

Effects of the Ketogenic Diet on Athletic Performance: A Systematic Review

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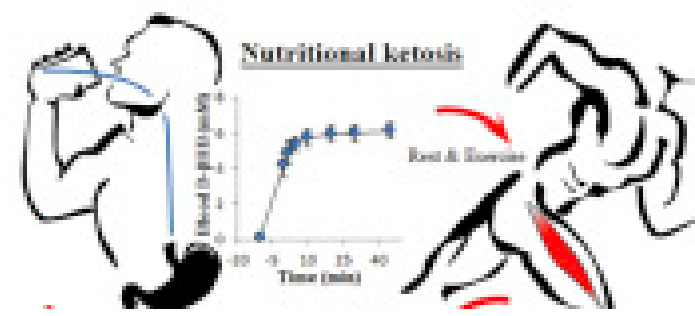
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INTRODUCTION & AIM

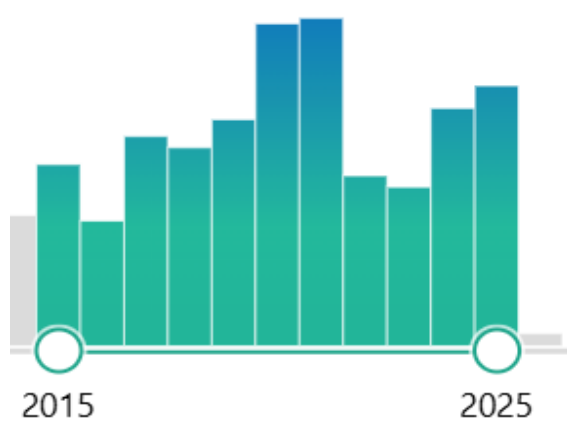
In recent years, the ketogenic diet (KD) has gained popularity beyond clinical settings, reaching the sports domain. Evidence suggests KD may enhance aerobic endurance through increased lipid oxidation and reduced reliance on muscle glycogen. Conversely, high-intensity and anaerobic performance can be compromised due to limited glucose availability. Individual responses may vary depending on training type and adaptation duration. While the ISSN Position Stand highlights the effects of ketogenic diets on **endurance, strength, and body composition**, it does not examine **underlying metabolic pathways or biomarkers** (e.g., insulin, triglycerides, cholesterol), which are crucial for understanding individual responses and adaptation mechanisms (Leaf A et al., 2024).

This systematic review aims to **fill this gap** by critically evaluating the effects of KD on athletic performance, examining both **metabolic adaptations** and **performance outcomes** across endurance and anaerobic disciplines.



METHOD

A systematic search of **PubMed** and **ClinicalTrials.gov** was conducted for studies published from **2015 to 2025**.



Search string

("Ketogenic diet" OR "ketogenic dieting" OR "nutritional ketosis" OR "low-carbohydrate diet" OR "very-low-carbohydrate diet" OR "cyclical ketogenic diet") AND ("exercise performance" OR "physical performance" OR "aerobic performance" OR "anaerobic performance" OR "VO2max" OR "fat oxidation" OR "energy metabolism")

Inclusion Criteria

Population:

- Athletes or physically active individuals (professional or amateur), aged 18–65 years.
- Healthy populations without chronic or metabolic diseases that could affect sports performance outcomes.

Intervention:

- Ketogenic diets or ketogenic protocols induced by carbohydrate restriction (<50 g/day) and/or ketone supplements (e.g., β-hydroxybutyrate).
- Minimum intervention duration: ≥2 weeks for ketogenic diets; ≥1 week for ketone supplements.

Comparison:

- Non-ketogenic diets (e.g., high-carbohydrate or moderate macronutrient diets).
- Placebo control groups for ketone supplement studies.

Outcomes:

- Sports performance measures:
 - VO_{2max} (maximal oxygen consumption)
 - Time to exhaustion
 - Anaerobic power
 - Body composition (fat and lean mass)
- Metabolic biomarkers related to performance:
 - β-hydroxybutyrate, blood glucose, lactate, ammonia, cortisol, alanine aminotransferase, bilirubin

Study Design:

- Randomized controlled trials (RCTs) or non-randomized trials (non-RCTs)
- Peer-reviewed studies published in English

Exclusion Criteria

Population

- <18 or >65 years
- Chronic/metabolic conditions (e.g., diabetes, obesity, CVD)

Intervention

- No defined ketogenic protocol
- Ketone levels or ketosis induction not reported

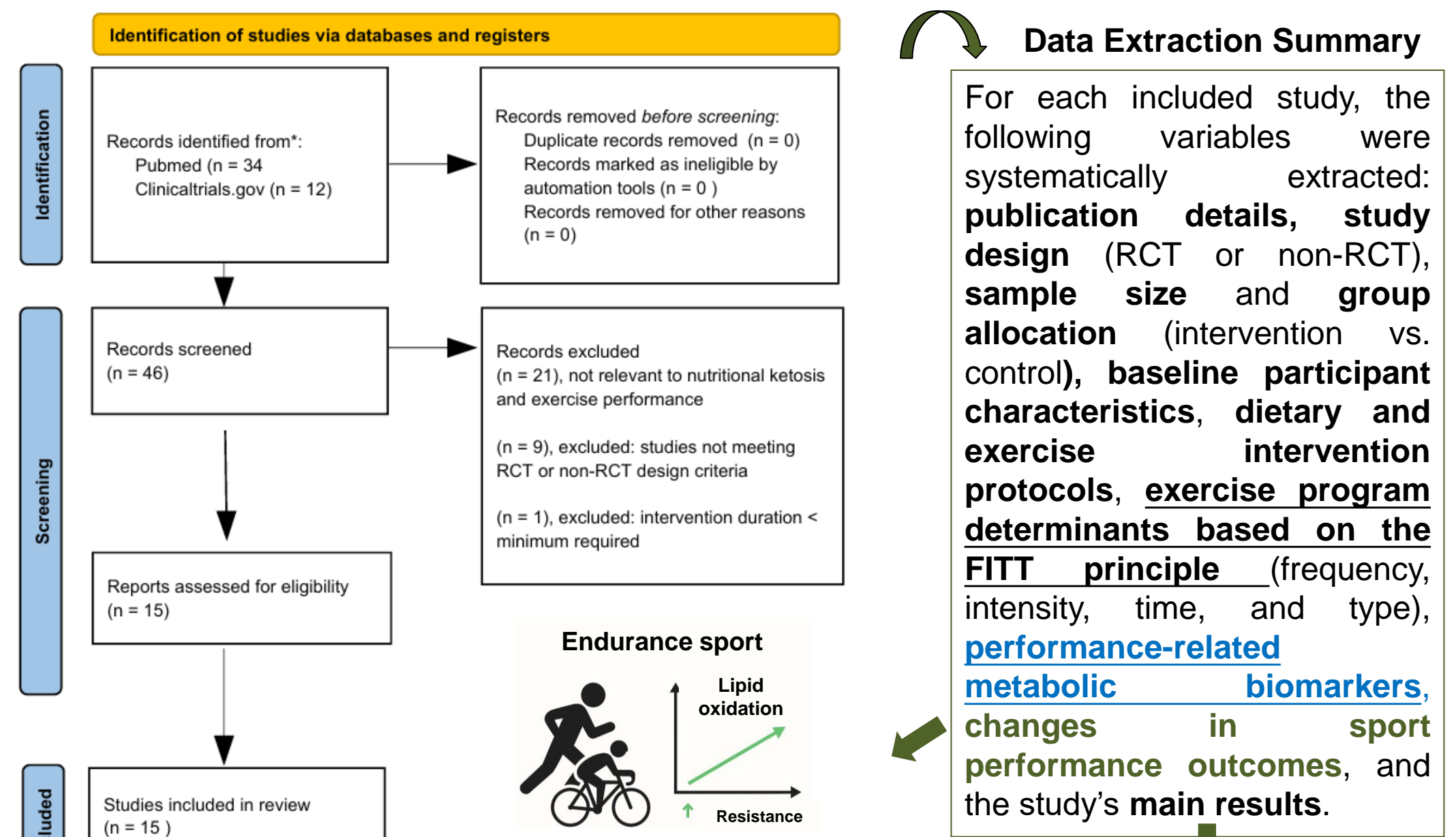
Comparison

- No appropriate control group or comparator

Outcomes

- Exercise performance not assessed
- **Outcomes unrelated to research question** (e.g., mental health, sleep)

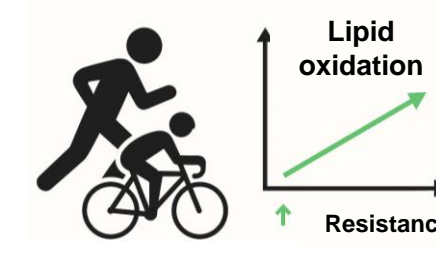
RESULTS & DISCUSSION



Data Extraction Summary

For each included study, the following variables were systematically extracted: **publication details, study design** (RCT or non-RCT), **sample size and group allocation** (intervention vs. control), **baseline participant characteristics, dietary and exercise intervention protocols, exercise program determinants based on the FITT principle** (frequency, intensity, time, and type), **performance-related metabolic biomarkers, changes in sport performance outcomes**, and the study's **main results**.

Endurance sport



ENDURANCE SPORTS (running, cycling, triathlon)

- ↑ Lipid utilization efficiency
- ↑ Long-term energy stability
- ↓ Performance if stable ketosis is not achieved
- ↓ Dependence on muscle glycogen

Anaerobic sport



ANAEROBIC SPORTS (weightlifting, sprinting, CrossFit)

- ↓ Power and explosiveness during the first 14–21 days
- ↓ Muscle glycogen availability
- ↑ Performance improvements following metabolic adaptation

MIXED SPORTS (soccer, basketball, rugby, functional training)

- ↑ Endurance + strength maintenance (if TKD/CKD)
- Metabolic flexibility (thanks to the hybrid approach)
- Highly individual response
- Careful monitoring of carbohydrate timing and load required
- ↓ Performance if applied rigidly (SKD)

Metabolic Marker	Direction of Change	Effect Interpretation	Physiological / Clinical Significance
β-Hydroxybutyrate (BHB)	↑	Positive	Confirms nutritional ketosis, enhances fat oxidation and endurance capacity
Fasting Glucose	↓	Positive	Improved glucose regulation and insulin sensitivity
Insulin levels	↓	Positive	Reduced insulin stimulation, improved metabolic control
Triglycerides	↓	Positive	Indicates improved lipid metabolism, supports long-term energy availability
HDL	↑	Positive	Improvement in lipid profile
LDL	↑/↔	Variable	Increased in some subjects, neutral in others
Total Cholesterol	↑/↔	Variable	Increased in some subjects, neutral in others
Fat mass	↓	Positive	Significant reduction in fat mass
Lean mass	↔ / ↓	Positive/variable	Maintained or slightly reduced if protein intake is inadequate
Cortisol	↑ (during initial phase)	Negative (acute phase)	Adaptive response to initial metabolic stress

CONCLUSION

Ketogenic interventions in athletes can reduce fat mass, enhance fat utilization as an energy source, and support long-term energy stability. During the initial adaptation phase, performance may decline, especially in high-intensity activities. Careful monitoring of metabolic markers is recommended to optimize adaptation and individual responses.

REFERENCES

- Leaf A et al., 2024 International society of sports nutrition position stand: ketogenic diets. J Int Soc Sports Nutr. doi: 10.1080/15502783.2024.2368167.
- Cox PJ et al., 2016 Nutritional Ketosis Alters Fuel Preference and Thereby Endurance Performance in Athletes. Cell Metab.