



INTERNATIONAL  
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CZECHIA  
Prague

# 2024 IIHF INTERNATIONAL COACHING SYMPOSIUM



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Physical testing

Martin Musalek





# **Youth Hockey Potential: Leveraging Biological Age Metrics for Fair Off-Ice and On-ice Performance Comparison**



# Content of presentation

**Biological  
age in sport –  
State of art**

**Fair comparison of on-ice  
and off-ice performance  
in differently maturing  
players**

**How much differ early and  
late maturing players  
during puberty**



# Biological age in sport – state of art



## Biological age in sport state of art: History and current trends in sport

- Individual maturation tempo influencing the physique readiness advancing the early maturing was recognized more than 70 years ago (Frank, 1945)
- Rapid developmental changes (testosterone and growth hormone) significant (Acheson & Dupertuis, 1957)
- Investigations into school sports competitions (athletic, swimming) for early mature students (Krogman, 1959)
- During the puberty period games (soccer, ice-hockey, basketball) are preferred (Bloom, 2000; Malina et al., 2004; Malina et al., 2015).
- <https://www.youtube.com/>





A man with short brown hair and a beard is speaking directly to the camera. He is wearing a blue t-shirt with the word 'PLAY' in large white letters and 'FOUNDATION OF GREATNESS' in smaller white letters below it. Two white text boxes with black text are overlaid on the image. The background is a plain, light-colored wall.

**The no.1 Factor  
in Determining...**

**Youth Sports Performance**



## Biological age in sport state of art: advantages of early maturing athletes

- Biologically advanced (BA) maturing players achieved earlier capacities in strength, speed, endurance or body mass (Lau, Berg, Latin, & Noble, 2001; Glaister, 2005; Burr et al., 2008; Malina et al., 2015)
- BA players usually receive better care. They have greater sports experience (i.e. longer ice time), are invited to extra events, etc. (Sherar, Baxter-Jones, Faulkner, & Russell, 2007; Vaeyens, Lenoir, Williams, & Philippaerts, 2008)
- Is the better physical readiness of BA players not a function of maturation and, therefore, just the time-limited advantage? (Ackland, & Bloomfield, 1996)
- How can we define ice hockey from the perspective of player development?
- <https://cdn1.sportngin.com/attachments/document/0108/6547/LTAD Story May 15 -2013 - OMHA.pdf>





## Biological age in sport state of art: Is the advance to be biologically advanced?

- Only **15-20% of BA** athletes achieved for senior professional level (multisport finding)
- We talk about „junior burnout. “
  - BA players do not receive adequate physical stimuli. They have the worse acquisition of specific motor skills and early physical plateau (Malina et al., 2015; Blakemore, Burnett, & Dahl, 2010; Blakemore, 2012).
- In biologically delayed players (BD), there are frequently „dropouts “. Leaving the sport for psychological and physical reasons (Kreipe & Gewanter, 1985; Reeves et al., 2018)
  - BD players do not receive adequate physical stimulus. They are usually too physically forced.
  - However, coaches see those players usually as very skilful (soccer Figueiredo et al., 2009)



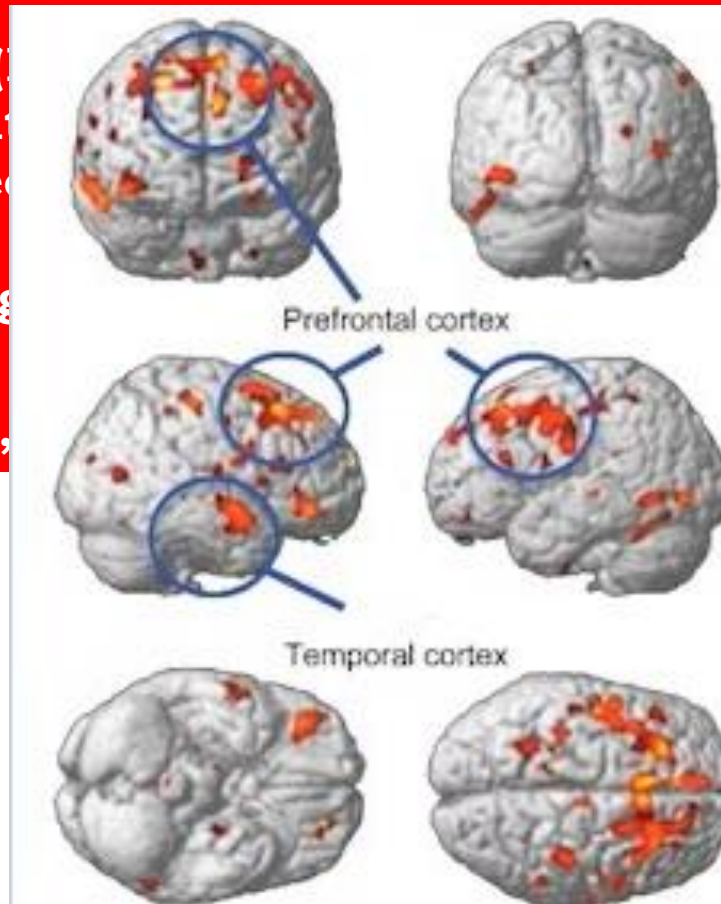
## Biological age in sport state of art: Beyond the physical capacities

- It is evident that physical readiness is essential; however,
- in senior sports with open skill, in the case of ice hockey, another quality – anticipation decision-making, the hockey sense is crucial.

- Meta-networking theory (between motor and cognitive coordinative and non-specific)

- This cross-talk is boosting sports

- (Chaddock-Heyman et al.,



ests cross-talk connections  
ring highly speedy

t of individual in collective

## **How much differ early and late maturing players during puberty**

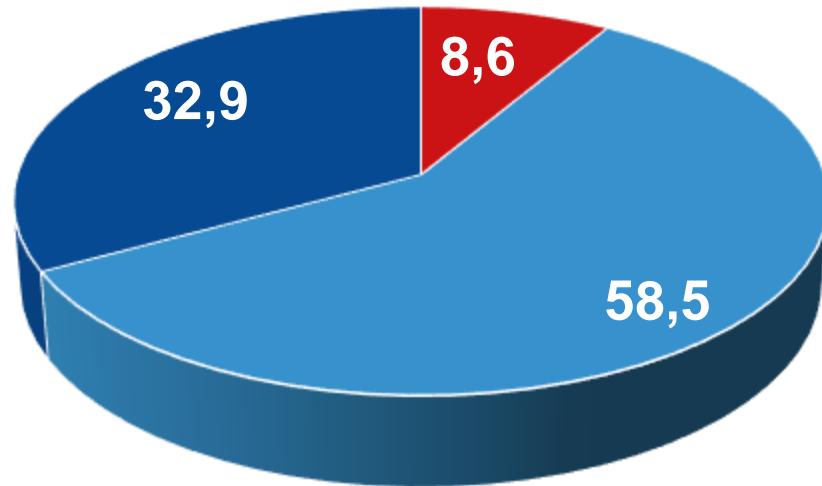
- Selected players from categories Czech competition U13-U15
- Sample size n=543; age range (11.76 – 15.06 years)
- Anthropometry characteristic:
  - Height,
  - Weight,
  - %body fat
- Skeletal age assessed by Tanner-Whitehouse 3.Ed



## Distribution of players considering their biological age

- In U13 there is more than twice BA players
- In U14 there is more than 2.6 times more BA players
- In U15 there is almost four times more BA players

U15



■ BD ■ Bpro ■ BA

BD: biologically delayed; Bpro: average maturing;  
BA: biologically advanced

## Difference between chronological and biological age considering maturation status

- In U13 difference in maturation is almost three years
- In U14 the difference maturation maintain at three years
- In U15 the difference start to slightly shorter 2.6 years due to rapid growth spurt in biologically delayed players

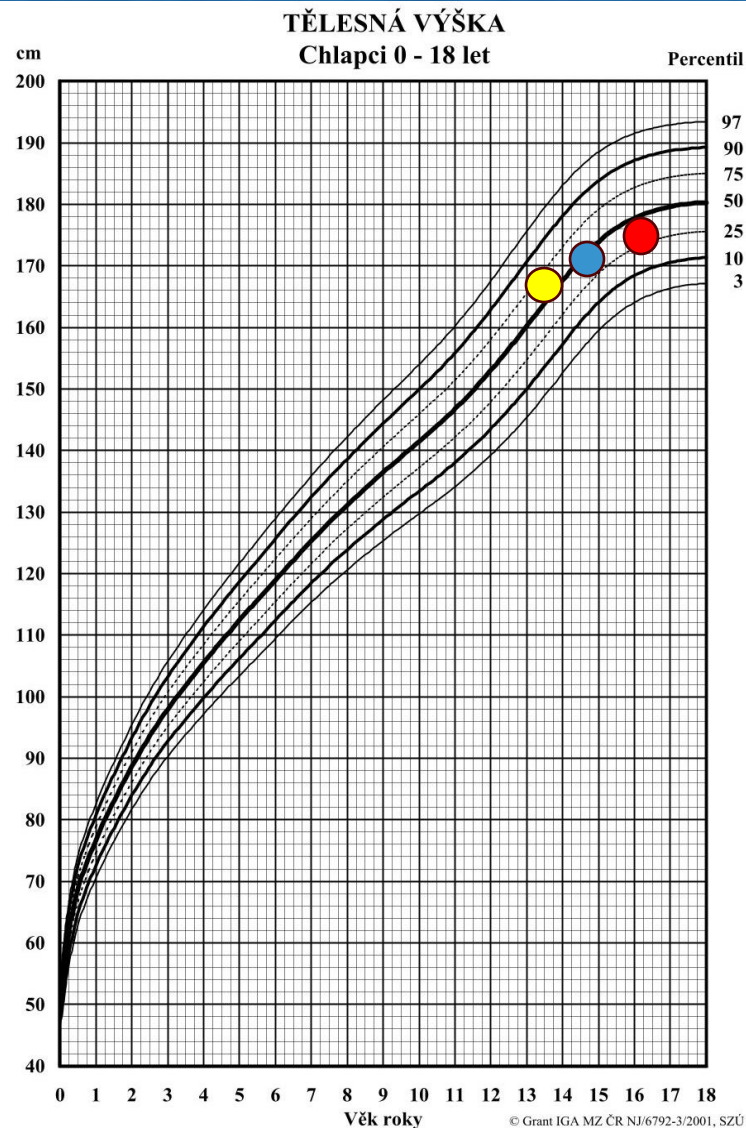
	U13	
	Chron age	Biol age
BD	12.5	<b>11.2</b>
Bpro	12.5	12.5
BA	12.5	<b>14.0</b>

	U14	
BD	13.5	<b>12.0</b>
Bpro	13.5	13.7
BA	13.5	<b>15.0</b>

	U15	
BD	14.5	<b>13.4</b>
Bpro	14.6	14.6
BA	14.5	<b>16.0</b>

BD: biologically delayed; Bpro: average maturing;  
BA: biologically advanced





**BD:** biologically delayed; **Bpro:** average maturing;  
**BA:** biologically advanced

## Anthropometry differences considering maturation status

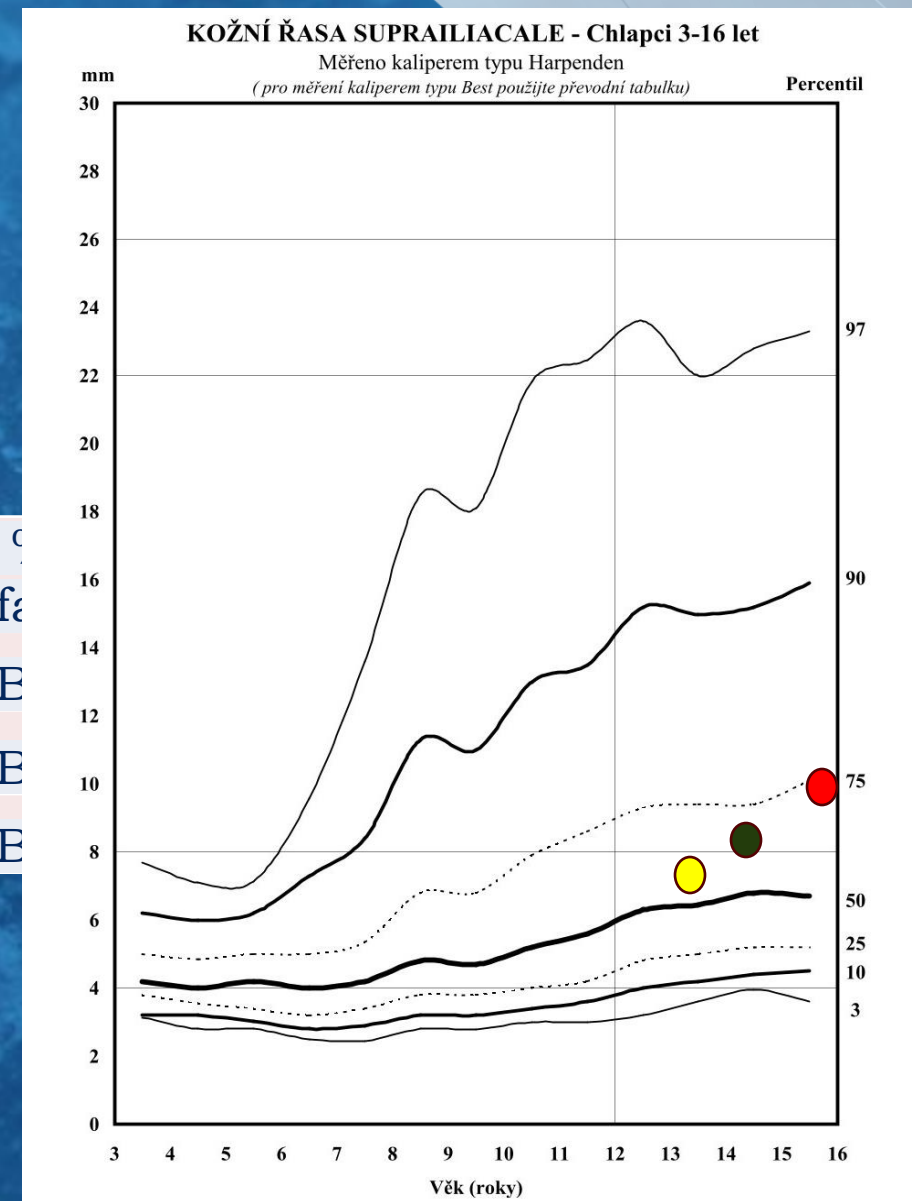
- One real extrem in U14. Two players in the same competition with the same chronological age:
- Player A 144.5cm and 35kg, Player B 190.0cm and 87kg
- Dif: **54.5cm and 52kg**
- Although BD players are shorter in absolute value their growing disposition seems to predict be finally taller than BA players !!!





## Anthropometry differences considering maturation status

- In % of body fat no sig. differences
- However, in fat distribution, on trunk BA players have in U15 about 20 centile points higher than BD players
- BA players tend to be more centropenic, accumulating the body fat earlier in trunk area.
- Good question would be what is the cause?

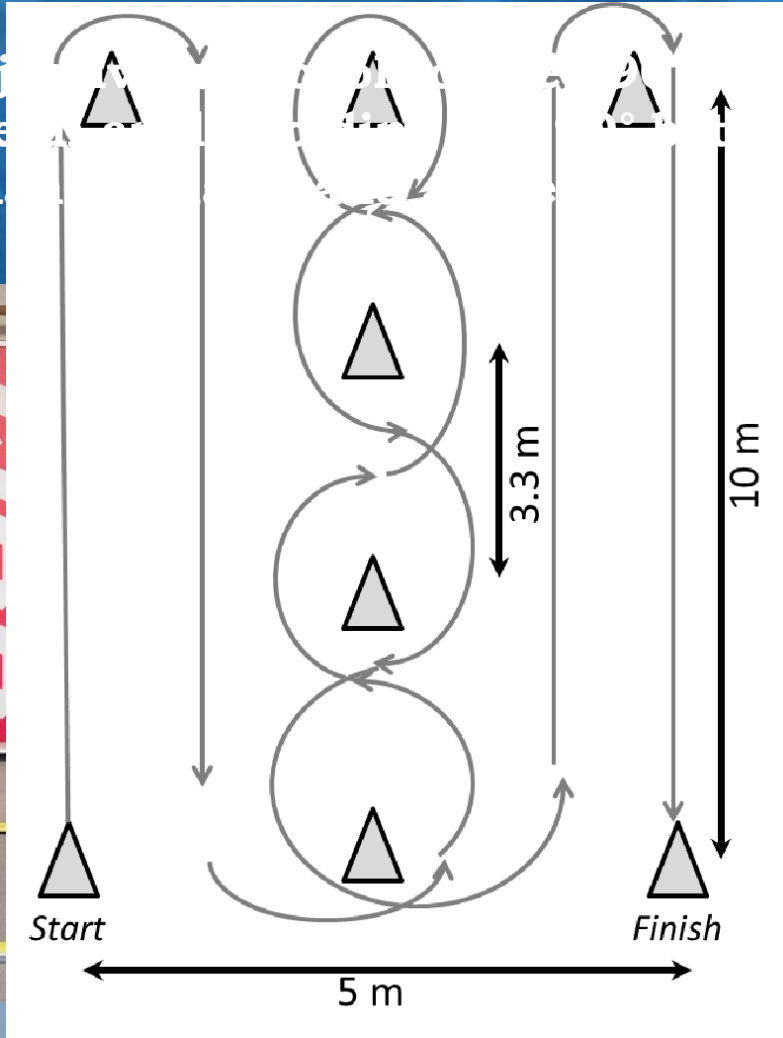


**BD:** biologically delayed; **Bpro:** average maturing;  
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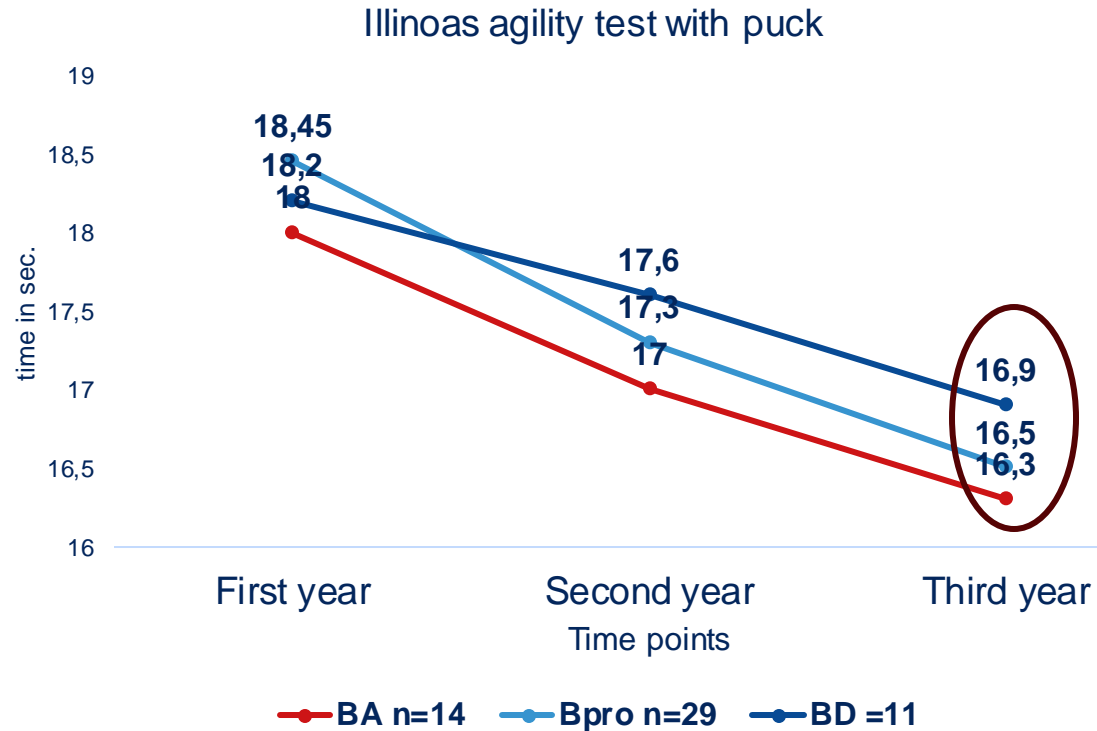


Only illustrative image

## On-ice off-ice differences considering maturation status

- Sample of 54 players measured each year from U13 to U15
- Squat jump
  - Method by Combine NHL from 2015
- On-ice Illinois agility test passing the track with and without the puck

## Comparison based on chronological age



At this moment we could conclude  
BD players are simply worse

- Very expectable BA players performer in squat jump better in all measured time-points
- Another quite clear results Illinois test with and without puck in both cases BA players are in all time-points better
- **0.6sec means to lose on approx 67 meters 2.5m**





## Difference between chronological and biological age considering maturation status

- Something would be wrong if such biologically advanced were worse!
- Lets give all players the biological chance
- We fixed their maturation status and we have a look what happens

U13		
	Chron age	Biol age
BD	12.5	<b>11.6</b>
Bpro	12.5	12.3
BA	12.5	<b>13.5</b>

U14		
BD	13.5	<b>12.3</b>
Bpro	13.5	<b>13.5</b>
BA	13.5	<b>14.8</b>

U15		
BD	1.5	<b>13.3</b>
Bpro	14.6	14.4
BA	14.5	<b>15.9</b>

BD: biologically delayed; Bpro: average maturing;  
BA: biologically advanced



## Difference between chronological and biological age considering maturation status

- Situation markedly changed!
- The fixing of the biological age showed significant differences in opposite directions.
- BD players performed much better because slow maturation gives them time!!!!
- It means dramatically different time frames for the development of BA and BD players.

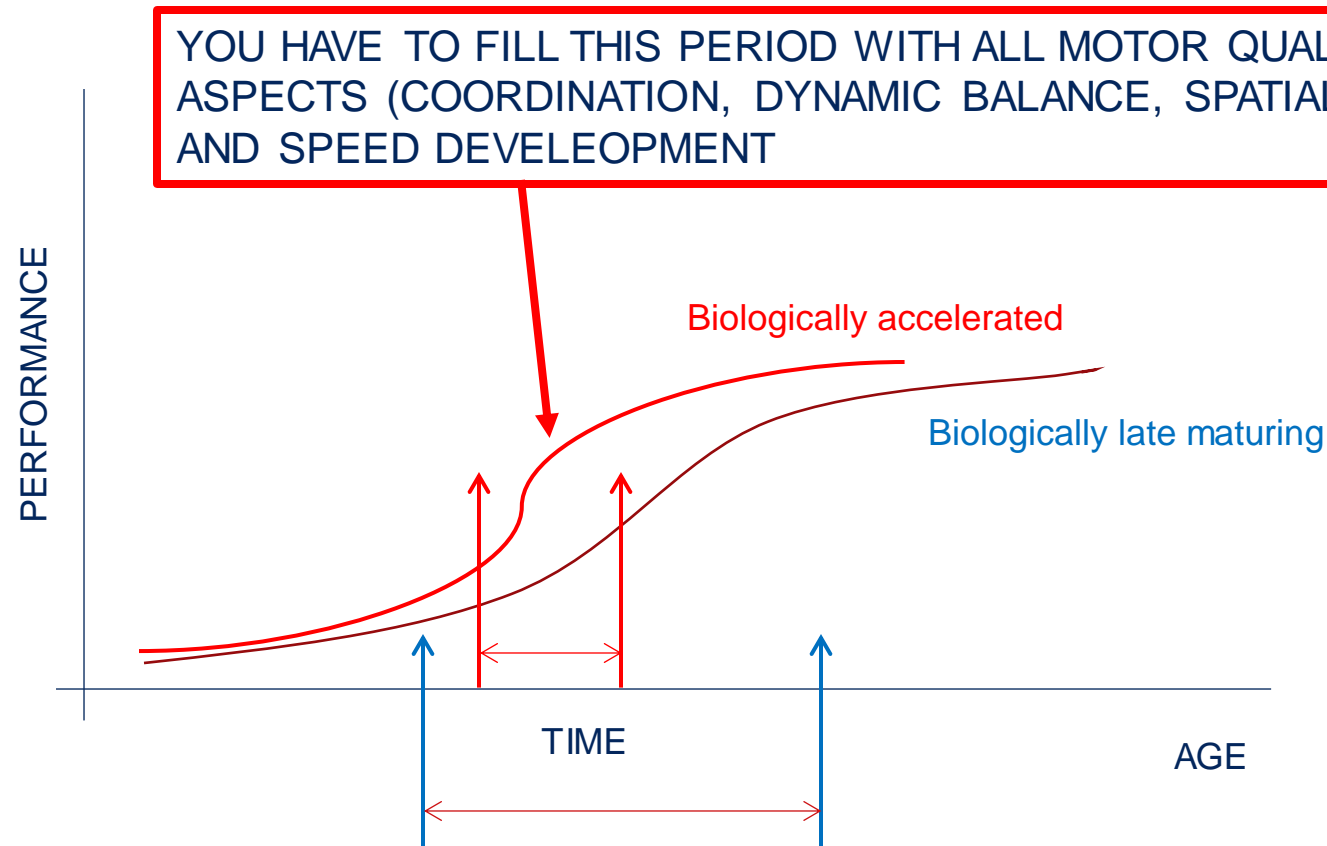
	Biological age	Squat jump	Illinoia without puck	Illinoia with the puck
BD	13.3	<b>27.8</b>	<b>16.1</b>	<b>16.9</b>
Bpro	13.4	27.9	16.4	17.3
BA	13.5	<b>26.6</b>	<b>16.8</b>	<b>18</b>

**BA players lose  
2.8m in Illinoia without puck  
and  
4.1m in Illinoia with puck**

BD: biologically delayed; Bpro: average maturing;  
BA: biologically advanced



## Should the maturational status discriminates anyone?



- If you miss this period, which is approx 18 months, the observed positive changes are significantly the function of boosted maturation
- If you do not respect the late and longer maturation of BD players, then you markedly increase the probability for sports drop out before approaching a fully matured individual



## **Closing remarks**

- **The main challenge is not to say whether the player matures early or late. This information come too late**
- **The main challenge is to estimate when precisely the puberty changes start**
- **If we want to work on player's long-term development effectively, we must not take some players for their biological clocks as sacrifices**
- **The new direction is to prepare the strategy far before the changes occur**
- **It seems we found the way PHV approaches estimating sensitively the moment of a future growing spurt and puberty changes – research started**



# THANKS FOR YOUR ATTENTION

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