



NEW ZEALAND POLICY
RESEARCH INSTITUTE
TE KĀHUI RANGAHAU MANA TAURITE

Neurodegenerative Diseases in Male Former First-Class New Zealand Rugby Players

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Anns, F., Quarrie, K. L., Milne, B. J., Li, C., Gardner, A. J., Murphy, I. R., Verhagen, E., Wright, C., Morton, S. M. B., Lumley, T., Tippet, L., & D'Souza, S. (2026). Neurodegenerative diseases in male former first-class New Zealand rugby players. *Sports Medicine*, 56(2), 543–558.



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Disclaimer

Disclaimer for output produced from the IDI:

These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) which is carefully managed by Stats NZ. For more information about the IDI please visit <https://www.stats.govt.nz/integrated-data/>.

WHY IS THIS RELEVANT?

Background

- Increasing concern regarding the effects of repeated head acceleration events (HAEs) in collision sports
- Linked to the discovery of chronic traumatic encephalopathy (CTE)
- 2 reviews found a consistent association between collision sport and neurodegenerative disease



POSSIBLE MECHANISMS

- Repeated HAEs
- Pain killers, anaesthetics, alcohol, PEDs, pesticides

Evidence in Rugby Union

High rate of mTBI in rugby, yet research remains limited

Russell et al. (2022)

Former rugby players had **2.7x** the risk of neurodegenerative disease than general population males in Scotland



Do sport-specific factors influence risk?



Position – Forwards vs Backs

Differing contact, injury, and size profiles



Level – International/professional vs Provincial/first-class amateur

Different intensity and exposure



Career duration – Years and matches played

Cumulative exposure

Russell et al. found no difference by playing position

Mixed results reported for playing level and career duration

Study aims

- 1 Are the higher rates of neurodegenerative disease observed in Scotland similar in other rugby cohorts?
- 2 Do risks vary by playing position or playing level?
- 3 Does greater exposure (years and matches) influence risk?



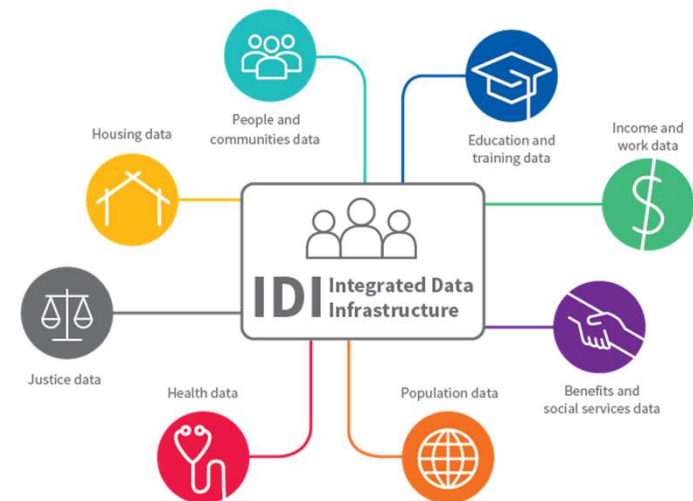
Rugby register & IDI

NZ rugby register – players at the provincial union level or higher

- Those who started their career between 1950-2000 were provided to Stats NZ for linkage

Integrated Data Infrastructure (IDI) – whole-of-population, de-identified administrative database

- Contains linked data from various government & non-government organisations
- Female players not included



COHORT

Cohorts

Using the NZ rugby register & the Integrated Data Infrastructure (IDI)

12,861 players

Careers starting 1950–2000

2.4 million comparisons

Age-aligned

POSITION



Forwards or backs

LEVEL



International/professional or provincial/first-class amateur

CAREER DURATION/EXPOSURE



Years and matches played

Neurodegenerative diseases

Public hospitalisations & mortality records – 1988-2023

- Alzheimer's disease
- Other dementias
- Parkinson's disease
- Motor neuron disease (MND)

**Any neurodegenerative
disease**

*CTE not included

Players vs general population



Cox proportional hazards models

- Tracked from age 30 – right censored if died, left country, no diagnosis



Proportional hazards assumption tested

- Where violated, hazards computed for 10 year ranges: 30-39...90+

Adjusted for birth-year, ethnicity, NZ-born status

Player-specific analyses

- **Position** – Forwards vs backs
- **Playing level** – International/professional vs provincial/first-class amateur
- **Career duration / exposure to high-level rugby:**

Low

1 year

1 – 4 matches

Moderate

2 – 5 years

5 – 20 matches

High

6+ years

21+ matches



Secondary & sensitivity analyses

Position x exposure

- Explore whether associations between player position and neurodegenerative disease risk varied by exposure to high-level rugby

Sensitivity analyses

- Pharmaceuticals data for case ascertainment – available from July 2006
- InterAl geriatric assessment for older individuals receiving support – available from 2014
- Competing risks for neurodegenerative disease mortality versus other causes of death
- The effect of plausible fractions of the general population exposed to rugby as adults, assuming similar levels of neurodegenerative disease risk

Players vs general population

6.5%

players diagnosed with any neurodegenerative disease

5.2%

general population males diagnosed with any NDD

79.3 vs 78.3

mean diagnosis age for players and the general population

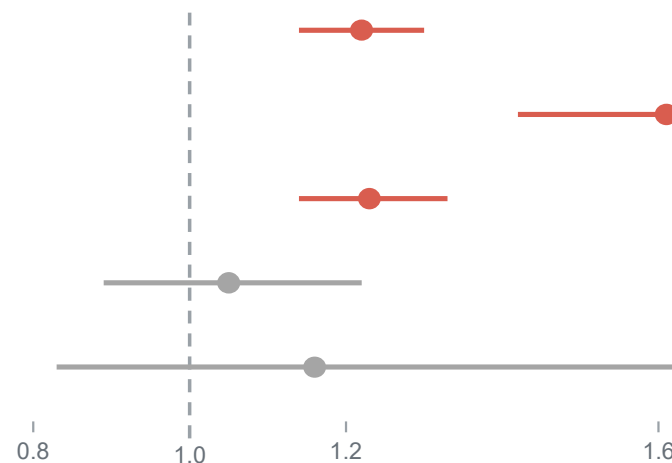
Any neurodegenerative disease

Alzheimer's disease

Other dementias

Parkinson's disease

Motor neuron disease



Hazard ratio (95% CI)

1.22 (1.14–1.30)

1.61 (1.42–1.83)

1.23 (1.14–1.33)

1.05 (0.89–1.22)

1.16 (0.83–1.63)

Effect of playing position



Backs

Higher risks than the general population

Any neurodegenerative disease,
Alzheimer's & other dementias

HRs 1.30-1.84

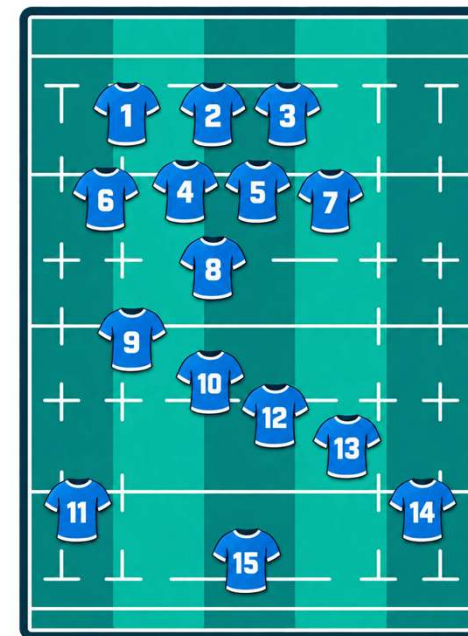


Forwards

Lower risk than backs

Alzheimer's & other dementias

HRs 0.7 & 0.8



Forwards

1. Loose-head Prop
2. Hooker
3. Tight-head Prop
4. Left Lock
5. Right Lock
6. Blindside Flanker
7. Open Side Flanker
8. Number Eight

Backs

9. Scrum-half
10. Flyhalf
11. Left Wing
12. Inside Centre
13. Outside Centre
14. Right Wing
15. Full-back



Effect of playing level



International / professional

Higher risks than the general population

Any neurodegenerative disease, Alzheimer's & other dementias

HRs 1.62-1.97



Provincial / first-class amateur

Higher risks than the general population

Any neurodegenerative disease, Alzheimer's & other dementias

HRs 1.18-1.56

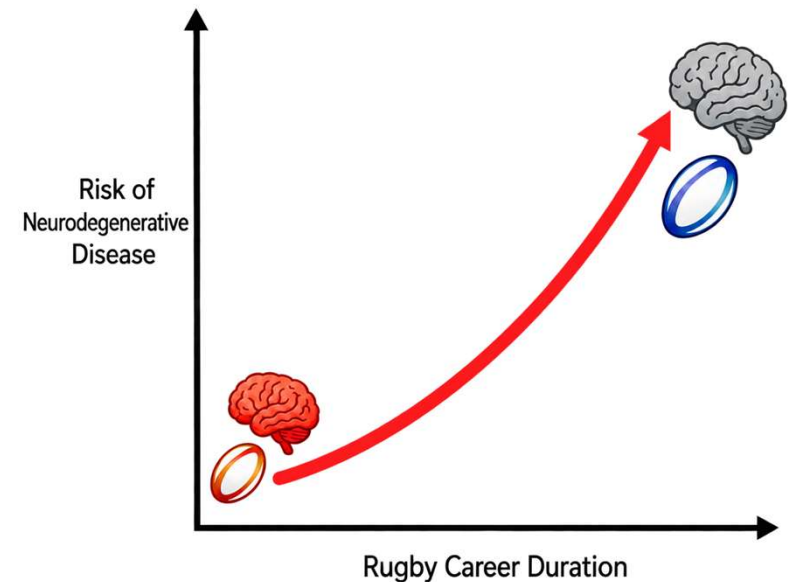
Players at the higher level had increased risks of any neurodegenerative disease and other dementias

HRs 1.42 & 1.46



Career duration / exposure

- Increased risks observed for low, moderate & high exposure groups (HRs 1.15-1.85)
- Some evidence of a dose-response relationship
- No difference in risk between moderate & high exposure groups vs lowest exposure group



Secondary & sensitivity analyses

Position x exposure

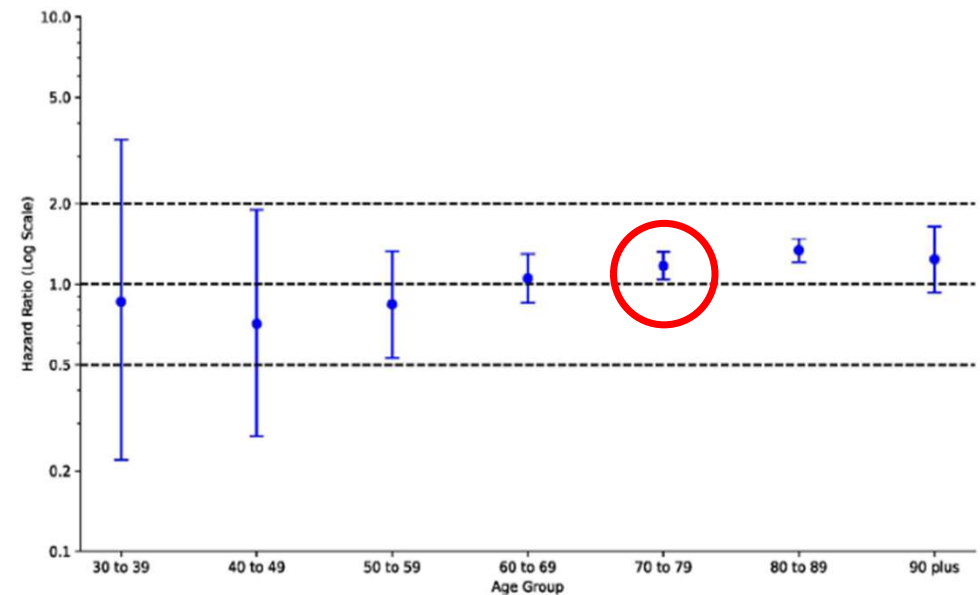
- The rates of neurodegenerative disease increased with greater exposure for backs, not for forwards
 - HR 1.38 for 5 – 20 matches
 - HR 1.42 for 21+ matches
 - HR 1.59 for 6+ years

Sensitivity analyses

- All sensitivity analyses had a minimal impact on results

Assumption testing

- Proportional hazards assumption violated for several analyses
- Increased risks began around **70-79 years**



Time-stratified HRS for any NDD among players compared with the general population

General findings



Increased risk of neurodegenerative disease among rugby players compared with the general population

- Backs
- International / professional
- Provincial / first-class amateur



Increased risk generally began around 70-79 years of age

- No evidence of early-onset risk



Some evidence risk increased along with more years and matches played

Little to no association with Parkinson's or MND

Put into perspective

General population



52 / 1000

+13

cases per 1000
players over study
period

Rugby players



65 / 1000

Effect sizes were smaller than some previous collision-sport studies.

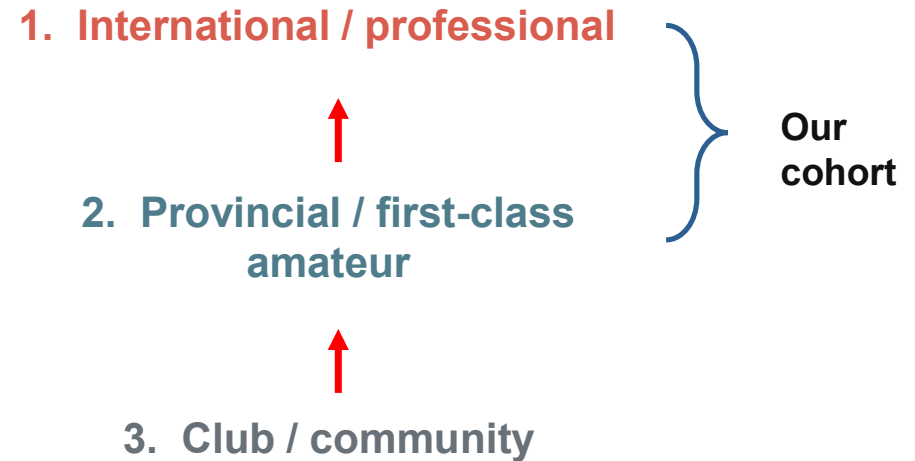
Possible explanations include differences in linkage rates, comparison groups, playing level and historical period.

Increased risk driven by backs

- The increased risk of neurodegenerative disease observed among rugby players appeared to be largely driven by an increased risk among backs
- Consistent with research in American football comparing speed and non-speed players
- Different HAE exposure suggests collision speed may play a role

Some effect of playing level

- Increased risks of NDD for both playing levels
- Effect sizes were greater for International/professional
- Could be due to greater exposure



Potential mechanisms

1. Repeated HAEs may lead to CTE which causes or occurs alongside dementia
2. HAEs decrease cognitive reserve = lowers age NDD becomes symptomatic

No evidence of early-onset disease found

- Repeated HAEs may lower the threshold for age-related neurodegeneration, not accelerate its clinical onset
- 'Healthy worker effect' may delay the clinical expression of disease

Strengths and limitations

STRENGTHS:

- Large, weighted cohort with extended follow-up
- More precise effect estimates

LIMITATIONS:

- Prior history of brain trauma and exposure to other risk factors unknown
- May not apply to women, lower levels, contemporary rugby

Moving forward

Future prospective studies are needed to understand the underlying mechanisms

Recommend the precautionary principle:

- Limited exposure to HAEs
- Proactively manage suspected concussions
- Communicate risks and benefits of sport

