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Gut Resistome in Athletes: Impact of Sports Nutrition on Antimicrobial Resistance Genes

•Oluchi Judith Osuala[1]; Umeji Theresa Chioma[1] ; Victor Onydikachi Etikudke[2] ; Chinyere Constance Ezemba[3] ; Charles Okeke Nnadi[4]; Angus Nnamdi Oli[5] ; Iheanyi Okonko[6]

•[1]Madonna University Elele Rivers State Nigeria , Elele, Nigeria; [2] Chukwuemeka Odumegwu Ojukwu University, Uli, Anambra State, Nigeria; [3] Chychy Gilgal laboratory and consultancy services, Ichida Anambra State Nigeria; [4] University of Nigeria Nsukka Nigeria; [5] Nnamdi Azikiwe University Awka Anambra State Nigeria; [6]University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

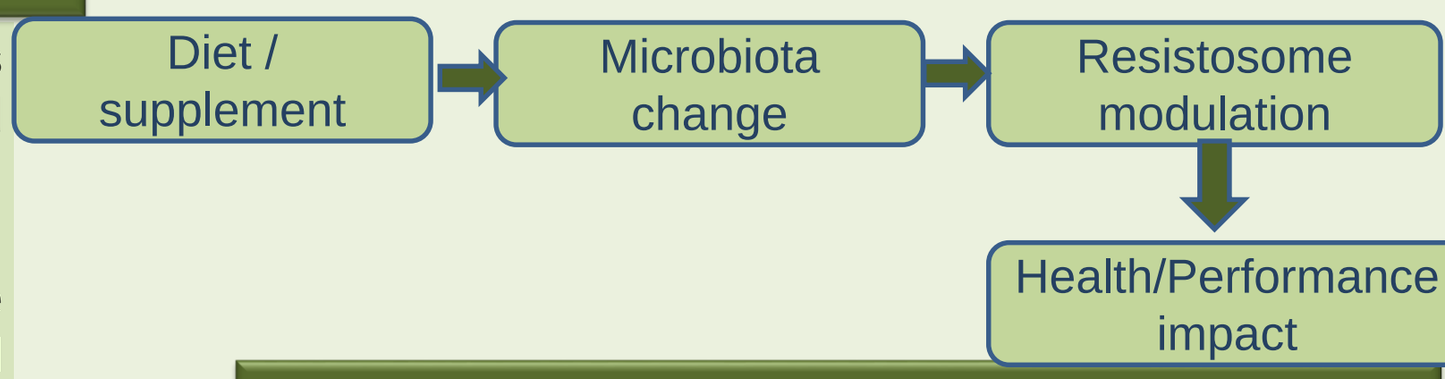
INTRODUCTION & AIM

•Athletes exhibit unique microbiome signatures influenced by training intensity, dietary patterns, and supplement use. (Hughes and Holscher 2021)

•Parallel to beneficial microbes, the gut antimicrobial resistance genes (**ARGs**)—the **resistome**—which can be modulated by ecological shifts in the microbiota. (Fri *et al.*, 2024)

•Despite extensive work on microbiota in athletes, we know little about how their lifestyle may influence resistome dynamics and the implications for health and performance.

•**AIM:** To **explore** how sports nutrition and exercise-driven changes in the gut microbiota may influence the gut resistome, highlighting areas for future investigation and intervention.



KEY THEMES

Diet + Training Shape the Athlete Microbiome	Protein-rich diets, prebiotics/probiotics, and training intensity drive shifts in key taxa. (Hughes and Holscher 2021)
	Exercise influences short-chain fatty acid (SCFA) production, gut barrier integrity, and immune signalling.
Exercise Intensity and Microbial Diversity	Meta-analytic data show that exercise modestly increases microbial diversity (e.g., Shannon index), depending on modality and duration. (Min *et al.*, 2023)
	Resistance training, specifically, shows unclear effects on diversity but may reduce inflammation via gut integrity changes. (Wagner *et al.*, 2024)
Resistome Dynamics in the Gut	Systematic evidence suggests lower microbiota diversity correlates with a higher abundance of ARGs in healthy individuals. (Fri *et al.*, 2024)
	The human gut resistome shows high inter-individual variability; disease states can lead to “resistome expansion” even without extreme taxonomic shifts. (Wagner *et al*., 2024)
Potential Intersection : Athlete Lifestyle & ARG Spread	Shared athletic environments, travel, supplement use, and recurrent minor infections may promote ARG transmission.
	Excess training stress may compromise gut barrier function, possibly facilitating horizontal gene transfer (HGT) of ARGs.

Microbiota benefits	Resistosome risks
❑ Metabolism	❑ ARG Carriage
❑ Immunity	❑ Infection risk
❑ recovery	❑ Antibiotic response

IMPLICATIONS & FUTURE PROSPECTS

Nutritional Interventions

- Design targeted synbiotics or probiotics that suppress ARG-harbouring taxa while supporting beneficial microbes.
- Develop dietary strategies (e.g., specific fibre, prebiotic timing to mitigate resistome expansion.

Surveillance & Monitoring

- Integrate **resistome profiling** into athlete health assessments to identify risk of ARG enrichment.
- Conduct longitudinal studies to track resistome dynamics ove training cycles, competition, and recovery.

Biotechnological Approaches

- Explore metagenomic-guided engineering of microbiota (e.g., phage therapy, designer probiotics) to reduce ARG burden.
- Investigate barriers to ARG transmission within athlete populations (HGT, mobile genetic elements).

Policy & Education

- Promote hygiene practices in shared training spaces to reduc microbial exchange.
- Educate medical/nutrition teams in sports settings about prudent antibiotic use

CONCLUSION

- This review shows the **resistome as an underappreciated dimension** in sports microbiome research.
- Athlete-specific practices—not just for performance but also for antimicrobial resistance management—deserve greater attention.
- Combining sports nutrition, microbiology, and resistome science could unlock interventions that optimize athlete health and antimicrobial stewardship.

FUTURE WORK / REFERENCES

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- Min, L., Ablitip, A., Wang, R., Luciana, T., Wei, M., & Ma, X. (2023). Effects of Exercise on Gut Microbiota of Adults: A Systematic Review and Meta-Analysis. *Nutrients*, *16*(7), 1070. https://doi.org/10.3390/nu16071070
- Wagner, A., Kapounková, K. & Struhár, I. The relationship between the gut microbiome and resistance training: a rapid review. *BMC Sports Sci Med Rehabil* **16**, 4 (2024). https://doi.org/10.1186/s13102-023-00791-4

osualaoluchioo@gmail.com; ugwutheresa@madonnauniversity.edu.ng; victordike0703@gmail.com; constancechinyere790@gmail.com; charles.nnadi@unn.edu.ng; an.oli@unizik.edu.ng; iheanyi.okonko@uniport.edu.ng;