Exercise effects on health-related physical fitness of individuals with an intellectual
disability: a meta-analysis
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Authors' objectives
To determine the effects of exercise on health-related physical fitness of individuals with an intellectual disability.

Searching
The following sources were searched between 1979 and April 1996: ERIC, HEALTH, MEDLINE, PsycLIT, SPORTDiscus and HERACLES. Manual searches were conducted of Completed Research in Health, Physical Education, Recreation and Dance, Dissertation Abstracts International, and the Adapted Physical Activity Quarterly. Published papers, master's theses, and doctoral dissertations were located at library facilities and via interlibrary loans. The search mode of 'footnote chasing' or 'ancestry approach' was used (see White Other Publications of Related Interest). Reference lists of all available theoretical and empirical articles and books were examined.

Study selection
Study designs of evaluations included in the review
Studies of the effects of exercise programmes on at least one of five health-related physical fitness components of individuals with an intellectual deficit were included if they fulfilled the following criteria: studies had used exercise treatments only rather than combining exercise with other treatments; studies reported means, standard deviations and sample size for each group; a test was administered after the exercise programme was terminated; and the sample size of each group was more than 6. Twenty-nine identified studies were excluded due to inability to satisfy one or more of the specified inclusion criteria. Studies included between-subject designs without pre and post test and between-subject designs with pre and post tests.

Specific interventions included in the review
Interventions studied included aerobic, resistance and combined exercise programmes that were administered by the investigators.

Participants included in the review
Participants included adults, adolescents and children with intellectual deficit of varying degrees. Most participants were adults. Males and females participated. Intellectual deficit was defined in terms of mean IQ range, degree of intellectual deficit, and various combinations. Subjects with Downs syndrome were excluded.

Outcomes assessed in the review
The following outcomes were assessed: body composition evaluated by bioelectric impedance and skin fold measures; cardiovascular endurance evaluated by Cooper's 12 minute run/walk, 1,500 m run, 9-min run, 600-yard walk, 1.5-mile run/walk, maximum oxygen uptake, and physical work capacity; flexibility evaluated by floor touch, sit and reach, trunk extension, and trunk flexion; muscular endurance evaluated by back lifts, flexed arm hang, straight arm hang, leg lifts, push-ups, and sit-ups; muscular strength evaluated by bench press, leg press, leg curl, leg extension, right and left knee extension, military press, right and left hip abduction, lat pull, hand grip strength, pull-up, shoulder abduction, pullover, pectoral deck, biceps curl and triceps extension.

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were selected for review, or how many of the authors performed the selection.

Assessment of study quality
Validity was assessed according to sampling bias, experimental design and instrumentation. Internal validity was coded according to number of threats to internal validity as high (0-2 threats) or low (3-5 threats).
Data extraction
The following study variables were coded: document source (published or unpublished); chronological age (children < 12 years; adolescent 13 to 18 years; and adults >=19 years); gender (male, female, combined); degree of intellectual deficit (mild, moderate, severe or profound, or combination); type of exercise programme (aerobic, resistance or combined); frequency of exercise programme (3 times per week or > 3 times a week) with muscular strength frequency coded as 1-2 times a week or 3 times per week; and length of exercise programme (>= 8 weeks or >= 9 weeks).

Effect size from between-subjects design, without pre-and post tests was calculated using the method of Hedges and Olkin (see Other Publications of Related Interest). Effect size from between subject designs with pre-and post test was calculated by computing the standardised mean difference between the experimental groups (pre and post test) and the control groups (pre and post tests) and dividing by the pooled standard deviations. Effect size from within subject designs was calculated using methods described by Hunter and Schmidt (see Other Publications of Related Interest). Effect size was calculated so that a positive effect size indicated a positive treatment effect. No details are given of method used to extract data.

Methods of synthesis
How were the studies combined?
Effect sizes were calculated for the different outcome variables and corrected for sample size differences using methods described by Thomas and Nelson (see Other Publications of Related Interest).

How were differences between studies investigated?
The test of homogeneity Q-test statistic was conducted using the method of Hedges and Olkin (See Other Publications of Related Interest). Barlett's test for homogeneity of group variances was employed to examine the possible influence of experimental treatment on the variability of scores for each of the five health-related physical fitness components. A Mann-Whitney U statistic or a Kruskal-Wallis H statistics was calculated to examine differences among categories of the following proposed moderating variables: published versus unpublished studies; longer versus shorter exercise programmes; type of exercise programme; and level of exercise frequency.

Results of the review
Sixteen controlled studies (N = 698 subjects) and 5 uncontrolled studies (N = 133 subjects) were included.

Number of effect size measures used for specific health-related components was as follows: body composition (n = 9); cardiovascular endurance (n = 18); flexibility (n = 12); muscular endurance (n = 14); and muscular strength (n = 10).

No outliers of effect size (falling out with 3 standard deviations from the mean) were identified.

Mean effect size for health-related components was as follows: body composition - 0.05 (95%CI: -0.26, 0.16); cardiovascular endurance 0.99 (95%CI: 0.43, 1.55); flexibility 0.33 (95%CI: 0.04, 0.62); muscular endurance 1.29 (95%CI: 0.56, 2.02); and muscular strength 0.46 (95%CI: 0.09, 0.83).

Chi-squared tests showed significant heterogeneity between studies no matter if type of study design or outcomes measured. Examining moderator variables showed that for cardiovascular endurance, published studies produced significantly larger effect sizes than unpublished studies (P = 0.061), and longer exercise programmes (>= 9 weeks) produced larger effect sizes than shorter programmes (P = 0.068).

Similarly, for the construct of muscular endurance, published studies showed larger effects sizes than unpublished studies (P = 0.035), and longer exercise programmes larger effect sizes than shorter programmes (P = 0.025). Other moderating variables identified include type of exercise programme for muscular strength, and lower level of exercise frequency for flexibility.

It is reported that the degree of internal validity did not influence study outcomes but no data was presented.

Authors' conclusions
Exercise training appeared to improve several health-related physical fitness components. It is clear that muscular and cardiovascular endurance can be greatly influenced by exercise training. More research is needed in areas of body composition, flexibility and muscular strength. The review identified that longer exercise programmes for muscular and cardiovascular endurance, resistance exercise programmes for muscular strength, and higher frequency exercise programmes for flexibility can influence exercise treatment effectiveness. Future studies should upgrade their standards for reporting appropriate statistical information and information related to sample and exercise prescription components.

CRD commentary
The aim and inclusion criteria are clearly stated. A number of sources were searched for published and unpublished material. Validity was assessed. Details of statistical methods are stated. Heterogeneity was assessed and investigated. The following problems with the primary data were discussed: small number of studies for some outcome measures; lack of information on age, sex of participants; variability in information on the degree of intellectual deficit; and lack of specific description of intensity, exact type and duration of exercise programme. There may be publication bias in this research field since published studies showed larger effect sizes than unpublished dissertations.

No details of methods used to select primary studies, extract data or assess validity were stated. Fuller details of the individual studies would have been welcome including details of selection of participants, study population characteristics, study design, drop-out rates, and follow-up period. It is not clear whether analysis was by intention to treat. Given that statistical heterogeneity was present the conclusions must be, as the authors state, viewed as suggestions rather than definitive conclusions.

Implications of the review for practice and research
Practice: No clinical implications are stated.
Research: The authors offer the following recommendations for future research. The effect size and its interpretation should be provided; findings of unpublished literature should be reviewed more frequently; smaller age ranges should be used; more training should be conducted with children and adolescents; subjects gender should be stated and examined; more complete classification of subjects should be provided; sub-division of samples into groups based on level of functioning could be considered; inclusion of subjects with variable diagnosis should be done cautiously; exercise prescription components including exact type of exercise programme, duration of exercise session and intensity of exercise programme should be clearly outlined; more studies are required to evaluate the effects on all health related physical fitness components but particularly on body composition, muscular strength and flexibility; and mean and standard deviations should be included.

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**Record Status**
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.