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Unpacking the Success: An Ecological Systems Perspective on Distance Running Performance in Ethiopia

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Research Article

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Abstract

Background

Ethiopia's dominance in distance running is a remarkable sporting phenomenon, yet existing research remains fragmented, examining contributing factors in isolation and failing to capture their complex interplay. This study addresses this critical gap by employing a rigorous mixed-methods approach grounded in Ecological Systems Theory to investigate the multi-level environmental, genetic, and socio-cultural factors influencing athlete performance.

Objectives

This research aimed to identify and analyze the key factors across individual, interpersonal, organizational, and societal levels that contribute to the success of Ethiopian long-distance runners, providing a comprehensive model to inform athlete development and policy.

Methods

A convergent parallel mixed-methods design was utilized. Quantitative data were collected from 145 Ethiopian distance runners (elite, sub-elite, amateur) using a validated, culturally-adapted questionnaire. Data were analyzed using descriptive statistics and binary logistic regression to identify predictors of high performance (defined by achieving a national qualifying time). Qualitative data were gathered through semi-structured interviews (n = 24) and focus group discussions (n = 8), and analyzed using reflexive thematic analysis. The two datasets were merged using a joint display to provide a comprehensive, multi-layered interpretation.

Results

Quantitative analysis revealed that structured training environments (center vs. project: OR = 2.23, P = 0.022), primary education only (vs. secondary certificate: OR = 5.80, P < 0.001), and engagement in recovery practices (OR = 2.38, P = 0.008) were significant positive predictors of performance. Qualitative analysis yielded three core themes: (1) The Forged Resilience: Hardship as an Unseen Training Ground, (2) The Weight of a Nation: Community as Support and Pressure, and (3) The Crossroads: Tradition Versus Modernization in Training. Integration showed that quantitative predictors were profoundly shaped by socio-economic realities and organizational structures, with the "primary education" finding explained by athletes' physically demanding rural lifestyles.

Conclusions

Ethiopian distance running success is a multifaceted phenomenon best understood through an ecological lens. Performance is not merely a product of individual physiology but is deeply embedded within a complex system of community support, organizational culture, and socio-economic background. Addressing current challenges and sustaining success requires systemic interventions that extend beyond the individual athlete to strengthen the entire ecosystem in which Ethiopian champions are made.

1. Introduction

The sustained dominance of East African athletes, particularly from Ethiopia, in global distance running represents one of the most significant and compelling phenomena in modern sports (Wilber & Pitsiladis, 2012). While individual elements like high-altitude living (Scott et al., 2003), specific genetic markers (Zani et al., 2022), and dietary patterns (Beis et al., 2011) have been studied, the existing literature is fragmented. Research has predominantly adopted a reductionist approach, examining factors in isolation and failing to capture the complex, synergistic relationships that cultivate world-class talent. This fragmented understanding limits the development of effective, holistic athlete development programs.

1.1. Gap in Literature and Novelty of the Study

There is a critical gap in understanding how individual, social, and environmental factors interact to create a "perfect storm" for athletic excellence. Previous studies have not adequately explored the athletes' own perspectives and lived experiences within this system, nor have they employed methodologies capable of capturing both the measurable predictors of performance and the contextual nuances that give them meaning. This study, therefore, makes three novel contributions: (1) It is the first to apply Ecological Systems Theory as a comprehensive framework to understand distance running performance in Ethiopia; (2) It employs a rigorous convergent parallel mixed-methods design, integrating quantitative statistical analysis with qualitative thematic exploration to provide both breadth and depth; (3) It centers the voices of Ethiopian athletes, providing crucial insights into the socio-cultural dynamics that shape their careers.

1.2. Theoretical Framework

This study is grounded in Bronfenbrenner's Ecological Systems Theory (1979), which posits that human development is shaped by a series of interconnected environmental systems. This theory is particularly appropriate for understanding athletic performance because it moves beyond individual traits to consider the nested environmental contexts that shape opportunities, behaviors, and outcomes. We adapt this framework to athletic performance (Fig. 1), proposing that an Ethiopian runner's success is influenced by:

- **Microsystem**: Immediate factors like family, coaches, training groups, and personal nutrition.

- **Mesosystem**: Interactions between microsystems, such as the relationship between family and school or coaches and athletics clubs.
- **Exosystem**: Indirect environmental factors like organizational culture (project vs. academy), national athletics policies, and socioeconomic status.
- **Macrosystem**: The broader socio-cultural context, including national pride in running, cultural traditions, and the value placed on endurance sports

This framework allows us to systematically investigate factors at multiple levels and understand their cumulative impact.

(A professional diagram showing concentric circles: Individual Athlete at the center, surrounded by Microsystem, Mesosystem, Exosystem, and Macrosystem, with specific examples for each level relevant to Ethiopian running.)

1.3. Objectives

Based on this framework, our objectives were to:

1. Identify key individual (physiological, psychological), interpersonal (coaching, community), and organizational (training structure) factors affecting performance.
2. Assess the interplay between socio-economic background and athletic development.
3. Explore athletes' lived experiences of the challenges and opportunities within the Ethiopian running ecosystem.

2. Materials and methods

2.1. Study design

This study employed a convergent parallel mixed-methods design (Creswell & Plano Clark, 2018). Quantitative and qualitative data were collected simultaneously and analysed independently. The results were then merged during the interpretation phase using a joint display to triangulate findings, obtain a more complete understanding, and explore convergence or divergence between the datasets.

2.2. Participants

A stratified random sampling technique was used to ensure representation across performance levels and key geographical regions. Performance levels were defined as: elite (athletes who have represented Ethiopia internationally or achieved qualifying times for major championships), sub-elite (athletes competing at national level), and amateur (athletes competing regionally). Geographical regions were selected based on their altitude and athletic development history: Addis Ababa (moderate altitude, 2,355m), Asela-Bekoji (high altitude, 2,700m), and Debre Berhan (high altitude, 2,840m).

Inclusion criteria were: (1) Ethiopian citizenship, (2) age 18–35, (3) minimum 3 years of competitive distance running experience, and (4) participation in ≥ 3 official competitions in the past year. Exclusion criteria included recent injury (< 3 months) or medical conditions contraindicating high-intensity training.

Sample size was calculated a priori using G*Power 3.1 (Faul et al., 2007) for a logistic regression analysis with an effect size of 0.15, α = 0.05, and power = 0.80, indicating a minimum of 92 participants. We recruited 145 to ensure adequate power for subgroup analyses. Of 210 athletes contacted, 145 met inclusion criteria and agreed to participate (69% response rate).

2.3. Data collection

2.3.1. Quantitative Data Collection: Questionnaire Development and Validation

A comprehensive questionnaire was developed through a multi-stage process:

Item Generation: Based on a systematic literature review and consultations with 3 expert Ethiopian coaches.

Cultural Adaptation: Reviewed by a panel of 5 athletes and 2 sports scientists for cultural relevance and terminology.

Expert Validation: Evaluated by 7 international experts using a Content Validity Index (CVI). Items with CVI < 0.78 were revised (Polit & Beck, 2006).

Pilot Testing: Conducted with 15 athletes (not in the final sample) to assess clarity and completion time. 8 items were rephrased.

Reliability: Internal consistency (Cronbach's α > 0.70) and 2-week test-retest reliability (ICC > 0.75) were confirmed.

The final questionnaire comprised 62 items across domains aligned with the ecological framework. Performance was operationally defined as a binary variable: "High Performance" (1) if the athlete had achieved a national qualifying time for a major championship in the past year, and "Lower Performance" (0) otherwise.

2.3.2. Qualitative Data Collection

Purposive sampling was used to select 24 athletes for semi-structured interviews and 40 athletes for 8 focus group discussions (5 participants each), ensuring variation in gender, performance level, and region. A semi-structured interview guide explored topics like motivation, challenges, community influence, and perceptions of the training system. All sessions were audio-recorded, transcribed verbatim, and translated from Amharic/Oromiffa to English by trained research assistants.

2.4. Data Analysis

2.4.1. Quantitative Analysis

Data were analysed using SPSS v25. The analysis plan included:

Descriptive Statistics: Frequencies, means, and SDs for all variables.

Assumption Testing: Normality (Shapiro-Wilk), homoscedasticity (Levene's test), and multicollinearity (VIF < 5) were checked.

Multivariate Analysis: Binary logistic regression was used to identify significant predictors of the binary performance outcome. Odds Ratios (OR) with 95% Confidence Intervals (CI) was reported.

Missing Data: Handled using multiple imputations (5 iterations) after confirming data was Missing Completely at Random (MCAR). The Benjamini-Hochberg procedure was applied to control the false discovery rate.

2.4.2. Qualitative Analysis

Data were analysed using reflexive thematic analysis (Braun & Clarke, 2019) in NVivo 12. The six-phase process was followed: familiarization, coding, generating themes, reviewing themes, defining themes, and writing up. Trustworthiness was ensured through member checking (n = 5), maintaining an audit trail, and peer debriefing. Inter-rater reliability (Cohen's $\kappa > 0.75$) was confirmed.

2.5. Integration of Data

Following the independent analysis of both datasets, we undertook a systematic integration process. Quantitative and qualitative findings were merged in a joint display table (Table 2). This table was created by first listing the significant quantitative predictors. For each predictor, we then identified the qualitative theme(s) that offered a mechanism, context, or explanation for the statistical relationship. In the final column, we synthesized both datasets to produce an integrated interpretation that is more robust and nuanced than either dataset could provide alone. This process allowed us to identify where findings converged, complemented, or expanded upon each other, providing a rich, multi-layered interpretation of the factors influencing performance.

2.6. Ethical Compliance

The study received ethical approval from the Institutional Review Board of Debre Berhan University (IRB 06/2025). All participants provided written informed consent. Data were anonymized and stored securely.

3. Results

3.1. Microsystem: Individual and Interpersonal Factors

Individual Physiology and Practices:

Quantitative analysis revealed that a normal BMI was significantly associated with high performance compared to being underweight (OR = 2.85, 95% CI [1.31, 6.23], P < 0.001). Athletes who engaged in structured recovery practices were also more than twice as likely to be high performers (OR = 2.38, 95% CI [1.08, 5.28], P = 0.008).

Qualitative findings provided context for these results. Athletes described the constant challenge of managing their bodies and the gap between knowledge and resources. Theme 1, "The Forged Resilience: Hardship as an Unseen Training Ground," captured how early life physically prepared athletes but also created long-term challenges. One athlete noted:

"We were strong before we even knew what 'athlete' meant. But now, I struggle to eat enough food to recover from two sessions a day. I know what I should do, but I can't always afford it." (Male, 24, Asela-Bekoji)

This quote explains the quantitative link between recovery practices and performance, highlighting that recovery is not just a choice but a resource-dependent behaviour.

3.2. Exosystem: Organizational and Socioeconomic Influences

Training Environment and Education:

The most striking quantitative finding was that athletes with only primary education were nearly six times more likely to be high performers compared to those with a 10th/12th-grade certificate (OR = 5.80, 95% CI [2.12, 15.81], P < 0.001). Furthermore, athletes in training centers were over twice as likely to achieve high performance compared to those in project-based settings (OR = 2.23, 95% CI [1.02, 4.88], P = 0.022).

The qualitative data, particularly from Theme 1, provided a compelling explanation for the education paradox. Athletes with only primary education were more likely to come from rural, high-altitude areas where their daily lives (walking to school, farming) provided a foundation of endurance. They also began focused athletic training earlier, free from the academic and social distractions of urban secondary education. An athlete explained:

"In the city, school is a priority. In the countryside, running is the priority. It's your way out. So you focus on it earlier and harder." (Female, 22, Debre Berhan)

Theme 3, "The Crossroads: Tradition Versus Modernization in Training," directly addressed the training environment finding. Athletes in structured centers valued the access to scientific knowledge and professional coaching, which contrasted sharply with the more ad-hoc, project-based system.

"In the center, we have a plan. We have a coach who watches us. In the project, you just run. You might have talent, but you don't know how to develop it." (Male, 21, Addis Ababa)

3.3. Mesosystem and Macrosystem: The Overarching Influence of Community and Culture

While not directly measured in the logistic regression, the qualitative data were saturated with the influence of the mesosystem and macrosystem. Theme 2, "The Weight of a Nation: Community as Support and Pressure," captured the dual role of community.

"The whole village looks to you. When you win, they celebrate. When you lose, they feel it. It gives you strength, but it is also a heavy weight to carry." (Female, 27, Addis Ababa)

This theme provides the essential backdrop for all other findings. It explains why running is such a viable and valued career path, creating the motivation for athletes to persevere through hardship and navigate the tensions between traditional and modern training approaches.

Table 1
Logistic Regression Analysis Predicting High Performance in Ethiopian Distance Runners (N = 145)

Predictor Variable	B (S.E.)	Wald X^2	P-Value	Odds Ratio (OR)	95% CI For OR
Constant	-3.12 (0.84)	13.94	< 0.001	0.04	
Training Institution		14.26	0.001		
Project (Ref)				1.00	
Center	0.80 (0.40)	4.03	0.022	2.23	[1.02, 4.88]
Academy	0.88 (0.38)	5.23	0.001	2.40	[1.13, 5.08]
Club	0.38 (0.51)	0.57	0.451	1.47	[0.54, 3.98]
Education Level		20.82	0.001		
Reading & Writing (Ref)				1.00	
Primary Education Only	1.76 (0.51)	11.77	< 0.001	5.80	[2.12, 15.81]
10th/12th Certificate	-1.64 (0.57)	8.13	0.004	0.20	[0.06, 0.60]
Diploma & Above	0.36 (0.62)	0.34	0.562	1.43	[0.43, 4.84]
Recovery Practices					
No (Ref)				1.00	
Yes	0.87 (0.41)	4.58	0.008	2.38	[1.08, 5.28]
BMI		7.93	0.019		
Underweight < 18 (Ref)				1.00	
Normal (18-24.9)	1.05 (0.40)	6.94	< 0.001	2.85	[1.31, 6.23]

Table 2
Joint Display of Integrated Quantitative and Qualitative Findings

Quantitative Finding	Qualitative Theme(S) Providing Explanation	Integrated Interpretation
Primary Education Only is a strong positive predictor of performance (OR = 5.80).	Theme 1: The Forged Resilience. Athletes with primary education often come from rural areas where daily life (walking, farming) builds endurance. They begin focused training earlier, seeing running as a primary way out of hardship.	The statistical relationship is not about education itself, but what it represents: a rural, physically demanding lifestyle that serves as a long-term, unintentional training ground and allows for earlier athletic specialization.
Training in a Center is a strong positive predictor of performance (OR = 2.23).	Theme 3: The Crossroads. Centers provide structured plans, scientific knowledge, and professional coaching, contrasting with ad-hoc project-based training. Athletes feel their talent is being systematically developed.	The superior performance in centers is due to access to organizational resources (exosystem) that provide structure, expertise, and a professional culture, which are critical for translating raw talent into elite performance.
Engaging in Recovery Practices is a positive predictor of performance (OR = 2.38).	Theme 1: The Forged Resilience. Athletes understand the importance of recovery but face resource constraints. "I know what I should do, but I can't always afford it."	Recovery is not merely an individual choice (microsystem) but is constrained by socioeconomic realities (exosystem). The ability to recover effectively is a marker of having the resources to support high-level training.
Normal BMI is a positive predictor of performance.	Theme 1: The Forged Resilience. Athletes discuss the challenge of consuming enough calories to fuel training and recovery, highlighting the link between nutrition, resources, and performance.	Maintaining a healthy BMI is an indicator of sufficient nutritional intake, which is a challenge for athletes from low-resource backgrounds. This links individual physiology directly to socioeconomic capacity.
(Not measured quantitatively)	Theme 2: The Weight of a Nation. Community provides immense motivation and support but also creates intense pressure to succeed and provide for family.	This mesosystem/macrosystem theme provides the essential cultural context that underpins all other factors. It explains the powerful motivation that drives athletes to persevere through hardship and pursue running as a viable career path.

4. Discussion

This study provides one of the most comprehensive examinations of the factors influencing Ethiopian distance running performance by integrating quantitative predictors with qualitative lived experiences within an ecological framework. Our findings confirm that success is a multi-level phenomenon, rejecting single-cause explanations and offering a more nuanced, systemic understanding.

The Exosystem: The Critical Role of Structure and Opportunity

Our key quantitative finding that athletes in structured training centers significantly outperform those in project-based setups highlights the critical role of the exosystem. This aligns with previous research noting gaps in coaching management and resource allocation (Thompson, 2009; Gizaw, 2013). However, our qualitative data (Theme 3) and the joint display (Table 2) provide a novel mechanism: these centers offer not just better facilities, but access to scientific knowledge, structured coaching, and a professional culture that fosters athlete development. This suggests that investment in organizational infrastructure is a direct lever for performance enhancement.

The Microsystem Paradox: Re-evaluating Education and Socio-Economic Background

The counterintuitive finding that primary education was a stronger predictor of success than secondary education is one of our most significant contributions. Our integrated findings (Table 2) suggest a compelling explanation: athletes with only primary education are more likely to remain in rural, high-altitude areas, engaging in endurance-building daily activities and beginning focused training earlier. This challenges assumptions about the linear benefits of formal education for athletic performance and underscores the powerful, often hidden, influence of socio-environmental factors. It suggests that "hardship," in the form of a physically demanding rural lifestyle, may act as an unrecognized, long-term training ground.

The Integrated System: How Community and Culture Shape Everything

Our ecological framework proved robust. The findings demonstrate how factors at all levels from an athlete's individual BMI (microsystem) to national athletic culture (macrosystem) are interconnected. The "community as support and pressure" theme (Theme 2) exemplifies the mesosystem, where the interactions between family, coaches, and community create a unique motivational climate. This cultural backdrop (macrosystem) is the engine that drives the entire system, providing the meaning and motivation for athletes to persevere.

Theoretical and Practical Implications

This study makes two key contributions. Theoretically, it demonstrates the utility of Ecological Systems Theory for sports science, providing a framework that captures the complexity of athletic development in a way that reductionist models cannot. Practically, our findings provide clear, evidence-based recommendations:

For Policymakers: Invest in establishing structured training centers in emerging athletic regions outside of Addis Ababa. Develop policies that support athletes' nutritional and recovery needs.

For Coaches: Recognize that athletes from rural backgrounds may possess a unique "forged resilience" but also require specific support in areas like nutrition and recovery. Integrate scientific principles with traditional high-volume training methods.

For Athlete Support Programs: Address the psychological pressures of community expectations through mental skills training and support networks.

5. Limitations and Future Research

The cross-sectional design limits causal inferences. Future longitudinal research is needed to track athlete development over time. While our sample was diverse, it may not be fully representative of all Ethiopian runners. Future studies should incorporate direct physiological and genetic testing to quantify the biological factors discussed here and build upon the ecological model we have established.

6. Conclusion

Ethiopia's continued dominance in distance running is not a matter of genetics or altitude alone; it is the product of a complex, dynamic ecological system. Success emerges from the interplay between an athlete's individual resilience, the unwavering support of their community, the structure of their training environment, and the deep cultural significance of running. To sustain this legacy, stakeholders must look beyond the individual athlete and implement systemic interventions that strengthen the entire ecosystem in which Ethiopian champions are made.

Abbreviations

BMI
Body Mass Index
CI
Confidence Interval
CVI
Content Validity Index
ICC
Intraclass Correlation Coefficient
IRB
Institutional Review Board
MCAR
Missing Completely at Random
OR
Odds Ratio
P
Probability value
SD
Standard Deviation
SPSS
Statistical Package for the Social Sciences

κ
Cohen's kappa coefficient

Declarations

Ethical Approval and Consent: The study received ethical approval from the Institutional Review Board of Debre Berhan University (IRB 06/2025). All participants provided written informed consent after the study procedures were fully explained.

Data Availability Statement: Data supporting the findings of this study are available from the corresponding author upon reasonable request but are not publicly available due to privacy concerns.

Competing Interests: The authors declare no competing interests.

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Author Contributions: Dr. Arefayne Mesfen Dessye contributed to study design, data collection, analysis, and manuscript drafting. As the sole author, he reviewed and approved the final version of the manuscript.

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Figures

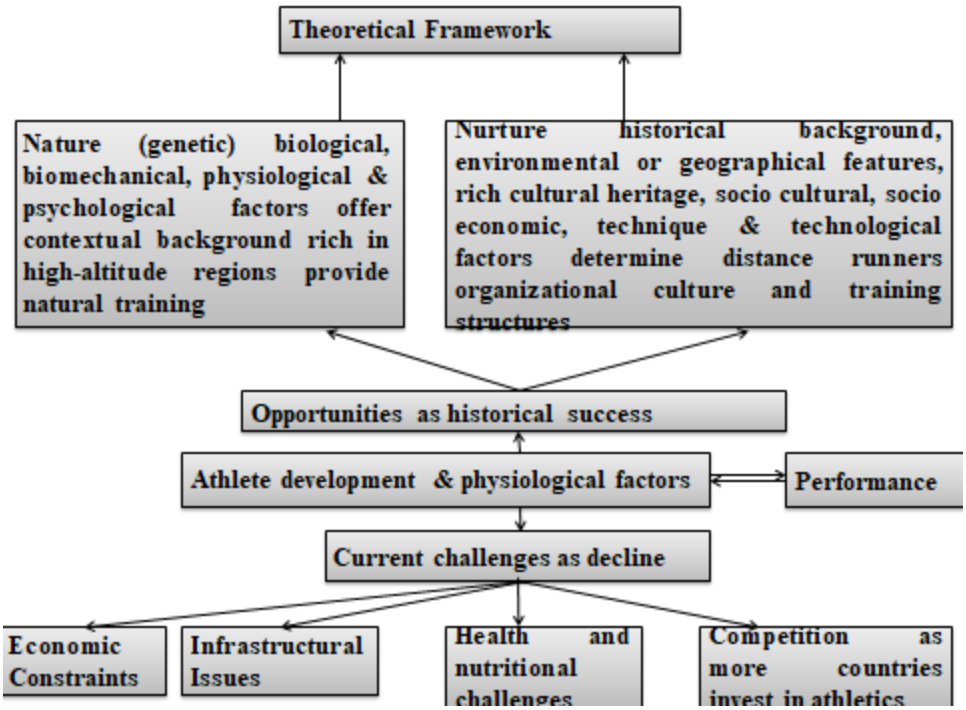


Figure 1

Ecological Systems Framework of Ethiopian Distance Running Performance

(A professional diagram showing concentric circles: Individual Athlete at the center, surrounded by Microsystem, Mesosystem, Exosystem, and Macrosystem, with specific examples for each level relevant to Ethiopian running.)

Supplementary Files

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