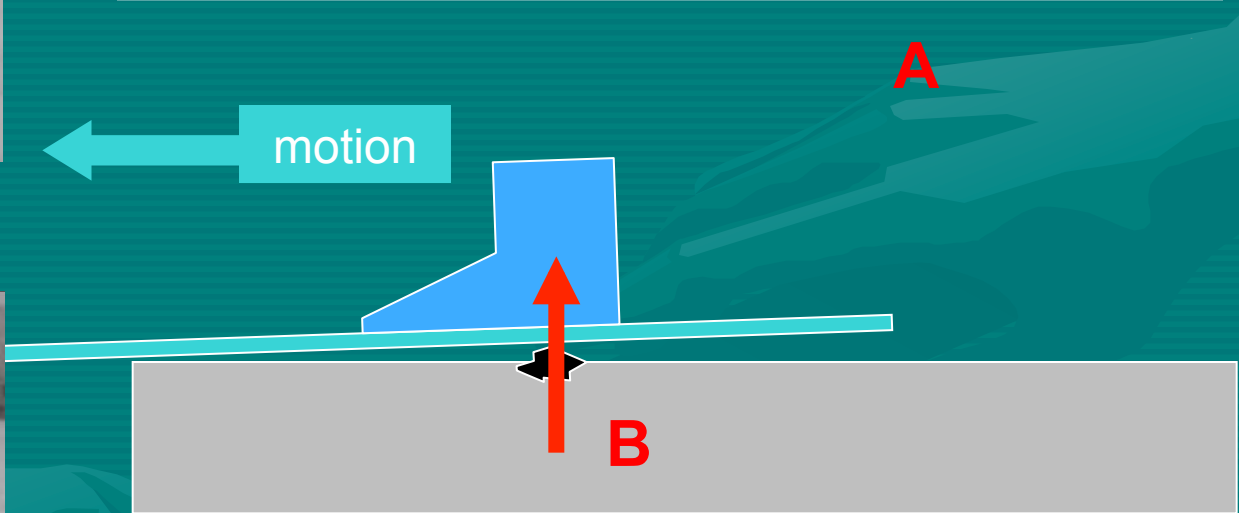
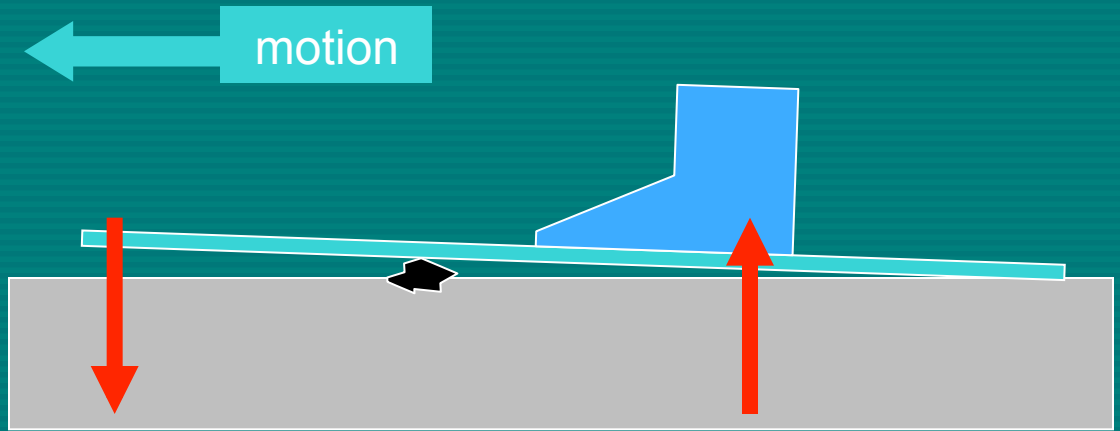
Can't be used to generalize findings to other situations involving other individuals.

# Case Studies

- *An example:*  
“An uncommon intraarticular distal tibia fracture (pilon) in a professional skier”

*Zacharopoulos ISSS 2013*





Total shank impact compression = **A + B**



- We cannot conclude that every time this fall happen will result this kind of fracture...

# Case Studies

They used:

1. To illustrate a problem
2. Stimulate interest
3. Help formulate research questions

# Case Series

## Uncontrolled “Clinical Study”

- Observes broader questions about a group of injured athletes.
- No evaluation of the population at risk. (no controls)
- Weakest of commonly used study designs – can't lead to causal or temporal conclusions

# Case Series

A mistake commonly made in case series occurs when conclusions about the group studied are transferred to the population at risk.



# Case Series

- *An example:*

Evaluation of factors resulting in injury to a group of skiers who are evaluated in a single clinic.



# Case Series

- 75% of skiers who sustained a knee sprain were found to use a specific binding.
- Cannot conclude that avoidance of that binding type could reduce the risk of injuries to all skiers.
- The population at risk is unknown.



# Case Control Studies

Observe not only the affected population, but also the population at risk.

- ✓ Deal with exposure to risk
- ✓ Comparative demographic data
- ✓ Goal - determine the injury incidence rate

# Case Control Studies

$$\text{Injury incidence} = \frac{\text{number of injured}}{\text{population at risk}}$$

# Case Control Studies

- Data are collected while investigating a naturally occurring phenomenon.
- By from their nature are retrospective.



# Case Control Studies

- Can be used to evaluate the effect of a condition, the cause, or the outcome (including treatment).

*Wade, AJSM Supp.1;p.S-53, 1998*

- In many instances case control studies are the only sufficient method of studying the cause and effect of an injury.

# Case Control Studies

- Begins at the end rather than the beginning of causal pathway. Start by identifying individuals who sustain an injury and comparing them to a control who were injury free.
- Must have:
  - ✓ A sufficient number in the study population
  - ✓ A large control demographically similar population

# Case Control Studies

## Controls:

Must have same characteristics of those in current study group. Often data required to demonstrate comparability to current group is missing.

# Case Control Study - Example

*Zacharopoulos et al. Skiing Trauma and Safety 15<sup>th</sup>  
Ed. 2008,*

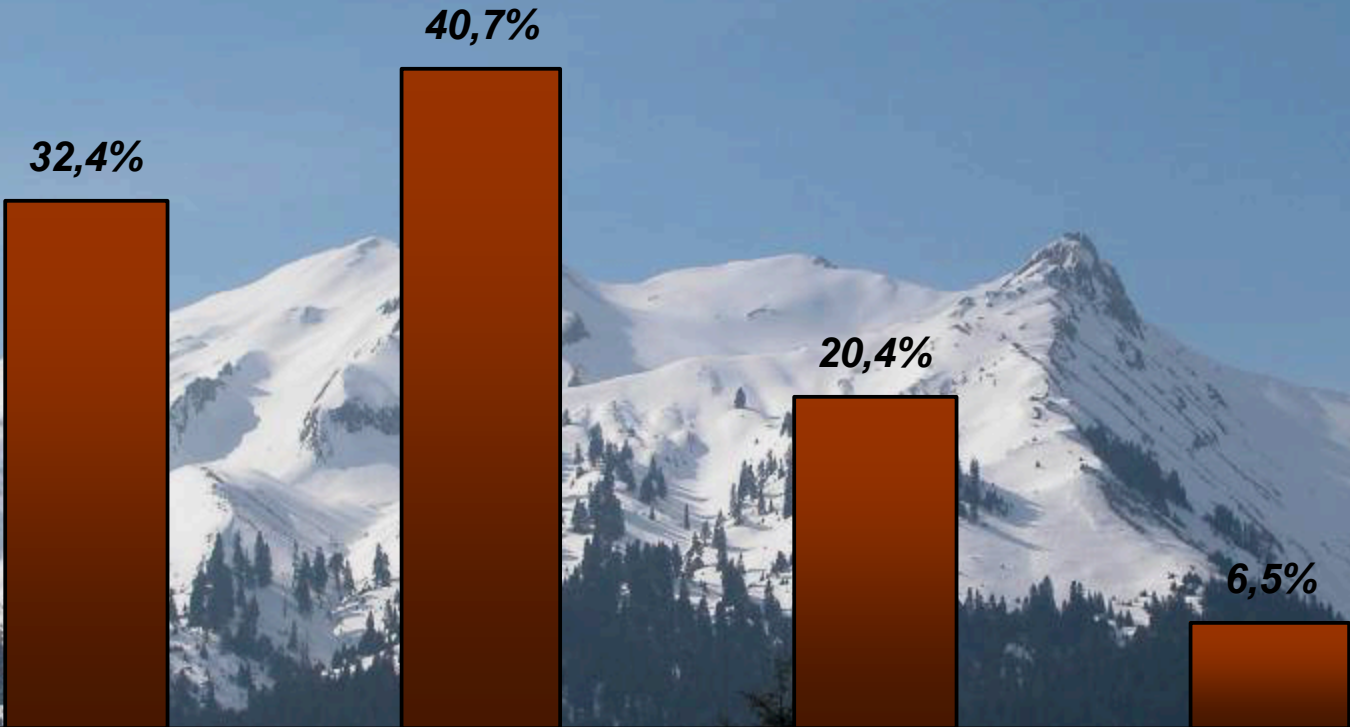
978 injured skiers

775 uninjured skiers

Evaluated risk factors for injury  
according to the level of skiers

# Level of Skiers

■ Injured



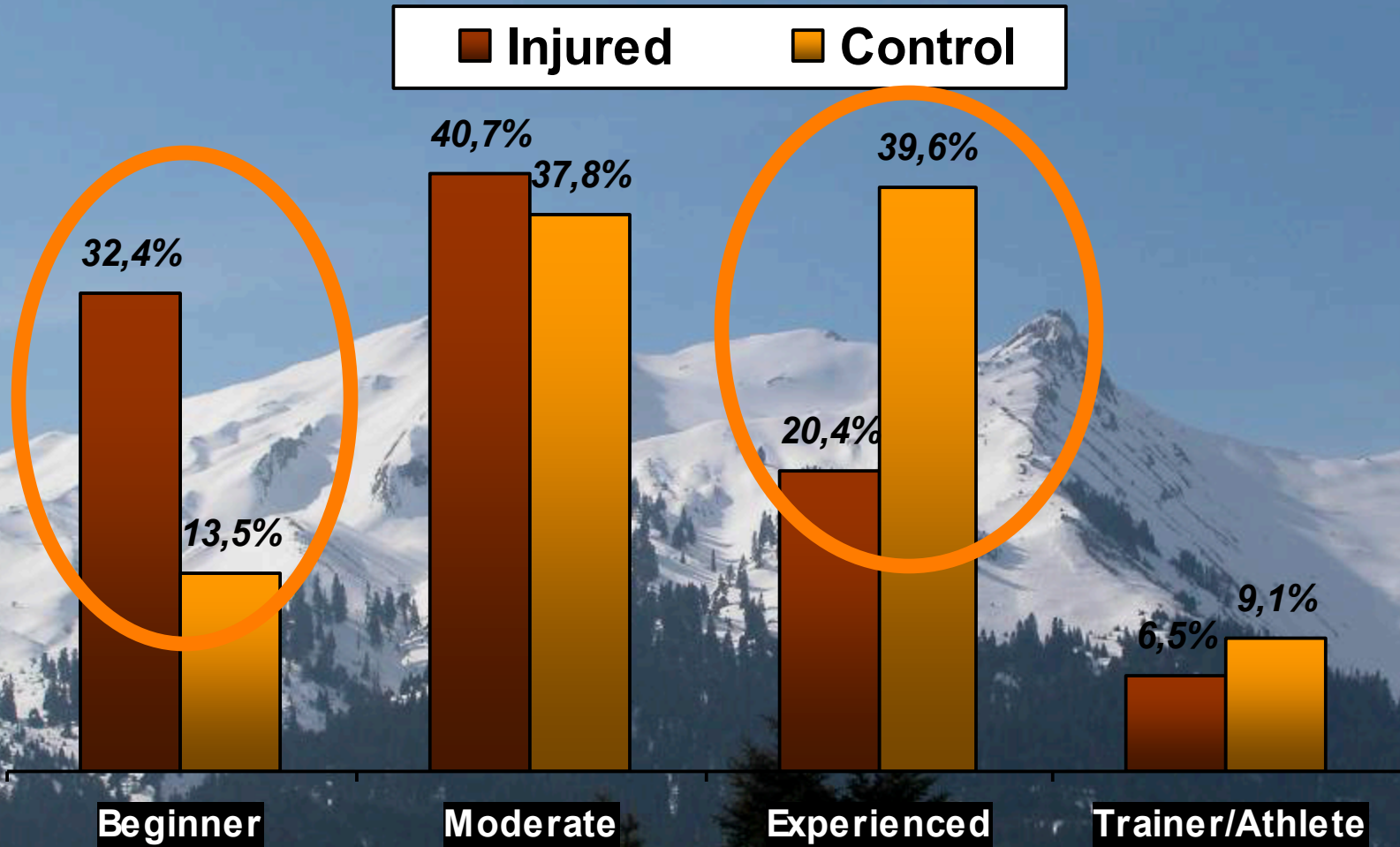
**Beginner**

**Moderate**

**Experienced**

**Trainer/Athlete**

# Level of Skiers



**Beginners are more as twice likely to be injured as the other skiers  
Conversely experience is a protective factor against injuries**

# Case Control Study - Example

From this case control study valid conclusions were drawn and recommendations made about ski experience which would reduce the risk of injury.

# Case Control Study - Example

“The findings would be difficult to obtain, if not impossible, through any other experimental method than the case control study design.

*C.E. Wade, In Sports Injury Research  
Am J Sports Med Supp 1;p. S-53, 1988*

# Cohort Studies:

## (Followup or longitudinal Studies)

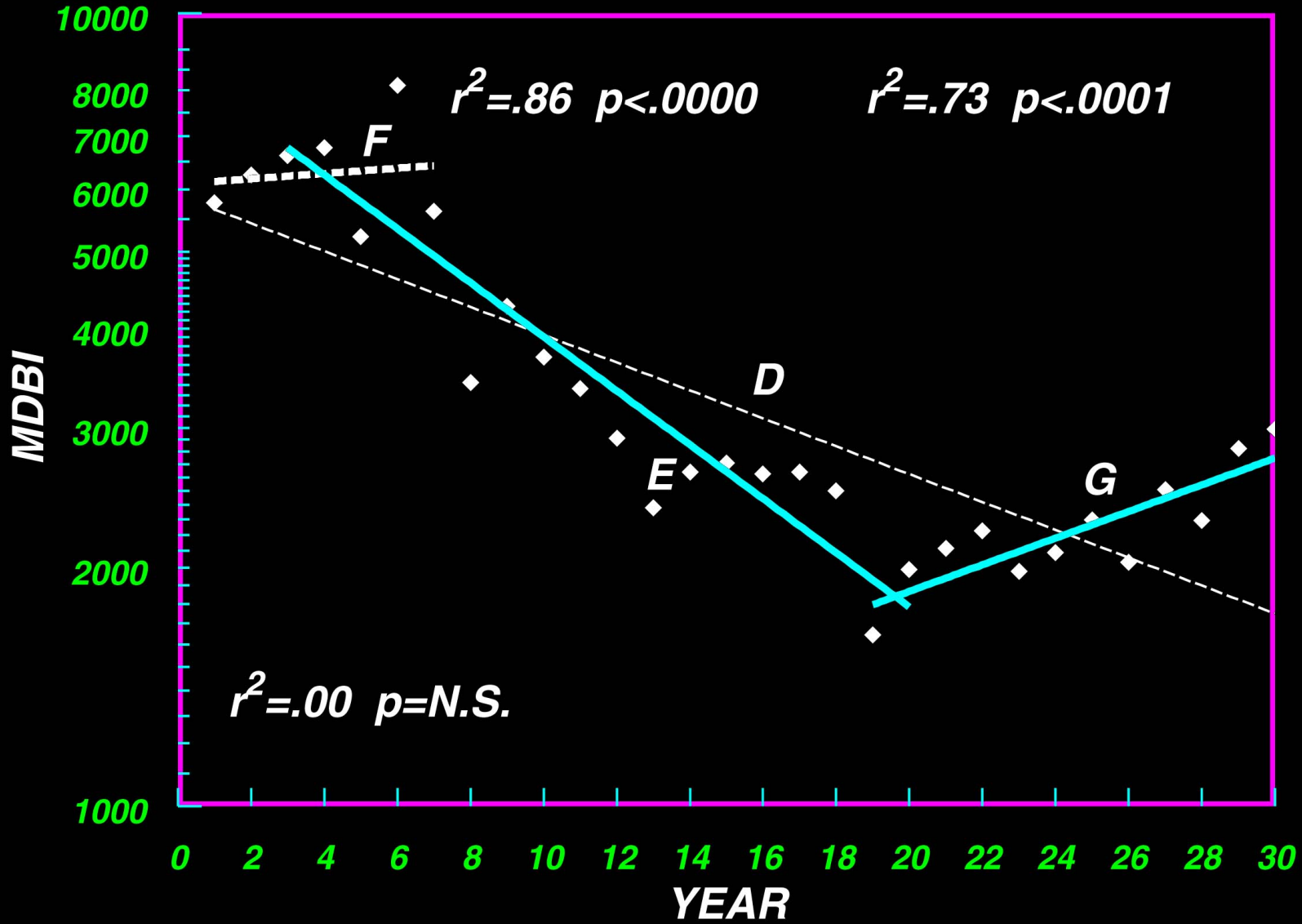
1. Identifies a population at risk of developing a condition or disease
2. Follows group forward in time
3. Risk factors are identified before study
4. Determine risk by identifying those who do and don't develop condition studied

# ACL SPRAINS (ALL)

YR1=6280 MDBI

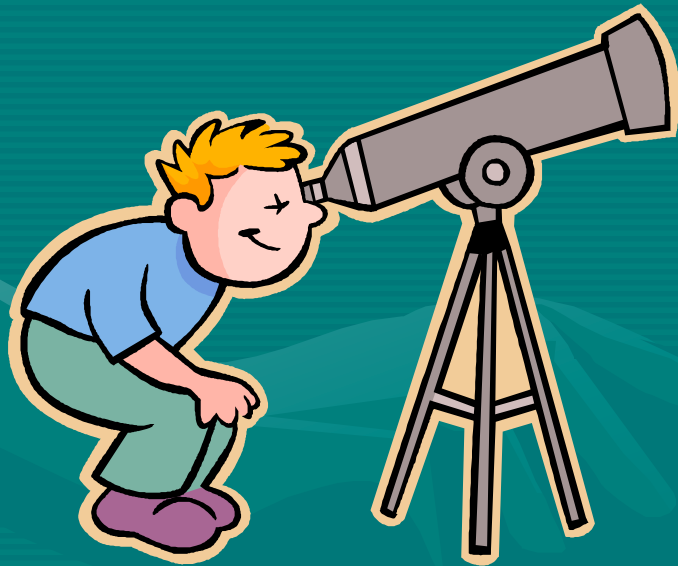
$\Delta=-129\%$

YR30=2747 MDBI



# Cohort Studies:

Often require large groups and long follow-up period



# Experimental studies: (clinical trials)

Randomized or not  
randomized

Data are recorded after or during an alteration of a system which occurs naturally or is induced during the study.



# Randomized Clinical Trial

- ❖ Most powerful research tool – experimental
- ❖ Best method to determine which treatment method is most effective
- ❖ Is the “golden way” for determining the medical truth

# Randomized Clinical Trial

1. Expensive
2. Demanding
3. Requires cooperation of many experts
4. Often very complex

# Randomized Clinical Trial

Well designed randomized clinical trial studies can be used to determine whether or not changes in protective equipment, rules changes, or other attempts to make sports safer, can be truly effective



# Ski injury researchers mostly use:

**case control studies**, analyzed with multivariate logistic regression, to investigate the injury incidence and the risk factors for injury

and

**randomized clinical trials** to determine the effectiveness of the new equipment.

They use also the two Major Indexes for calculating the ski injury rates:

**1. Injuries Per Thousand Skier Days (IPTSD)**

$$IPTSD = \frac{\text{number of injuries}}{\text{number of skier days}} * 1000$$

**2. Mean Days Between Injury (MDBI)**

$$MDBI = \frac{\text{number of skier days}}{\text{number of specific injury}}$$

# Problems with ski injury epidemiology make comparisons between studies difficult.

Variations in:

1. Injury definition
2. Methods of quantifying the at risk population
3. Measuring exposure to risk (skier days)
4. Site where data obtained – ski area clinic - hospital
5. Bypass effect – not all injured skiers report to the ski patrol or clinics near the ski area

# Questions that have to be answered

What is considered as “medically significant injury”?

- Those which required medical treatment and/or hospitalization?
- Those which keep a person from skiing for the rest of the day, for one day or how many days?
- Or anyone on admission at the medical center?

# Questions that have to be answered

Where and how injury data collected?

- Ski patrollers?
- Ski area's medical station?
- Nearby medical center or hospital?

And how can we be sure for the exact diagnosis?

# Questions that have to be answered

How we determine the “skiers days”?

- Total tickets numbers?
- Ski passes?
- Lift passages?



# Questions that have to be answered

How we can determine the skier's experience level?

- Self estimated?
- Number of lessons: when (last week or totally) and from whom (ski instructor, a friend or combined)?
- Hours of skiing and when: last week, last month, last year?

# Questions that have to be answered

What we mean exactly with “collision”?

- The fall over a person or an obstacle during free riding?
- A strike from the back while standing or skiing with low speed?
- Or a fall from a height on the ground?



# Questions that have to be answered

How we can estimate the quality of the protective equipment?

- Rented or personal?
- Wrist guards: flexible, rigid, long, sort?
- Helmets, knee braces, sun glasses etc?



# Questions that have to be answered

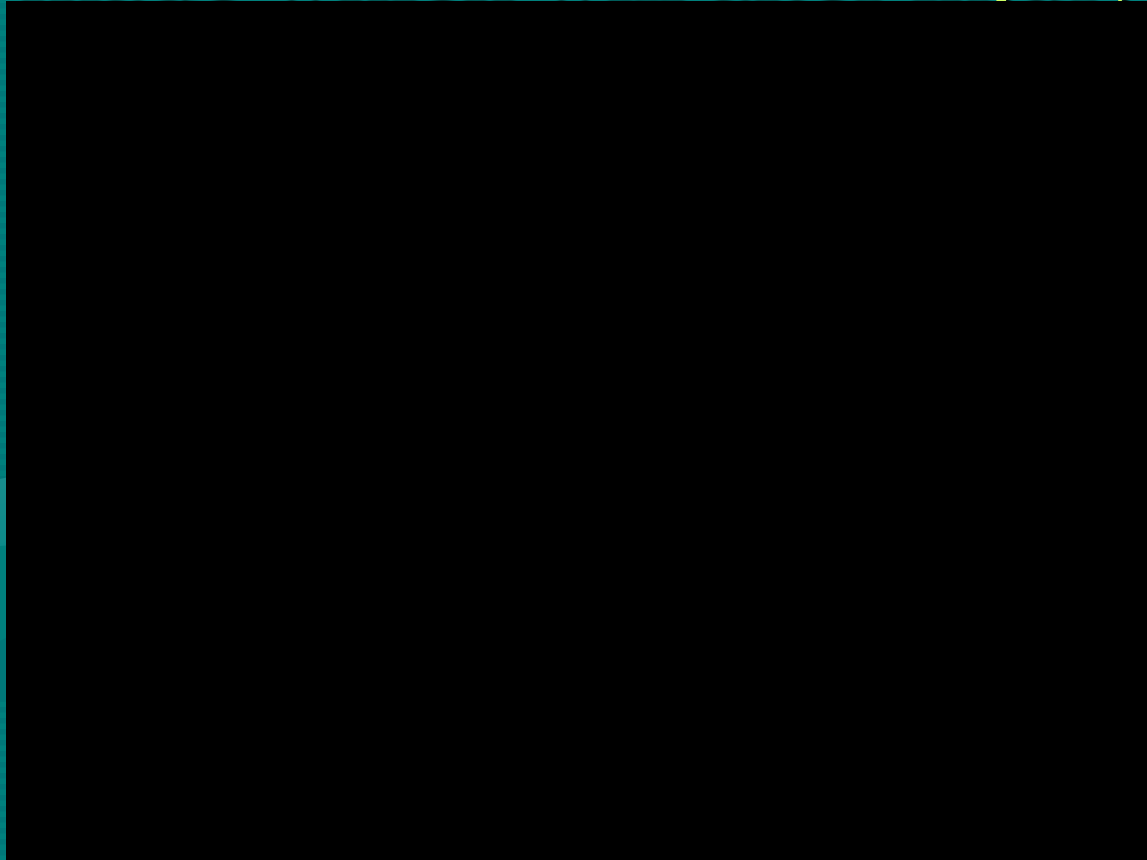
What is the best method for collecting data from snowparks?

- Different designs
- Different population
- Different activity

# CONCLUSIONS



**Too many studies provide only descriptive data and not the critical analysis required to address specific questions so that recommendations can be made which will alter injury rates**



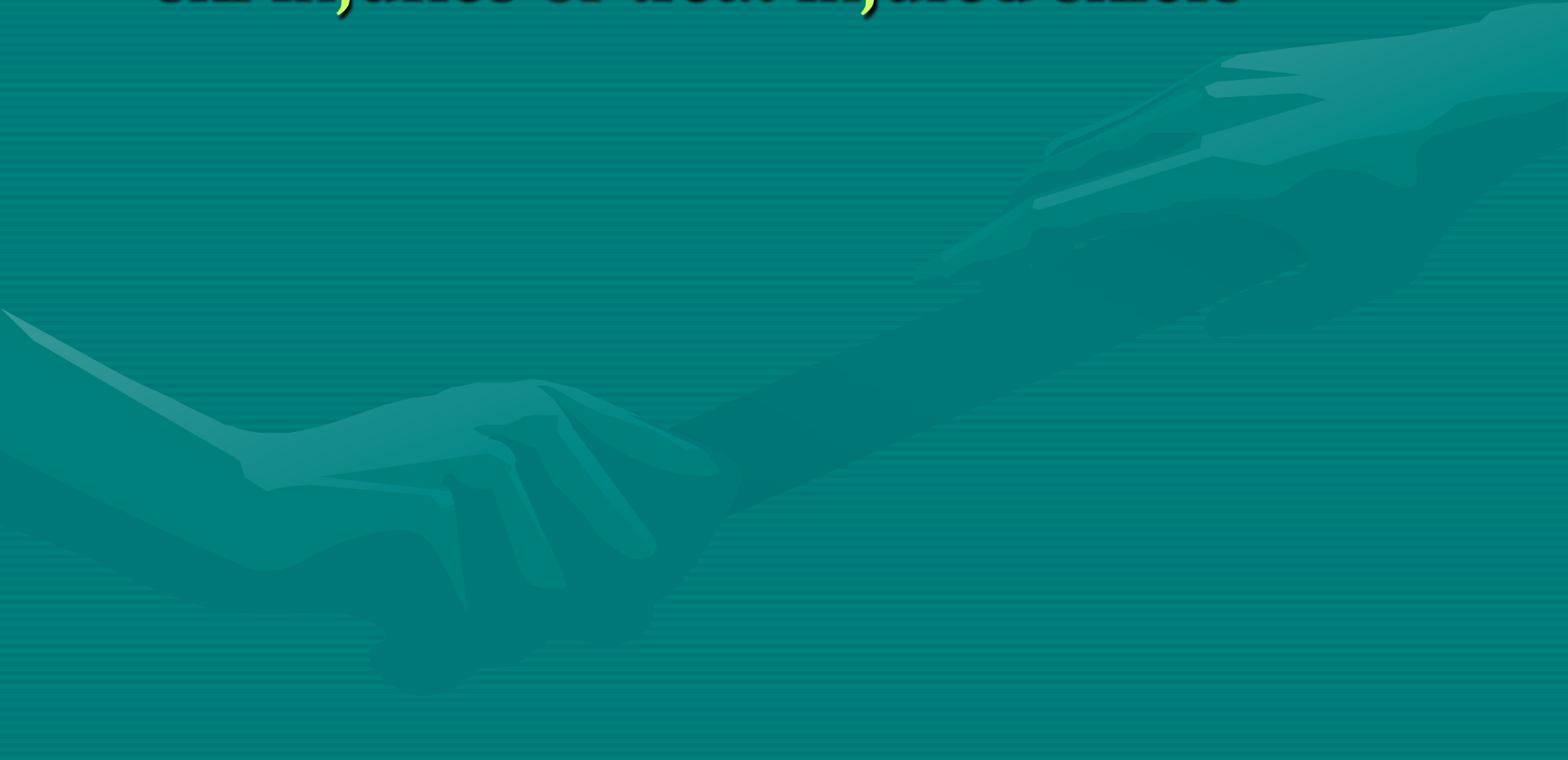
**We need interested and well trained  
investigators willing to spend the amount  
of time necessary to produce well  
designed epidemiologic studies.**



Future studies must focus on speaking  
the same language and effectively  
eliminate biases or,



- otherwise we will continue to be in difficulties in our efforts to determine the best method to reduce the risk of ski injuries or treat injured skiers



# خىلىلى مەن ون

## EYXAPICTΩ

