Nutrition

for Sport and Exercise, Third Edition

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J. Andrew Doyle

1 Introduction to Sports Nutrition

Learning Objectives

- Why you need an integrated training and nutrition plan
- Basic nutrition principles and how they might be modified to meet the needs of athletes
- List sports nutrition goals
- Outline the basic issues related to dietary supplements and ergogenic aids
  - Legality, ethics, purity, safety, and effectiveness
- Distinguish between types of research studies, weak and strong research designs, and correlation and causation
- Compare and contrast the academic training and experience necessary to obtain various exercise and nutrition certifications

1.1 Training, Nutrition, and the Athelete

- Sports nutrition
  - –A blend of nutrition and exercise physiology
  - –Based on sound scientific evidence
  - –Requires some “art” to apply scientific principles to humans

The Term Athlete Is Very Broad and Inclusive

- A person who participates in a sport
  - Elite, well-trained, recreational


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AP Images/St. Joseph News-Press, Jessica A. Stewart


Steve Cole/Digital Vision/Getty Images

Physical Activity, Exercise, and Sport Differ from Each Other

- Physical Activity — bodily movement resulting in an increase in energy expenditure above resting levels
- Exercise — physical activity that is planned, structured, and purposive
- Sport — competitive physical activities

AP Images/Sang Tan

Physical Activity, Exercise, and Sport Differ from Each Other

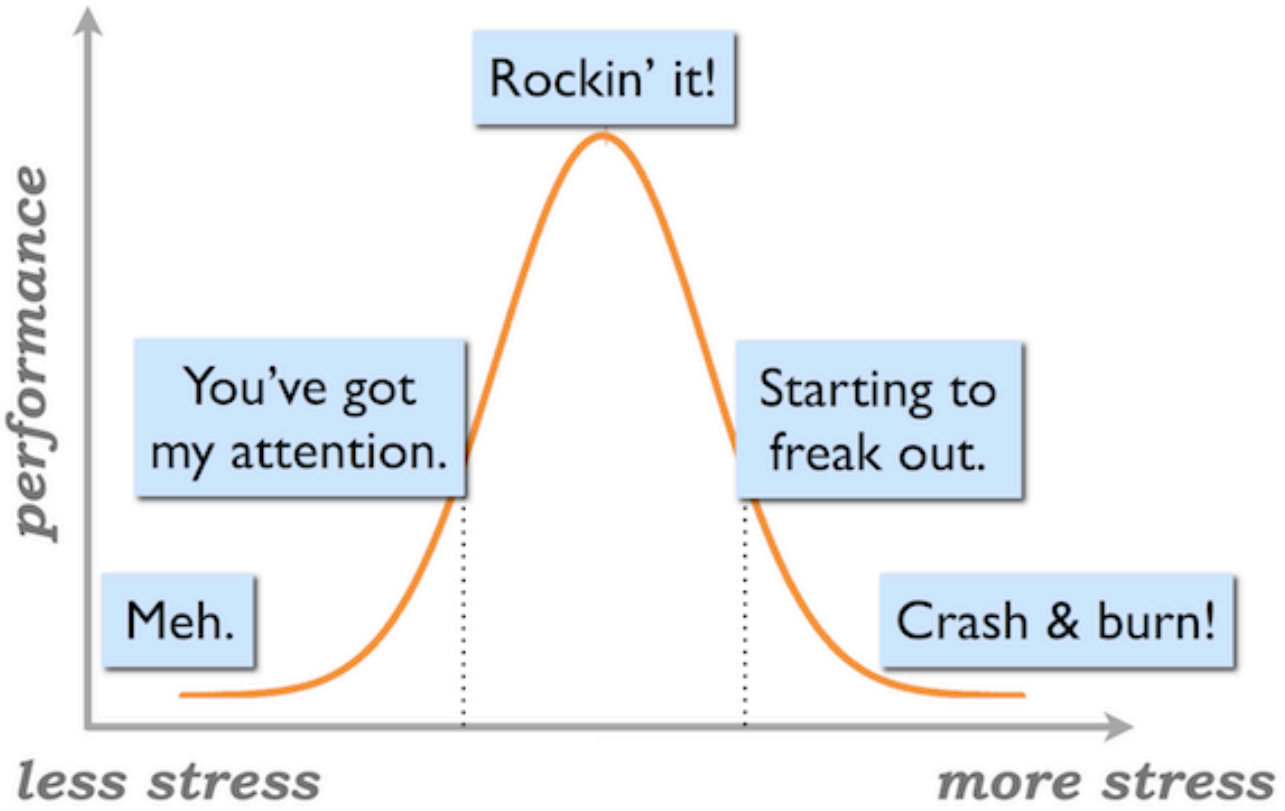
- Exercise
  - Aerobic — with oxygen
    - Oxidative phosphorylation
    - Can be prolonged
    - Requires endurance
  - Anaerobic — without oxygen
    - Creatine phosphate
    - Anaerobic glycolysis
    - Short in duration
    - High in exercise intensity

Training and Nutrition Go Hand in Hand

- Skill development
- Sports specific training
  - –Cardiovascular fitness
- Consistent daily proper nutrition
- Nutrition for recovery

Nutrition Supports Training, Recovery, and Performance

- General training goals
  - Improving performance
  - Improving specific components of fitness
  - Avoiding injury and overtraining
  - Achieving top performance for selected events (i.e., peaking)



6 Long-Term Sports Nutrition Goals

1. Suitable energy intake
2. Replenish muscle and liver glycogen with carbohydrates
3. Protein intake for growth and repair
4. Hydration
5. Diet to maintain good health
6. Healthy weight and body composition

5 Short-Term Sports Nutrition Goals

1. Consume enough food and beverages to delay fatigue
2. Minimize dehydration/hypohydration
3. Dietary strategies to benefit performance
    1. pre-competition meal
    2. timed caffeine intake
    3. carbohydrate loading
4. Intake nutrients that support recovery
5. Timing of nutrients

Basic Training Principles

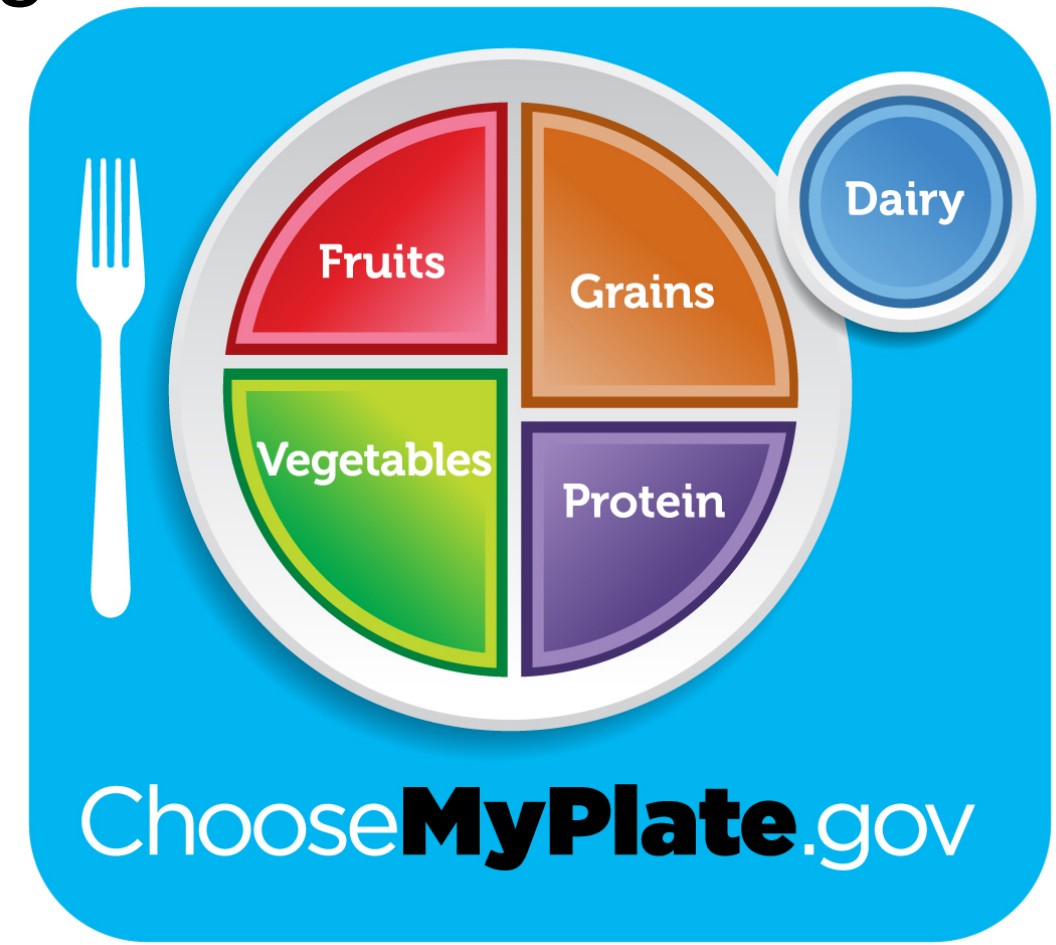
- Progressive overload
- Individuality
- Specificity
- Hard/Easy
- Periodization
  - Macrocycle
  - Mesocycle
  - Microcycle
- Disuse

A Training and Nutrition Periodization Plan

	Prior to Season					Pre-Season			Racing Season		Off-Season	
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Training Goal	Training volume increases		Training volume high			Training volume decreases			Training volume decreases		No formal training	
Body Comp Goal	Drop 5 lbs. fat		Gain 5 lbs. muscle			Maintain muscle mass			Maintain body comp		Slight muscle loss and fat increase	
Energy Intake	Decrease energy intake		Increase energy intake			Caloric intake = Caloric expenditure					Reduced caloric intake	
Nutrient Intake	More carbs and fluid Less high fat foods		Increase carbs and protein			High carbohydrate diet Moderate protein Moderate/low fat					Diet that meets MyPlate guidelines	

1.2 Basic Nutrition Standards and Guidelines

- Sound general nutrition principles
  - Dietary Reference Intakes (DRI)
  - Dietary Guidelines for Americans
  - MyPlate
  - Food pyramid for athletes
  - Food exchange system
  - Carbohydrate counting



The Dietary Reference Intakes (DRI) Reference Values Defined

- **Recommended Dietary Allowance (RDA):** Meets nutrient requirement of 97-98% of healthy individuals.

- **Adequate Intake (AI):** approximations of nutrient intake when an RDA cannot be determined.

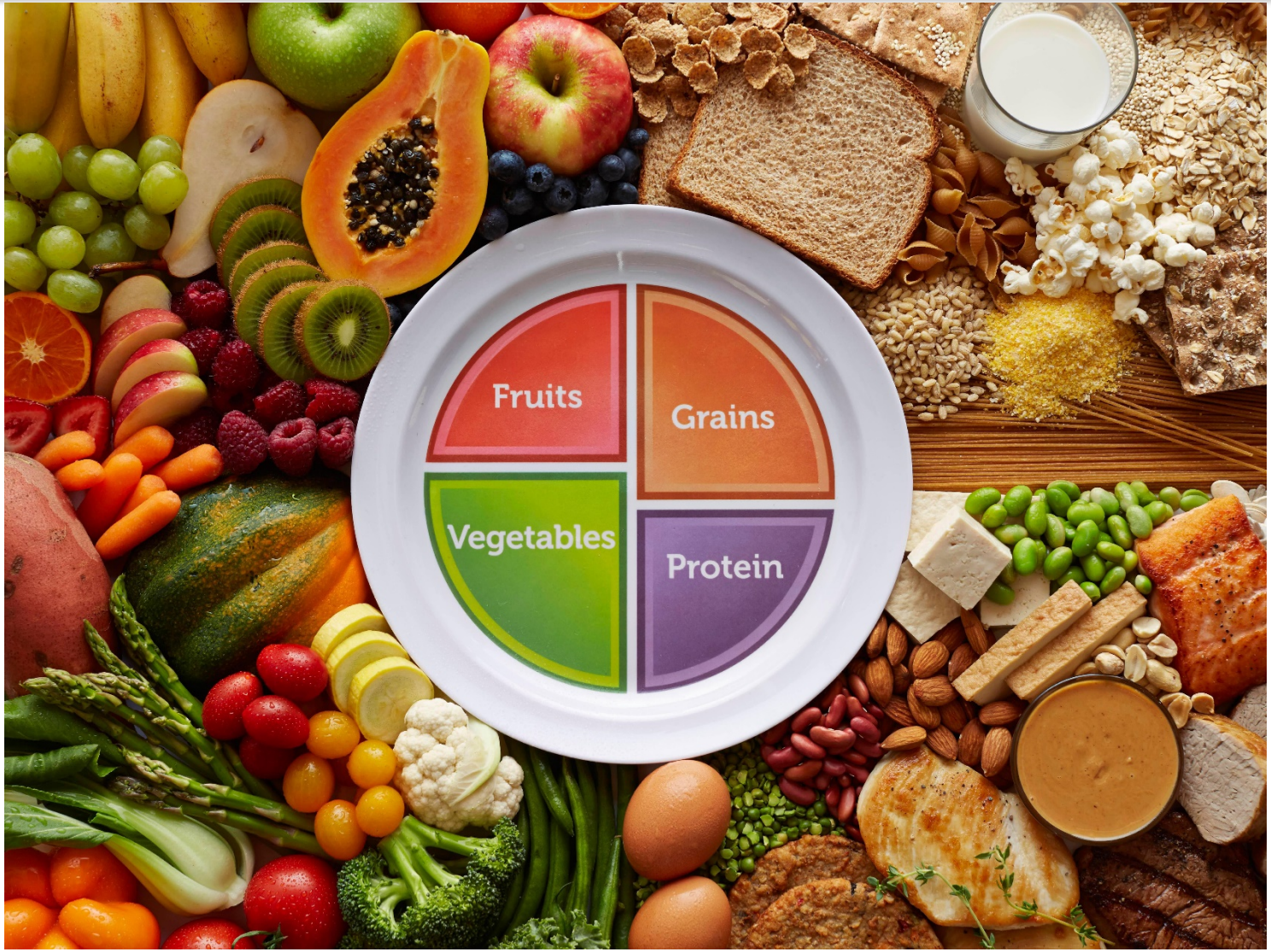
- **Tolerable Upper Intake Level (UL):** the highest level of daily nutrient intake that is likely to pose no risk. As intake increases above the UL, the risk of adverse effects increases.

- **Estimated Average Requirement (EAR):** a nutrient intake value meets the requirement of 50% of healthy individuals.

Dietary Guidelines for Americans, 2010 (Soon to be 2015)

- Two over-arching goals
  - Maintain calorie balance over time to achieve and sustain healthy weight
  - Focus on consuming nutrient-dense foods and beverages
- Major categories
  - Balancing Calories to Manage Weight
  - Foods and Food Components to Reduce
  - Foods and Nutrients to Increase
  - Building Healthy Eating Patterns

MyPlate Is a Tool for Creating a Nutritious Diet



Other Meal-Planning Tools

- Food exchange system
- Food pyramid for athletes
- Carbohydrate counting

1.3 Basic Sports Nutrition Guidelines

- More fine tuned and precise to meet demands of training
- Recommendations
  - Energy
  - Carbohydrates
  - Proteins
  - Fats
  - Vitamins and Minerals
  - Fluid

1.4 Dietary Supplements and Ergogenic Aids

- Dietary Supplement Health and Education Act (DSHEA)
- Umbrella of dietary supplements
- Use among athletes is high
- Reasons
- Legality, safety, purity, and effectiveness
- Quackery

1.5 Understanding and Evaluating Scientific Evidence

Andrew Rubtsov/Alamy

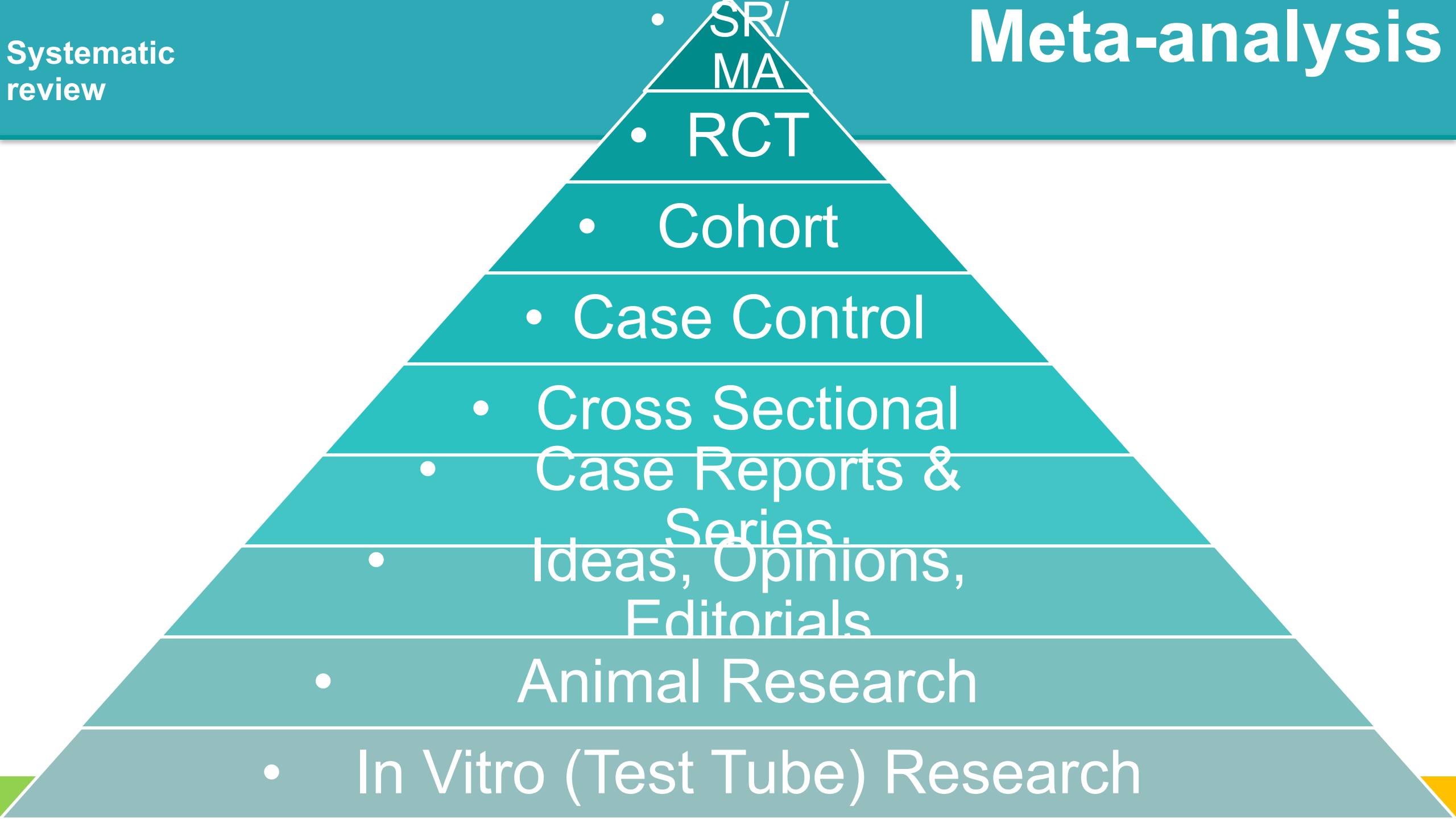
Understanding and Evaluating Scientific Evidence

Understanding and Evaluating Scientific Evidence

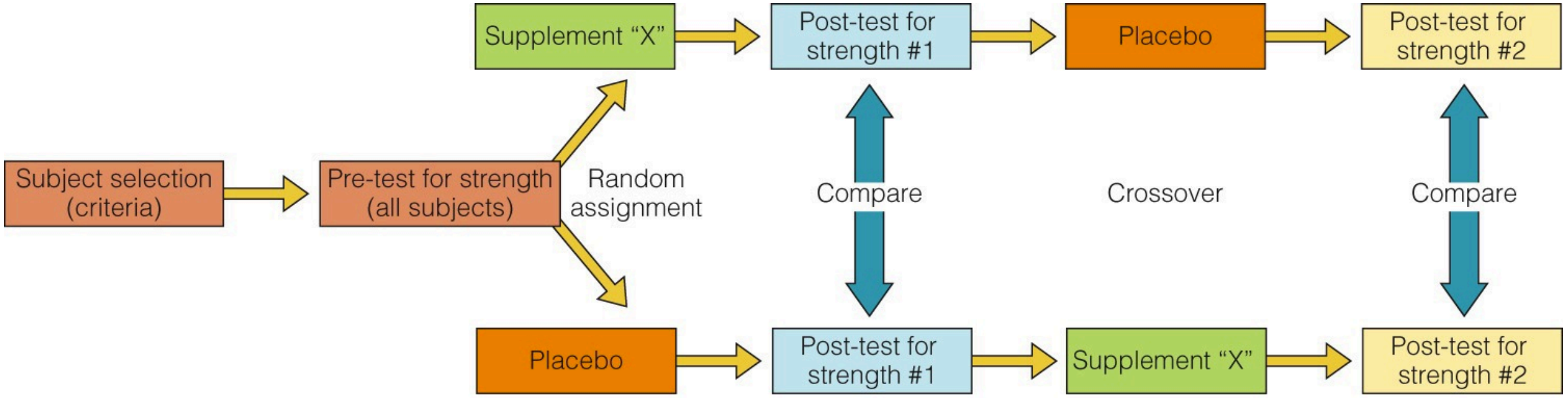
- Types of research studies
  - Case studies
  - Epidemiological studies
  - Experimental studies
- Research design and methods
  - Control/experimental groups
  - Randomization
  - Placebo
    - Double-blind
  - Crossover design

Systematic review

Meta-analysis



The Basis of Good Research is Strong Research Design and Methodology



Peer Review Is an Important Safeguard in the Publication of Scientific Research

Peer-Reviewed Journals

American Journal of Clinical Nutrition

European Journal of Applied Physiology

International Journal of Sports Medicine

International Journal of Sports Physiology and Performance

International Journal of Sport Nutrition and Exercise Metabolism

Journal of the Academy of Nutrition and Dietetics

Journal of the American Medical Association

Journal of Applied Physiology

Medicine and Science in Sports and Exercise

Sports Medicine (reviews)

Levels of Evidence and Grades of Recommendations

- Grade I (Level A)
  - Supported by good evidence; consistent results of well-designed, large, randomized research studies; confidence high
- Grade II (Level B)
  - Supported by fair evidence; less-convincing results due to inconsistent results or limited number of well-designed studies, or studies with weaker designs

Levels of Evidence and Grades of Recommendations

- Grade III (Level C)
  - Supported by limited evidence; confidence limited by study size and/or design or by size of body of literature
- Grave IV (Level D)
  - Supported by expert opinion (panel consensus judgment) based upon review of body of experimental research
- Anecdotal evidence
  - Personal accounts

Human Effect Matrix

The **Human Effect Matrix** looks at human studies (excluding animal/petri-dish studies) to tell you what effect Vitamin D has in your body, and how strong these effects are.

GRADE	LEVEL OF EVIDENCE
A	Robust research conducted with repeated double blind clinical trials
B	Multiple studies where at least two are double-blind and placebo controlled
C	Single double blind study or multiple cohort studies
D	Uncontrolled or observational studies only

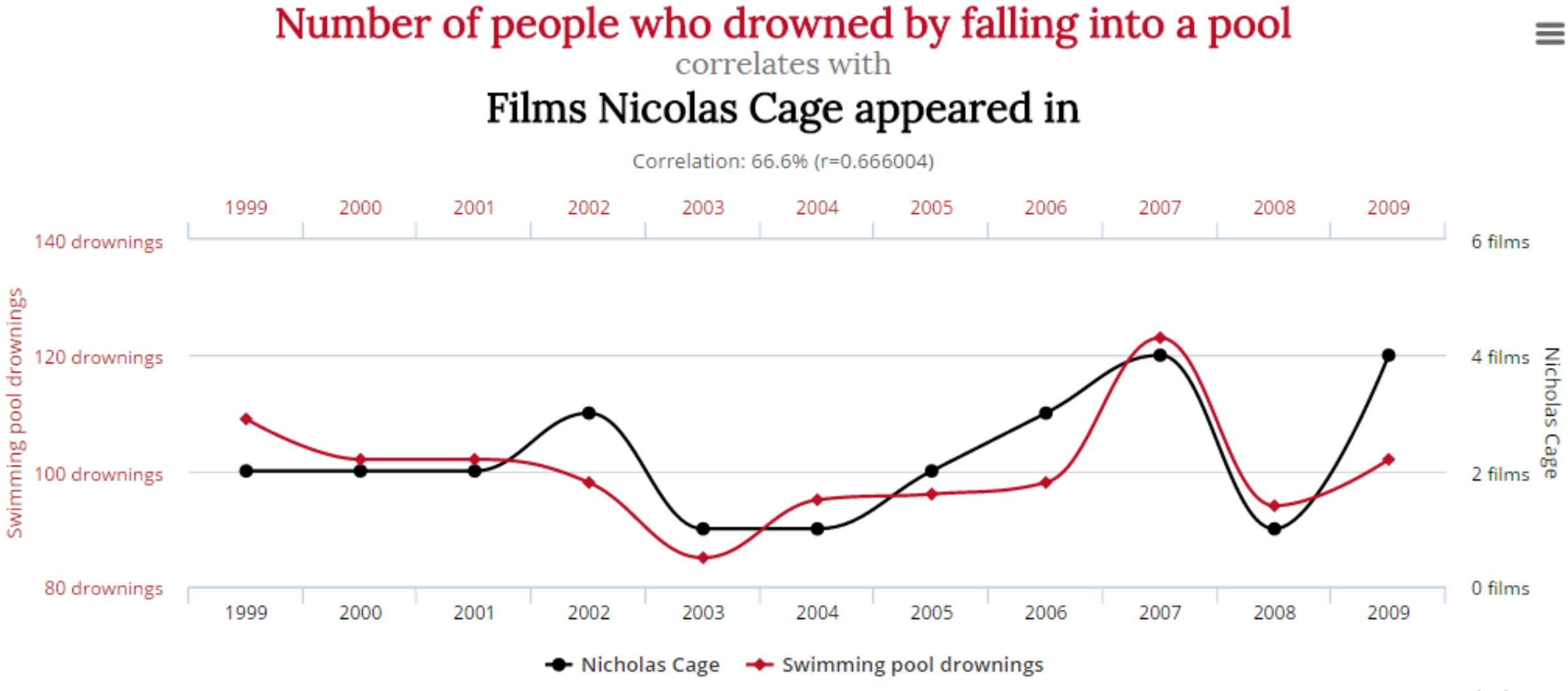
LEVEL OF EVIDENCE	EFFECT	CHANGE	MAGNITUDE OF EFFECT SIZE	SCIENTIFIC CONSENSUS	COMMENTS
A	Risk of Falls	↓	★★☆ Notable	50% See all 4 studies	The risk of falls in the elderly (and subsequently, rate of bone fractures) appears to be significantly reduced with Vitamin D supplementation at 700 IU or greater, with ... show
A	Cardiovascular Disease Risk	↓	★☆☆ Minor	50% See all 3 studies	There appears to be less risk of cardiovascular disease and related cardiovascular complications with supplementation of 1,000 IU of Vitamin D or higher serum levels of ... show
B	Parathyroid Hormone	↓	★★★ Strong	100% See all 4 studies	Vitamin D supplementation is the reference drug for reductions in parathyroid hormone due to directly negatively regulating its secretion

Drawing Appropriate Conclusions from Scientific Research

- Distinguish between correlation and causation
- Importance of replicating results
- Extrapolate with caution, if at all
- Interpret results correctly
- Focus on cumulative results and consensus
- Recognize slow evolution of knowledge
- Research as a marketing tool

Drawing Appropriate Conclusions from Scientific Research

- Distinguish between correlation and causation



Drawing Appropriate Conclusions from Scientific Research

- Importance of replicating results

Andrew Wakefield - Vaccines and Autism

- First of its kind to show association
- 12 children
- Stated in a press release that the vaccine should be broken up into 3 separate injections (unsupported by the paper)

Early report

Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield, S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

Summary

Background We investigated a consecutive series of children with chronic enterocolitis and regressive developmental disorder.

Methods 12 children (mean age 6 years [range 3–10], 11 boys) were referred to a paediatric gastroenterology unit with a history of normal development followed by loss of acquired skills, including language, together with diarrhoea and abdominal pain. Children underwent gastroenterological, neurological, and developmental assessment and review of developmental records. Ileocolonoscopy and biopsy sampling, magnetic-resonance imaging (MRI), electroencephalography (EEG), and lumbar puncture were done under sedation. Barium follow-through radiography was done where possible. Biochemical, haematological, and immunological profiles were examined.

Findings Onset of behavioural symptoms was associated, by the parents, with measles, mumps, and rubella vaccination in eight of the 12 children, with measles infection in one child, and otitis media in another. All 12 children had intestinal abnormalities, ranging from lymphoid nodular hyperplasia to aphthoid ulceration. Histology showed patchy chronic inflammation in the colon in 11 children and reactive ileal lymphoid hyperplasia in seven, but no granulomas. Behavioural disorders included autism (nine), disintegrative psychosis (one), and possible postviral or vaccinal encephalitis (two). There were no focal neurological abnormalities and MRI and EEG tests were normal. Abnormal laboratory results were significantly raised urinary methylmalonic acid compared with age-matched controls (p=0·003), low haemoglobin in four children, and a low serum IgA in four children.

Interpretation We identified associated gastrointestinal disease and developmental regression in a group of previously normal children, which was generally associated in time with possible environmental triggers.

Lancet 1998; **351:** 637–41
See Commentary page 611

Inflammatory Bowel Disease Study Group, University Departments of Medicine and Histopathology (A J Wakefield FRCS, A Anthony MB, J Linnell PhD, A P Dhillon MRCPath, S E Davies MRCPath) **and the University Departments of Paediatric Gastroenterology** (S H Murch MB, D M Casson MRCP, M Malik MRCP, M A Thomson FRCP, J A Walker-Smith FRCP,), **Child and Adolescent Psychiatry** (M Berelowitz FRCPsych), **Neurology** (P Harvey FRCP), **and Radiology** (A Valentine FRCR), **Royal Free Hospital and School of Medicine, London NW3 2QG, UK**

Correspondence to: Dr A J Wakefield

Introduction

We saw several children who, after a period of apparent normality, lost acquired skills, including communication. They all had gastrointestinal symptoms, including abdominal pain, diarrhoea, and bloating and, in some cases, food intolerance. We describe the clinical findings, and gastrointestinal features of these children.

Patients and methods

12 children, consecutively referred to the department of paediatric gastroenterology with a history of a pervasive developmental disorder with loss of acquired skills and intestinal symptoms (diarrhoea, abdominal pain, bloating and food intolerance), were investigated. All children were admitted to the ward for 1 week, accompanied by their parents.

Clinical investigations

We took histories, including details of immunisations and exposure to infectious diseases, and assessed the children. In 11 cases the history was obtained by the senior clinician (JW-S). Neurological and psychiatric assessments were done by consultant staff (PH, MB) with HMS-4 criteria.[1] Developmental histories included a review of prospective developmental records from parents, health visitors, and general practitioners. Four children did not undergo psychiatric assessment in hospital; all had been assessed professionally elsewhere, so these assessments were used as the basis for their behavioural diagnosis.

After bowel preparation, ileocolonoscopy was performed by SHM or MAT under sedation with midazolam and pethidine. Paired frozen and formalin-fixed mucosal biopsy samples were taken from the terminal ileum; ascending, transverse, descending, and sigmoid colons, and from the rectum. The procedure was recorded by video or still images, and were compared with images of the previous seven consecutive paediatric colonoscopies (four normal colonoscopies and three on children with ulcerative colitis), in which the physician reported normal appearances in the terminal ileum. Barium follow-through radiography was possible in some cases.

Also under sedation, cerebral magnetic-resonance imaging (MRI), electroencephalography (EEG) including visual, brain stem auditory, and sensory evoked potentials (where compliance made these possible), and lumbar puncture were done.

Laboratory investigations

Thyroid function, serum long-chain fatty acids, and cerebrospinal-fluid lactate were measured to exclude known causes of childhood neurodegenerative disease. Urinary methylmalonic acid was measured in random urine samples from eight of the 12 children and 14 age-matched and sex-matched normal controls, by a modification of a technique described previously.[2] Chromatograms were scanned digitally on computer, to analyse the methylmalonic-acid zones from cases and controls. Urinary methylmalonic-acid concentrations in patients and controls were compared by a two-sample *t* test. Urinary creatinine was estimated by routine spectrophotometric assay.

Children were screened for antiendomyseal antibodies and boys were screened for fragile-X if this had not been done

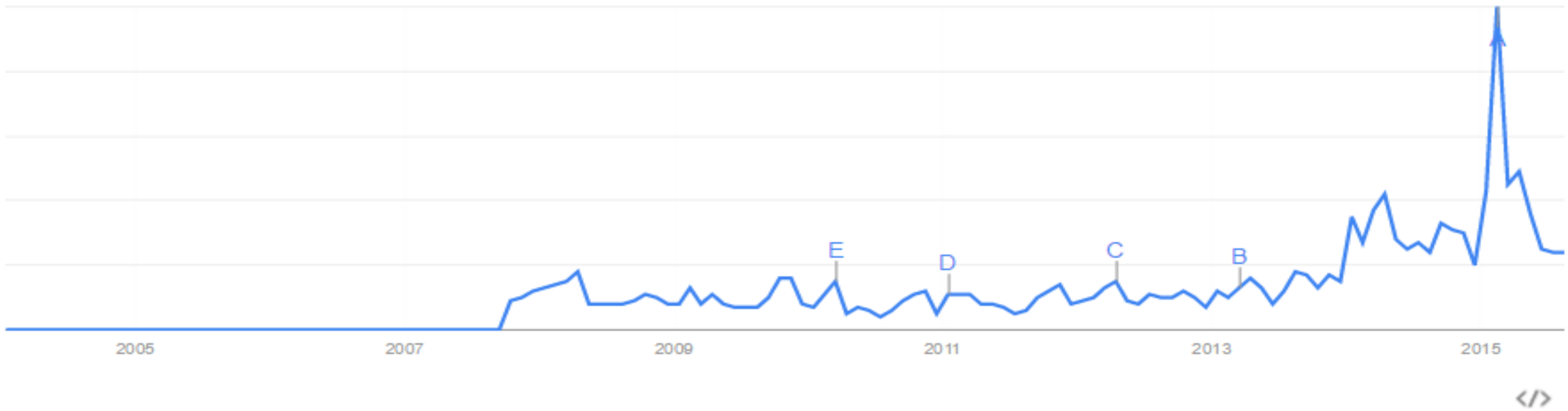
Andrew Wakefield - Vaccines and Autism

vaccines cause autism
Search term

+Add term

Interest over time

News headlines Forecast



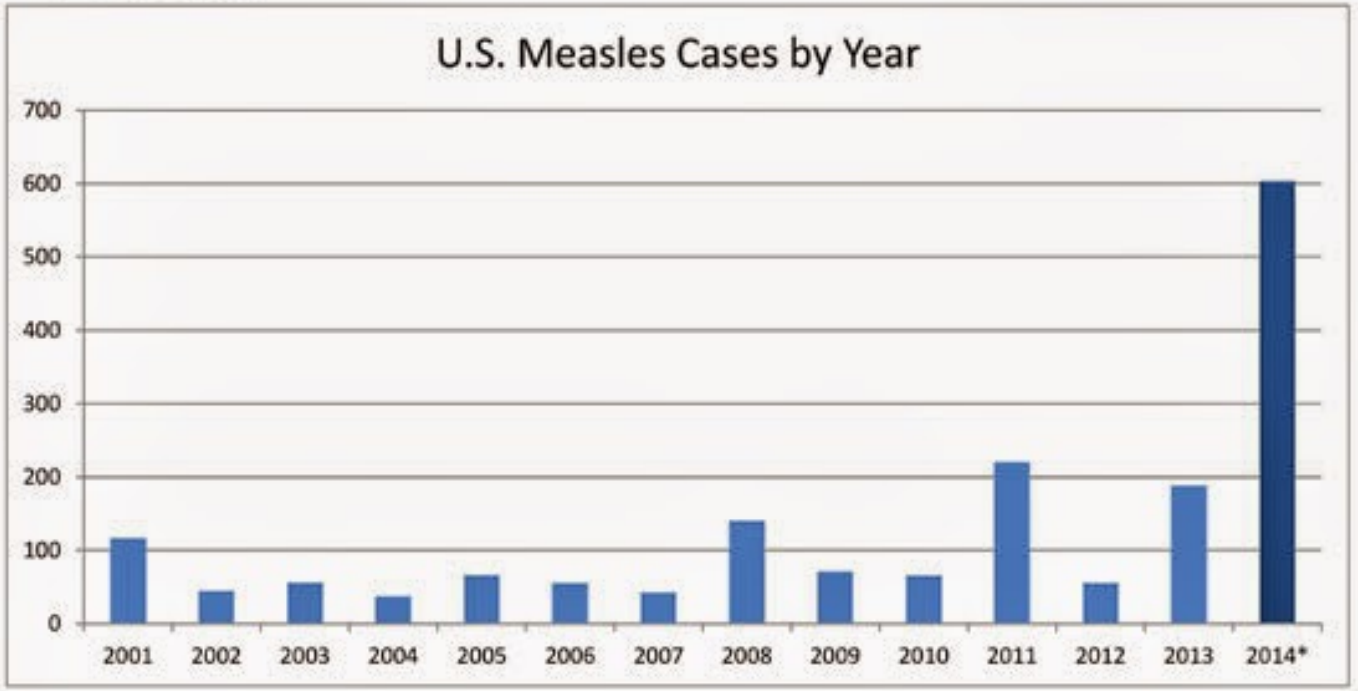
Andrew Wakefield - Vaccines and Autism

Measles Cases and Outbreaks

January 1 to October 31, 2014*†

603 Cases reported in 22 states: Alabama, California, Connecticut, Hawaii, Illinois, Indiana, Kansas, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin

20 Outbreaks representing 89% of reported cases this year



*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases

†Updated once a month

Andrew Wakefield - Vaccines and Autism

- Conflict of interest – paid $400,000 from lawyer hoping to sue MMR manufactures
- Faked the data
- Performed unapproved invasive procedures on the children
- Medical license was revoked
- Lancet retracted the paper

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Children were screened for antiendomyseal antibodies and boys were screened for fragile-X if this had not been done

RETRACTED

115 Paper's Showing No Link Between Vaccines and Autism

Abu Kuwaik G, Roberts W, Zwaigenbaum L, Bryson S, Smith IM, Szatmari P, Modi BM, Tanel N, Brian J. Immunization uptake in younger siblings of children with autism spectrum disorder. Autism. 2014 Feb;18(2):148-55. doi: 10.1177/1362361312459111. Epub 2012 Oct 8. PubMed PMID: 23045216.

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Drawing Appropriate Conclusions from Research

- Focus on cumulative results and consensus

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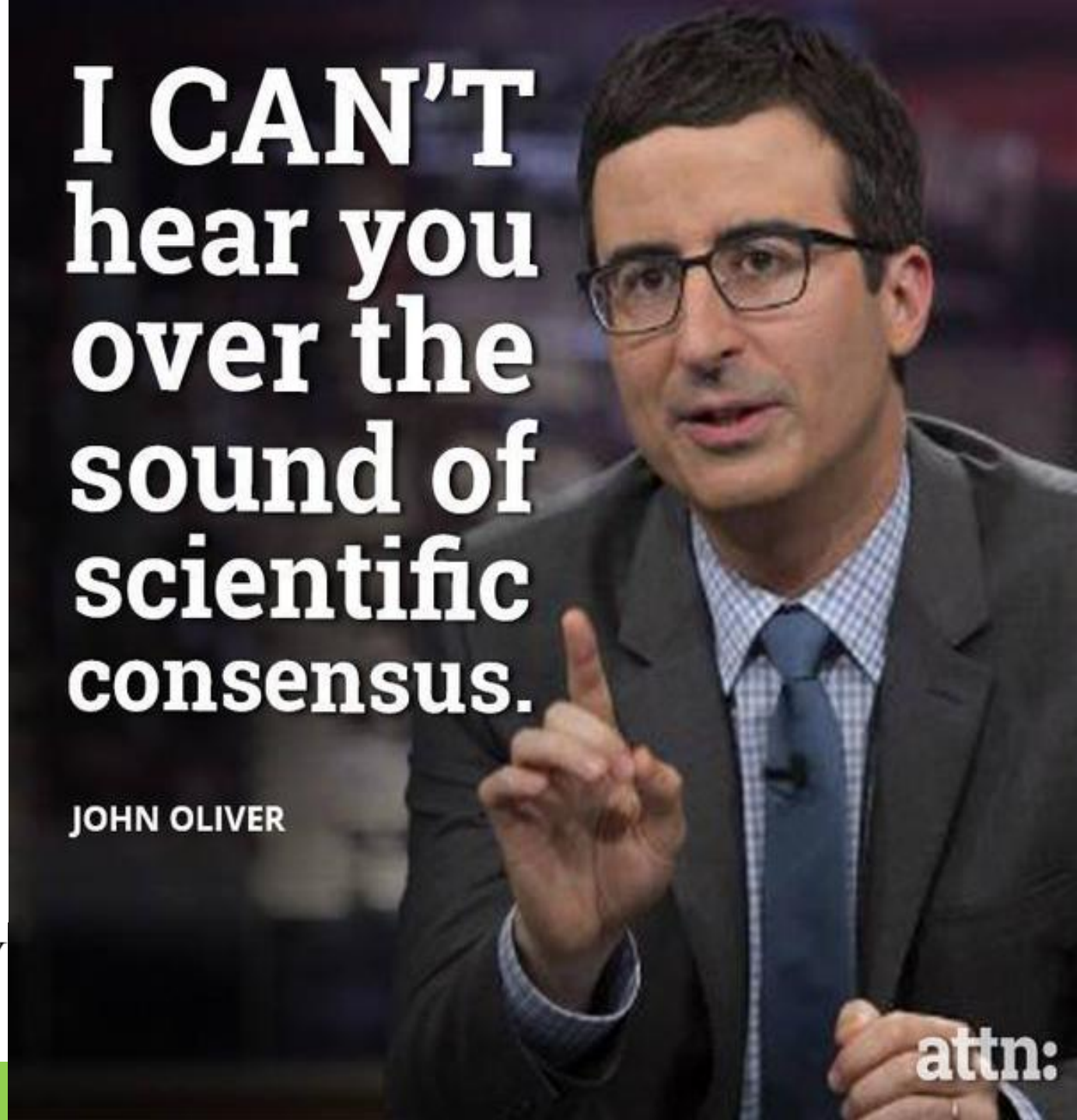
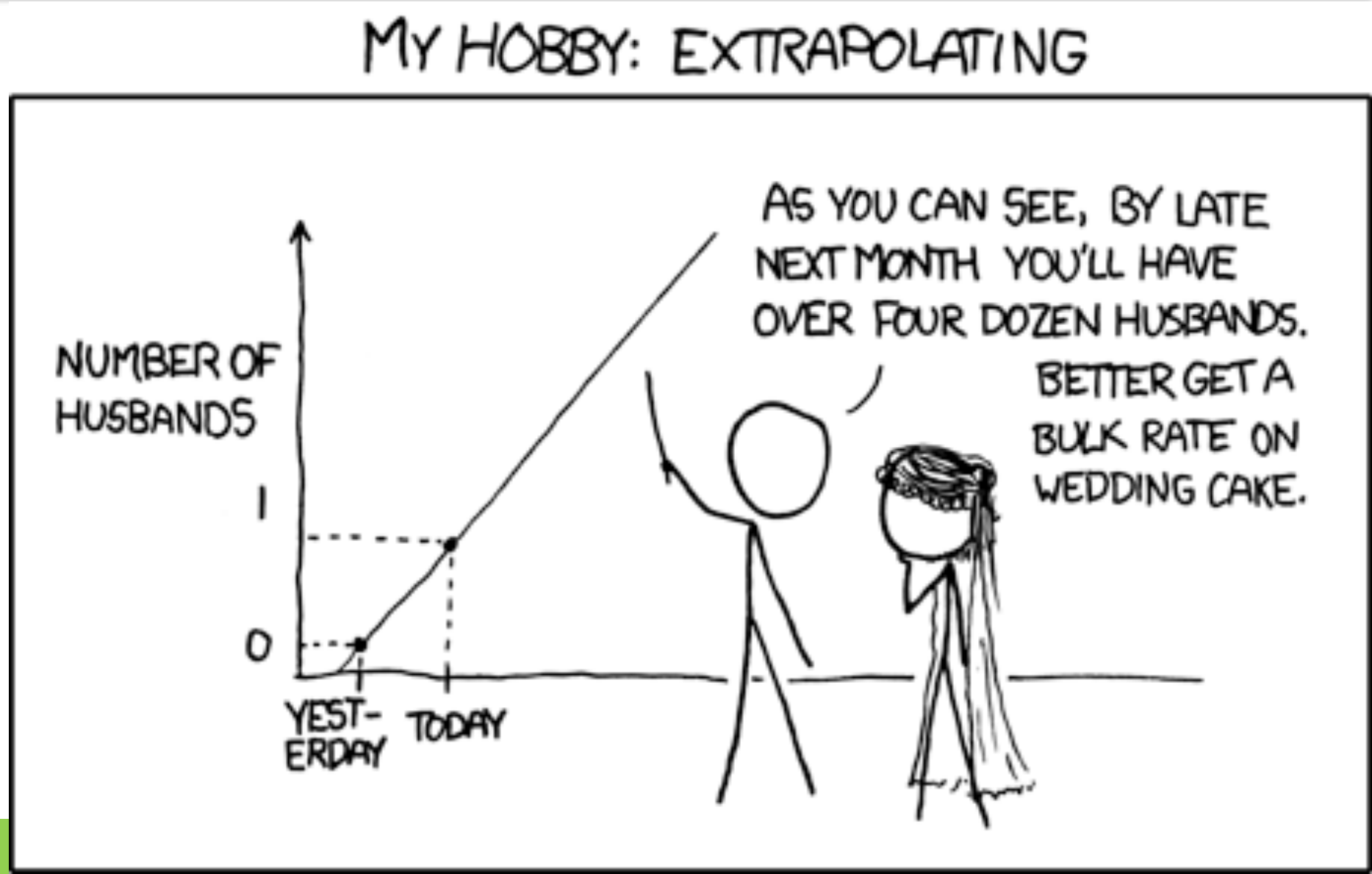


Drawing Appropriate Conclusions from Scientific Research

- Extrapolate with caution, if at all



Drawing Appropriate Conclusions from Scientific Research

- Interpret results correctly
  - What do you think the results of this study show based on the title?

Article

Cell Metabolism

Calorie for Calorie, Dietary Fat Restriction Results in More Body Fat Loss than Carbohydrate Restriction in People with Obesity

Drawing Appropriate Conclusions from Scientific Research

- Recognize slow evolution of knowledge

Drawing Appropriate Conclusions from Scientific Research

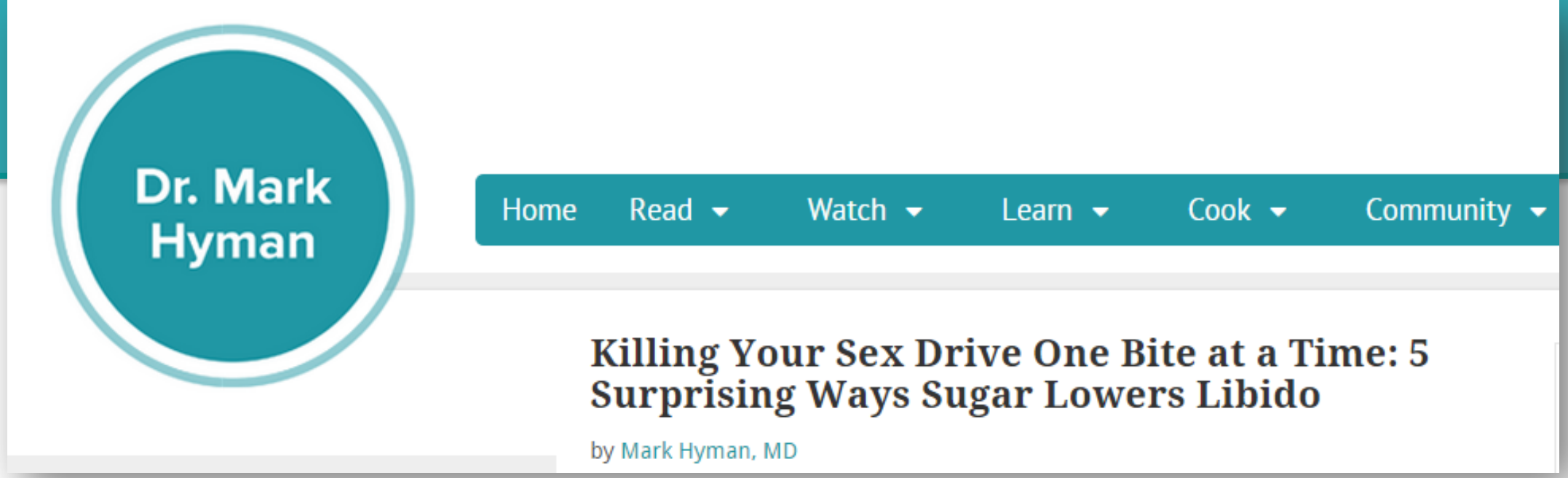
- Research as a marketing tool

Drawing Appropriate Conclusions from Scientific Research

- Research as a marketing tool

Inaccurate Information on the Internet

- Widely used for health information
- **Misinformation and commercial exploitation prevalent**



1. Sugar lowers testosterone
2. Sugar creates leptin resistance
3. Sugar reduces growth hormone (GH) production
4. Sugar makes you tired
5. Sugar triggers stress and anxiety

Dr. Mark Hyman

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Killing Your Sex Drive One Bite at a Time: 5 Surprising Ways Sugar Lowers Libido

by Mark Hyman, MD

If you would like to learn how to get rid of sugar and processed foods and improve your sex life, I encourage you to consider joining my 10-Day Detox Diet Challenge starting soon. More details about this Challenge here.

10-Day Detox Diet Support

You might find having a little extra support can boost your results on the 10-Day Detox Diet

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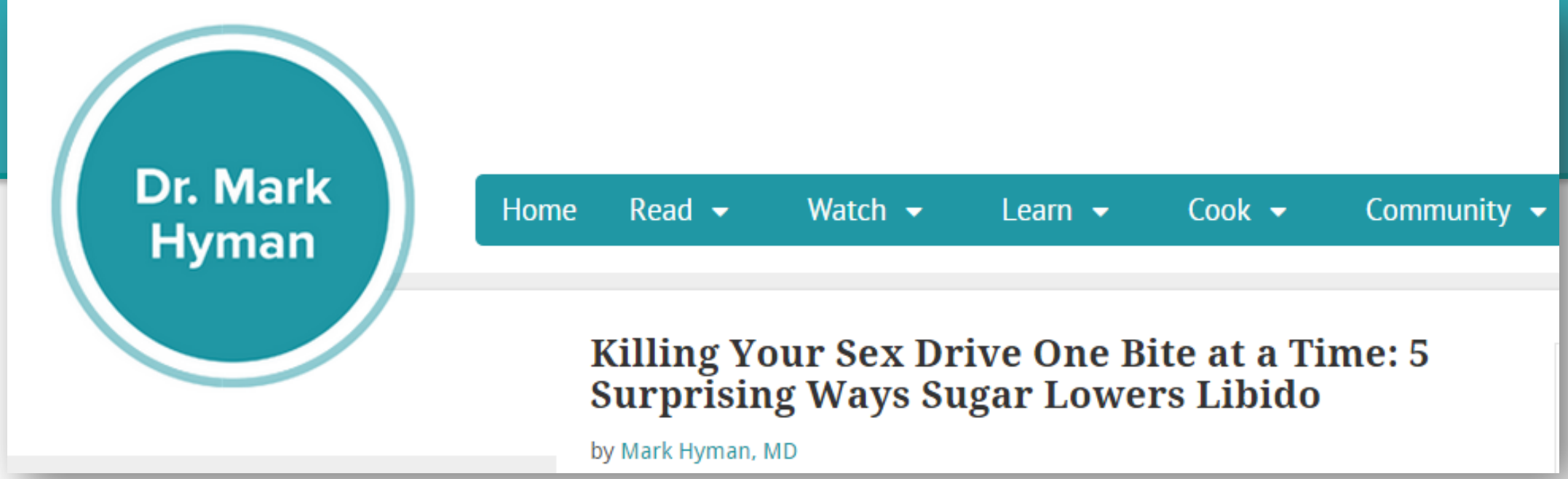
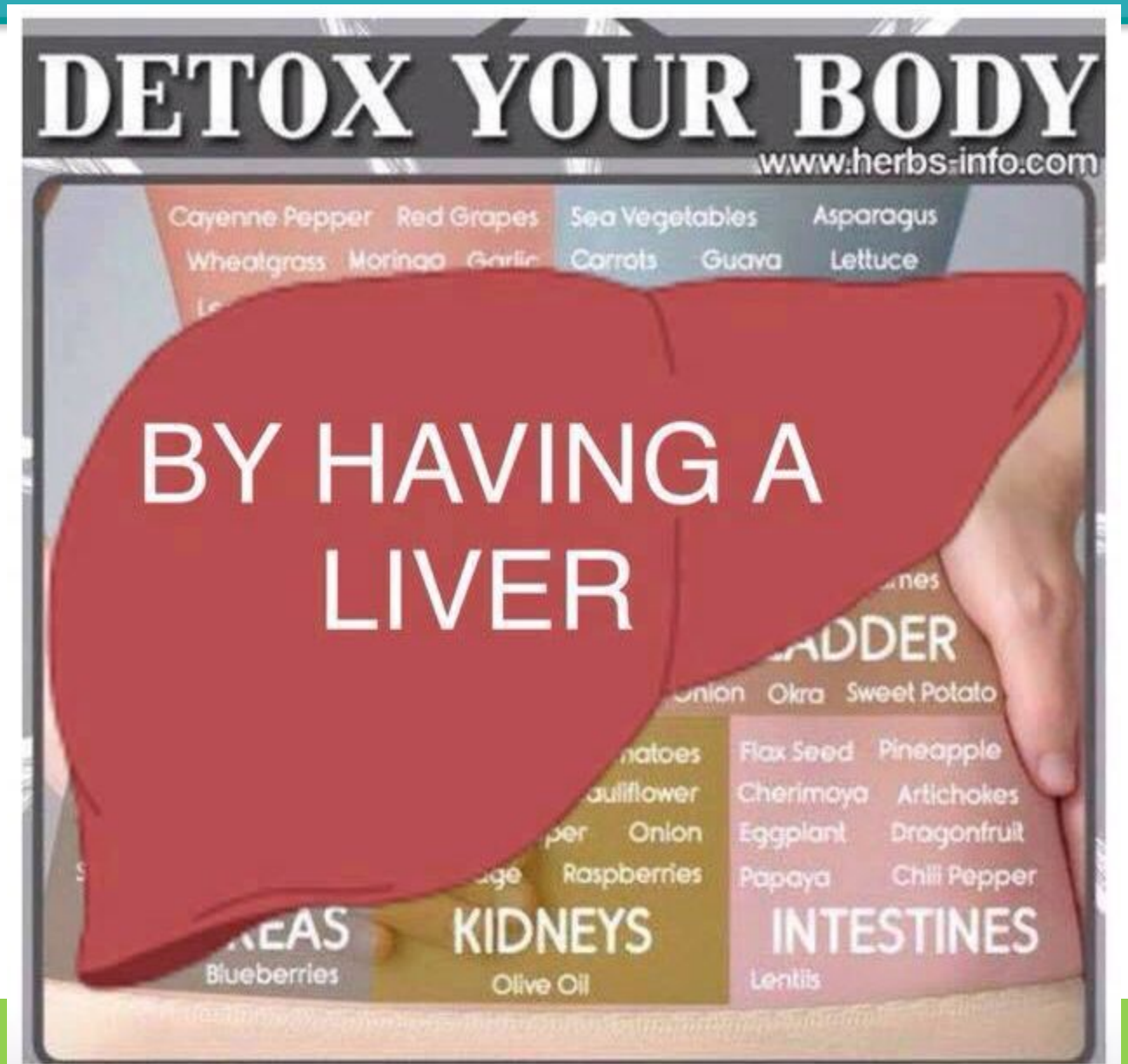


Not a single paper cited in the article support the claims he makes. Not even ONE!

“Detox” Diets Are Not A Thing



1.6 Exercise and Nutrition Credentials and Certifications

- Types of exercise practitioners
- Few regulations
  - American College of Sports Medicine
    - Registered Clinical Exercise Physiologist®
    - Exercise Specialist®
    - Health/Fitness Instructor®
    - Personal Trainer®
  - National Strength and Conditioning Association
    - Certified Strength and Conditioning Specialist®
  - National Athletic Trainers Association
    - Certified Athletic Trainer (ATC)

Exercise and Nutrition
Credentials and Certifications

- Types of practitioners
  - Nutritionist
  - Registered Dietitian (RD)
    - National certification
    - Licensure
  - Medical Nutrition Therapy (MNT)
- Nutrition-related certifications
  - Board Certified Specialist in Sports Dietetics (CSSD)
  - International Society of Sports Nutrition
    - Certified Sports Nutritionist (CISSN)

Exercise and Nutrition Credentials and Certifications

DIETITIAN vs NUTRITIONIST

Qualification
-Bachelor's degree
-Completion of a Dietetic Internship
-Passed a national exam
-Maintains on-going education credits

Definition
-A qualified health professional who helps promote good health through proper nutritional habits

Legal Status
-An expert on nutrition
-Registered with the Commission of Dietetics Registration (CDR)
-Licensed to practice diet and nutritional consultation

Qualification
-None required
-Self-proclaimed title

Definition
-Someone who works with food and nutritional science, aiming to prevent diseases related to nutrient deficiencies.

Legal Status
-Not legally accepted as an expert

Scope of Practice Helps Establish Professional Boundaries

- Exercise-related certifications
- Nutrition-related certifications
- Use of public domain documents
- Certifications vary widely in their requirements.
- Many exercise- and nutrition-related certifications do not require a bachelor's degree.
- **Practitioners must recognize the limits of their knowledge, training, and expertise, otherwise athletes can be harmed.**
  - Think about how much you knew about exercise science prior to studying at Mason

Summary

- The ultimate goal of sports nutrition is improved performance, which involves both skill development and training
- Proper nutrition helps to support training, performance, and recovery
- Sports nutrition principles are based on sound general nutrition principles that have been modified to reflect the demands of training and competition for the athlete's sport and position

Summary

- Dietary supplements are widely used by athletes but are not well regulated
- Sports nutrition recommendations should be evidence based
- Practitioners must understand and respect the limitations of their training, skills, and knowledge
- Many people who work with athletes are certified or licensed