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*Titre et résumé de la thèse – Title and abstract of the thesis*

**Improving talent identification through analysis and consideration of biological and relative age**

Modern talent identification (TID) and talent development (TD) models should include biological development. This requires practicable methods for the consideration of biological age (BA) and relative age (RA). Until 2008, most Swiss sports federations selected young athletes on the basis of current competition results rather than development potential. This meant that many of these talent selection processes failed to integrate important indicators when assessing young talent. Because of these shortcomings, a new standardised national talent selection instrument for all Swiss sports federations was developed. In addition to having six major assessment criteria, the instrument includes biological development, which is subdivided into BA, RA, and relative age effects (RAEs).

However, in the current sports system, the participants are categorised into annual age groups to reduce the developmental differences during childhood and adolescence. In this regard, an unfortunate problem remains because of the potential for RA and BA differences among individuals within an annual age cohort. This means that in many TID processes, the athletes do not have equal opportunities, the resources are used inefficiently, and potential talent is lost.

This thesis summarizes the last eight years of research in RA and BA. Questions arose about the prevalence and evolution of RAEs at the various development stages and selection levels. Furthermore, gaps exist in the research on RAEs in female athletes. The number of extant studies was limited, and the data were inconsistent. Therefore, this cumulative habilitation aims to show: (1) the prevalence of RAEs by sport type, competition level, and gender; (2) the underlying mechanisms in RAEs; and (3) the possible approaches for considering BA and RA in the selection process.

Studies on RA and BA have shown that even a small age difference of a few months could exert a significant effect on talent selection and TD. The current sports system, which uses chronological age categories, results in the selection of a disproportionate number of biologically and/or chronologically older athletes. This phenomenon has been observed throughout the Swiss TD program, particularly with regard to male athletes. RAEs also influence the selection of female athletes; therefore, these 5 effects must be taken into account. Comparisons of sports have shown that high physical demands and high performance density (many selection levels) strengthen RAEs.

Differences in BA are the principal cause of RAEs. This can lead to performance differences, which, along with parental influence, can trigger selection and self-selection processes. The most important environmental factors are the popularity (i.e. number of participants and economic factors), requirement profiles, and selection levels of the sports. The athletes who are selected benefit from greater support, better training, access to higher competition levels, higher involvement, and positive feedback, which have a positive influence on performance. This leads to an upward spiral for athletes at higher BAs and RAs and a negative spiral for those at lower BAs and RAs (the “vicious circle”). “False” talent is encouraged, and “true” talent is lost. Thus, many athletes with the potential for success in adulthood are overlooked. The suggested solutions to counteract the differences in RA and BA are: (1) the implementation of corrective adjustments to reduce RAEs and (2) low-dose hand–wrist imaging or coaches’ subjective evaluations to account for BA.

TID programmes must seek to reduce the risk of RAEs by raising awareness, monitoring the athletes' BAs, and avoiding early selection or deselection. If selection is necessary because of a lack of resources, RA and BA considerations should be integrated into a long-term multidisciplinary approach. With the implementation of these measures, TID can be more equitable, and the available resources can be used more efficiently.

*Titre et résumé de la leçon d'essai – Title and abstract of the inaugural lecture*

### **Höhentraining im Spitzensport: Massnahmen und Effekte**

Die Leistungsfähigkeit von Athletinnen und Athleten kann durch Höhentraining (HT) verbessert werden. Während der Nutzen der Höhenakklimatisation gut dokumentiert ist, werden die verschiedenen HT-Methoden zur Vorbereitung auf Wettkämpfe im Flachland kontrovers diskutiert. Die physiologischen Wirkungen eines HT auf den Organismus zeigen in erster Linie eine Erhöhung des Erythrozytenvolumens und der Hämoglobinmasse. Optimierte HT-Methoden versuchen den Vorteil von Höhenakklimatisationseffekten beizubehalten, während Nachteile, wie die reduzierte absolute Trainingsintensität in der Höhe minimiert werden sollen.

Nach einer Übersicht über bestehende Methoden, wird der Effekt des Höhentrainings auf die körperliche Leistungsfähigkeit dargestellt. Hierbei zeigt sich, dass das HT im Gruppenmittel einen positiven Effekt auf die Leistungsfähigkeit hat, sich jedoch auf individueller Ebene (individual response) grosse Unterschiede zeigen und es sogar zu einer Leistungsverminderung kommen kann (responder vs. non-responder). Abschliessend werden Empfehlungen für die Durchführung eines Höhentrainings zur Vorbereitung auf einen Wettkampf gegeben.