

早稲田大学審査学位論文
博士（スポーツ科学）
概要書

Energy Availability and Metabolic Suppression
in Korean Male Collegiate Soccer Players

アジア人男性アスリートにおける
エネルギー・アベイラビリティと代謝抑制

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Low energy availability (EA) and energy deficiency in athletes have been studied, and its effects on physiological function result in impairments of the endocrine system and bone metabolism have been investigated. However, there were limited studies on Asian male athletes. The purpose of this research was to evaluate EA and energy deficiency and to investigate the relations between energy deficiency and physiological function in Asian male athletes.

A cross-sectional and observational study design was implemented on 15 male soccer players (18-21 years) recruited from a local university in Korea. Anthropometric data, body composition, and bone mineral density (BMD) were measured prior to the VO₂max test and resting energy expenditure (REE) measurements. Hormones and bone turnover markers (BTMs) were analyzed by blood and urine assessments. Participants completed a 7-day recording period including food diary, physical activity, and training heart rate (HR) data. Twelve participants completed the experiment.

The mean EA of the participants was 31.9 ± 9.8 kcal/kg FFM/d, and 41.7% had low EA (<30 kcal/kg FFM/d). The low EA group had suppressed ratio between measured and predicted REE (REE_{ratio}) and lower insulin-like growth factor-1 (IGF-1) than the high EA group (REE_{ratio}: 0.91 ± 0.06 vs. 1.01 ± 0.05 , $p = .008$, IGF-1: 248.6 ± 51.2 vs. 318.9 ± 43.4 ng/mL, $p = 0.028$). Data of 10 participants were analyzed for associations of within-day energy balance (WDEB), REE_{ratio}, and hormones. The suppressed REE_{ratio} group had lower energy intake (EI) of rest days than the normal REE_{ratio} group (rest day EI: 3772 ± 463 vs. 2796 ± 800 kcal/day, $p = 0.046$), and there was a positive association between REE_{ratio} and IGF-1 ($r = 0.771$, $p = 0.009$). There was no association between WDEB factors and hormones, but hourly changes of energy status presented insufficient energy compensation during training days (energy balance (EB): -957 ± 503 kcal/d).

This research presented that there was a high prevalence of low EA in Korean male collegiate soccer players, but the effects of low EA on hormones and bone metabolism were inconclusive. REE_{ratio} can be applied for the assessment of the energy deficiency in free-living

athletes, and WDEB analysis can provide details of the energy status of athletes. Further research is required to investigate the effects of energy deficiency on various physiological alterations and performance in Asian male athletes.