Determining anemia & Iron status and their relation with the performance of professional Ethiopian Athletes.

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Presentation outline

1. Introduction
2. Statement of the problem
3. Objectives of the study
4. Materials and methods
5. Results and discussion
6. Conclusion and recommendation
1. Introduction

- The most common MN deficiencies include vitamin A, iron, iodine, vitamin B\textsubscript{12}, zinc & folic acid.
- Almost 1/3 of world populations suffer from the MN deficiencies.
  - The cause of these MN deficiencies is primarily due to
  - prolonged inadequate dietary intake of foods rich in these nutrients. (Uchendu, 2011).
- Anemia is the decrease in number and size of RBCs or
- Decreased the amount of Hb in RBCs.
- Functional ID occur when ferritin level below the normal range (<12µg/L), WHO, 2011).
- Anemia and ID affects O\textsubscript{2} and CO\textsubscript{2} exchange b/n blood and tissue cells,
  - And iron is an important nutrient in sports that require endurance for success.
  - Thus, deficiency of this nutrient limits athlete’s endurance and performance (Driskell & Wolinsky, 2006).
2. Statement of the problem

- There are researches done in different countries, such as
  - a study in Korea by Kim et al., (2007), in Israel by Dubnov & Constantini, (2004) and in Sweden by Sandström in 2014,
  - They reported high prevalence of ID and IDA in professional athletes.
- There are few researches done with elite endurance Ethiopian runners:
  - Demographic characteristics, Food & Ma.N intake,
  - Y-chromosome haplogroups, & Mitochondrial DNA lineages.
- Unfortunately, there is no any research has been done related to:
  - Hematological variables, Anemia & Some important MN status.
3. Objectives of the study

3.1 General Objectives
- To assess hematological variables, anemia & iron status then to find if there is any relation with performance of professional Ethiopian athletes.

3.2 Specific objectives
- To assesses FF & 24 Hr DD of the athletes.
- To Determine hematological variables by CBC analysis & compare with NRR.
- Determine infection/inflammation level by \((\alpha_1\text{-AGP})\) indicator.
- To measure serum Ferritin, Transferin level and then compare with their NRR.
- Looking for the relation of performance with hematological variables & body iron status.
4. Materials and methods

4.1. The study site and study subjects.

- The field work was carried out in A.A national stadium in the period of February to April 2014.
- The study subjects were male and female athletes of (short, middle, long & marathon runners),
- Who registered and doing continuous training under EAF with their respective coaches.

![Figure 1 study site and study subjects](image)
4.2 Ethical clearance

- The research proposal was submitted and presented at EPHI.
- Ethical clearance was obtained from the institute SERO.
- Before starting the field work & data collection, the EAF & the athletes were informed about
- the study objectives, importance & benefits of participation.
- Finally consent was obtained from each research participant athletes.

4.3 Sampling and Sample size

- Using convenient sampling; a total of 101 national athletes were participated in the study.
- The study participants were stratified based on their running dis.
  & the research participant athletes were from:-
  - Marathon running (16), long distance (18), 3000m steeple chase (14), middle distance (22) & short distance (31).
4.4 Data collection frame work

Data collection

- Socio demographic
  income, Health status, exercise intensity, supplement information...
- Dietary data
- Blood sample
  - Collection
    anti-coagulant
    w/o anti-coagulant
  - Centrifuged at 3000rpm
- Serum sample
  - (ferritin, transferin & AGP analysis)
- Weekly FFQ & 24-Hr DD
- Hematology (for CBC analysis)
4.5 laboratory analysis

Analysis of CBC (MCV, MCH, MCHC, RBC count, Hb, RDW lemphocytes, etc).

Transferin, AGP analysis

ferritin analysis

By Cobas Intgera 400 plus, Roche, Germany

by Cobas e-411 enzymelinked immunosorbent assay Roche, Germany,

Analyzed by SYSMEX XT, hematological analyzer @sysmex, Japan).
All results from biochemical analysis & dietary assessment were analysed using SPSS version 20.

The results of analyzed biomarkers & dietary data were summarized in terms of mean (x̄), median (x̂), (Sd), variance(V), quartile range (Q1, Q3) & correlation (r).

And also to find sig. dif. at 95% CI (p<0.05).

Given that the serum-ferritin data was skewed & did not meet the assumptions of normality (p< 0.05) for Shapiro-wilk test,

so the log-transformed data was used for stat. analysis &

the back transformed mean was used for inferential statistics.

However, the AGP, RBC, Hb, & transferrin data were fit for normality assumption, so, non-transformed data were used for inferential statistics.
Results & discussion

5.1 weekly diversity of food

![Graph showing weekly diversity of food consumption.]

**Figure:** 2 Weekly diversity of food consumption %age, by athletic popln

NNP related research finding dissemination workshop
5.2 weekly diversity of food by dis. category

Figure: 3 Animal & plant source food consumption %age by dis. category
The Dietary Diversity Scores (DDS) of individual subjects was ranged from 2 to 10. The overall mean DDS among subjects was 5.44 with a SD of 1.8.
5.3 Health and inflammation status of the athletes

- Based on the interview of the athletes & AGP figures show that, most, if not all, had no medical conditions & thus were healthy.
- The normal reference range of $\alpha_1$-AGP biomarker is 0.5-1.2g/L (Roche diagnostic, 2010).
- only 2% athletes had >the UNV & 11% had an $\alpha_1$-AGP < the LNV.
- Among the 11% with lower AGP, the 9% had an $\alpha_1$-AGP of $\geq 0.31$g/L, but the rest 2% had $\alpha_1$-AGP of $\leq 0.02$g/L.
- Higher level of $\alpha_1$-AGP is an indication of presence of infection/inflamn.
- very low level of $\alpha_1$-AGP associated with in hospital mortality in a population of hospitalized elderly patients (Henry et al., 2003).
5.4 RBC & Hb level of athletes

- The mean ± SD of crude and alt. adj. Hb for male was 16.7 ± 0.82 Vs 15.4 ± 0.82 g/dL.
- But for female athletes it was 15 ± 0.88 Vs 13.7 ± 0.88 g/dL.
- There was a sig. dif. b/n male and female Hb level at 99% CI.
- While the Hb dif. in running-dis. category was not stat. sig.
- The mean ± Sd of RBC count x (10^12/ L), for male and female athletes were (5.45 ± 0.34 & 4.85 ± 0.35 respectively.
- As in the case of Hb, there was sig. dif. b/n male and female RBC count at 99% CI.
- And the variation of RBC by running-dis. category was not stat. sig.
- The correlation b/n Hb & RBC count was sig. at 99% CI, (p<0.001).
5.5 Anemia status based on WHO Hb cut off

- According to the WHO Hb cut off points, for alt. adjusted; 
- athletes w/c were anemic (Hb<12g/dL) was 3% (3 athletes). 
- among them, 2 runner (1 male & female) were from long dis. 
- but the rest 1 male was from marathon running. 
- Despite of relatively few runners participated, the presence of anemia in 
  - marathon & long dis. runners in contrast to short and middle, 
  - indicate that very long distance running affect Hb level negatively.
5.6 Iron status

- The non-log-transformed mean and Sd of ferritin for male & female athletes were, 134.1 ± 86.8 and 63.9 ± 40.4 μg/L respectively.
- Based on the cut off pts (ferritin<12 μg/L) the ID athletes were 2% (1 male & 1 female athlete).
- 1st stage iron dep. (ferritin <50μg/L, but>30μg/L) was 22% &
- 2nd stage iron dep. (ferritin<30 μg/L, but >12 μg/L) was 13%.
- among the 13% 2nd stage iron dep. 11% were females athletes.
- The mean ferritin & % of 2nd stage iron dep. showed that,
- the female athletes showed low iron store than male w/c is
- an indication of more vulnerability to ID.
- Iron overload for male, (ferritin>200 μg/L) in the absence of inflammation WHO, (2011); was 11%.
- Among all iron overload athletes 8% were from short dis. runners.
Among 44 female athletes 27.3% had low iron store (<30μg/L) but only 3.5% for male. This finding is fairly consistent with a study done in 42 Iranian female athletes participating in team ball sport in 2010, w/c a report of, low iron store in 33.3% & iron overload in 12.5% of the study participants (Ahmedi et al., 2010).

But in this study no iron overload in female athletes.
Iron cont…

- Running distance category has brought sig. dif. in male athletes’ ferritin level but not in female athletes at 95% CI.
- However transferin was not sig. in both male & female across running dis.

Table 2: statistically analyzed Gender partitioned ferritin by running distance

<table>
<thead>
<tr>
<th>Distance category</th>
<th>Ferritin (male)</th>
<th>Ferritin (female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short distance (100-400m)</td>
<td>171 ± 1.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>52.0 ± 2.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Middle distance (800-1500m)</td>
<td>72 ± 2.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>39.0 ± 2.2&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Steeple chase (3km)</td>
<td>111 ± 1.8&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>64.0 ± 1.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Long distance (5 &amp; 10km)</td>
<td>124 ± 1.8&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>67.6 ± 2.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Marathon (42.2km)</td>
<td>65 ± 2.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>41.4 ± 1.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Superscript words of d/t letters in one column are statistically significant (p< 0.05)

- Despite of their food and MN intake, (EV) could affect iron status.
- Mean ferritin of female same as male across running dis., but none of them were statistically sig.
Iron cont...

- A study done in Korea by Kim et al., (2007), of runners (n=30), badminton players (n=8) &
- shooting athletes (n=26) the prevalence of anemia, ID & IDA were 23.4%, 23.4% & 14.0% respectively.
- There was a sig. dif. in the prevalence of ID among the 3 types of athletes;
- Runners & badminton players tend to affect more with ID than static athletes such as shooters.
- And the ID were 33.3%, 25.0% & 19.2% respectively.
- But in the current study there was no anemia & ID together.
### 5.8 Variation of MN & hematological variables by gender

**Table 3:** Analysis of MN & hematological variables by sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>RBC</th>
<th>Hb</th>
<th>Ferritin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>5.45 ± 0.34(^a)</td>
<td>16.7 ± 0.82(^a)</td>
<td>107 ± 2.1(^a)</td>
</tr>
<tr>
<td>Female</td>
<td>4.9 ± 0.35(^b)</td>
<td>15 ± 0.9(^b)</td>
<td>51 ± 2.0(^b)</td>
</tr>
</tbody>
</table>

Superscript words of d/t letters in one column are statistically significant (p< 0.05)
5.9 R/n of MNs & hematological variables with performance of the athletes’

- To investigate these association, data on performance for 2013 & 2014 archived best time (athletes’ speed) were obtained from the EAF.
- And the data was categorized into high and low performers according to their fast & slow speed registered.
- The mean ± Sd of their hematological variables was calculated &
- For each of hematological variables & MN, the stat. analysis was done.
- to find sig. association (p<0.05) with performance of the athletes.
R/n cont…

**Table 6: Hematological & MN values of high and low performer athletes**

| Hematological Variables (Mean ± Sd) of high performer Vs low performer athletes |
|---------------------------------|---------------------------------|------------------|
| Male & female                   | Hb (g/dL)                       | RBC count x (10^{12}) | Ferritin (µg/L) |
| High performer                  | 16.2 ± 1.2<sup>a</sup>          | 5.3 ± 0.14<sup>a</sup> | 84.5 ± 63.3<sup>a</sup> |
| Low performer                   | 15.5 ± 1.0<sup>a</sup>          | 5.0 ± 0.14<sup>b</sup> | 88.6 ± 60.8<sup>a</sup> |

➢ The table shows that a higher RBC & Hb level exhibited by high performer
➢ However only RBC level was stat. significant with performance.
➢ Irrespective of gender differences, higher performers athletes had higher RBC values than their low performing counterparts (p<0.05).
6. Conclusions and Recommendations

- Athletes need relatively high fluid, macro & MN intakes to balance losses associated with strenuous exercise & high alt. fatigue with traumatic movement of running w/c leads to losses of minerals & vitamins through sweating, urination & hemolysis.
- So nutritional counseling & monitoring is mandatory.
- Given the 11% of athletes has serum ferritin >200µg/L w/c indicates iron overload.
- Dietary supplements such as iron-folate, multivitamins & mineral prescription should be based on clinical laboratory testing,
- Rather of by broad spectrum of suspecting MN deficiencies.
- In general, it is recommended to conduct iron overload assessment in Ethiopia healthy populations.
- Future studies should investigate the reason behind the observed high RBC in high performing athletes.
Acknowledgments

To FSNRD & Hiv/Tb RD

EPHI  AAU  EAF  The athletes
THANK YOU FOR YOUR ATTENTION!!