Critical-Appraisal for Evidence-Based Practice in Kinesiology
Topic Outline

1. History of non-evidence-based practice in exercise science / kinesiology
   a. Importance of evidence-based practice
   b. Examples of research evidence contradicting common models of professional practice
2. Introduction to core concepts in evidence-based practice
   a. Steps of evidence-based practice approach
   b. Hierarchy of research evidence
   c. Examples of observational studies and Randomized Controlled Trials (RCTs)
   d. Systematic reviews and study selection flow diagrams
   e. Meta-analysis and effect size
   f. Cochrane reviews, interpreting a Cochrane meta-analysis summary figure
   g. Levels of evidence in developing clinical practice guidelines
   h. The Guide to Community Preventive Services
3. Basics of research design
   a. Types of research designs: observational, quasi-experimental, true experimental
   b. Importance of randomization
   c. Types of randomization
   d. Sampling & Stratified sampling
   e. Advantages and disadvantages of within-subject designs
4. Searching for evidence
   a. Searching PubMed
   b. Medical Subject Heading (MeSH) vocabulary
   c. PubMed field tags
   d. Boolean operators (AND, OR, NOT)
   e. Searching PsycINFO, Web of Science / Citation Index
5. Bias in research -- Ioannidis (2005): "Most published research findings are false"
   a. Sampling error: Importance of sample size and variability
   b. Confidence intervals
   c. Alpha, beta
   d. Errors of statistical inference: Type I, Type II
   e. Inflation of alpha by multiple tests of significance (multiplicity problem)
   f. Holm-Bonferroni and Šidák corrections
   g. Power analysis, with examples (G*Power)
   h. Methods of increasing statistical power
6. Basics of analysis of variance
   a. Main effects and interactions in factorial designs
   b. "True" vs "error" variance
7. Basics of measurement
   a. Relation of reliability to random measurement error
   b. Effects of unreliability on statistical power
   c. Relation of reliability to validity
8. Basics of critical appraisal

a. "Bare bones appraisal"
b. Concealment of group allocation
c. Intention-to-treat
d. Blinding
e. Reporting guidelines
f. CONSORT (CONsolidated Standards of Reporting Trials) checklist and diagram

9. Emerging role of exercise in healthcare: Dynamics of bias
   a. Exercise is Medicine initiative: Implications
   b. Commercialization of treatments, drug development, examples from Alzheimer's
   c. Corporate influence on research, examples from tobacco-industry internal documents
   d. Conflicts of interest
   e. Medical education and communication companies
   f. Ghostwriting
   g. Fraud cases involving major pharmaceutical companies (paroxetine, risperidone)
   h. Importance of published trial protocols and trial registries
   i. Selective publication of results from clinical trials
   j. Federal requirements for the approval of pharmaceuticals by the Food and Drug Administration
   k. Use of mass media by commercial interests
10. Example of critical appraisal of a Randomized Controlled Trial (RCT)
   a. Introduction to the TREAD-UK trial
   b. National Institute for Clinical Excellence (NICE) clinical guidelines for depression
   c. Kirsch et al. (2008) meta-analysis comparing SSRIs to placebo
   d. Notion of "stepped-care" in the treatment of depression
   e. Role of physical activity in the "stepped care" model: Economic implications
   f. Statistics on use of exercise prescriptions by general practitioners
   g. TREAD-UK publicity campaign
   h. Importance of social-political context: depression in the United Kingdom
   i. "Layard hypothesis": Cognitive Behavioral Therapy (CBT) to reduce mental health problems and unemployment
   j. The A+B vs B experimental design (usual care plus treatment to usual care alone)
   k. Inconsistencies between NICE guideline and TREAD-UK
   l. Participant characteristics: Inclusion and exclusion criteria
   m. Lack of control for exposure to parallel treatments (e.g., antidepressant medication, psychotherapy)
   n. Direct effects of independent variable versus mediational hypothesis
   o. Power calculations
   p. Determining the target effect size based on previous literature
   q. Bias from revising the power calculations while the trial is ongoing
   r. "Usual care" vs "unusual care": Lack of control for exercise in "usual care"
   s. Attrition/retention rate: Effects on statistical power
   t. Handling of missing data
   u. Last valid observation carried forward vs sensitivity analyses

v. Measurement: Beck Depression Inventory (BDI)
w. Evaluating remission rates
x. Sensitivity (true positives) and specificity (true negatives)
y. Receiver Operating Characteristic (ROC) curves
z. Measurement: physical activity by self-report logs, validity and reliability
aa. Validation of physical activity logs by accelerometers
bb. Inter-method comparisons: Bland-Altman plot
cc. Common method bias in measurement
dd. Determining the "sufficient dose" of treatment
ee. "Pragmatic" vs "explanatory" trials
ff. Internal vs external validity
gg. Comparative effectiveness research
hh. Superiority, equivalence, non-inferiority
ii. Principle of clinical equipoise
jj. Theoretical basis of behavior-change interventions
kk. Delivery of the intervention
ll. Training of personnel
mm. Analysis of group by time designs, Main effects and interaction
nn. Analytic plan specified in trial protocol, Protocol violation
oo. Claims in the Abstract versus details in Results section

11. Example of critical appraisal of a systematic review and meta-analysis
    a. PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses)
    b. PRISMA flow diagram
    c. Cochrane Collaboration and Handbook
    d. Risk of bias assessments
    e. RevMan software
    f. Meta-analysis, Network Meta-analysis
    g. Standardized Mean Difference, SMD
    h. Data extraction and data integrity
    i. Inclusion & exclusion criteria
    j. Importance of comparators: What qualifies as "control"?
    k. Operational definitions of independent and dependent variables
    l. Consistency in the application of rules
    m. Funnel plot to detect publication bias
    n. Egger bias test
    o. Trim-and-fill analysis, sensitivity analysis
    p. Forest plots
    q. Models of meta-analysis: fixed-effects versus random-effects
    r. Tests of heterogeneity, tau, I^2, Cochran Q
    s. "Apples and oranges" problem
    t. Tests of moderators, meta-regression
    u. Fail-safe number
12. Review of core concepts in critical appraisal
13. Student-led group discussions