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Good Vibrations? An investigation examining the effects of speed, tyre pressure and wheel choice on whole-body vibration during road cycling

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What is WBV?

The vibration and shock felt when sitting or standing on a vehicle or machine, travelling over rough ground.

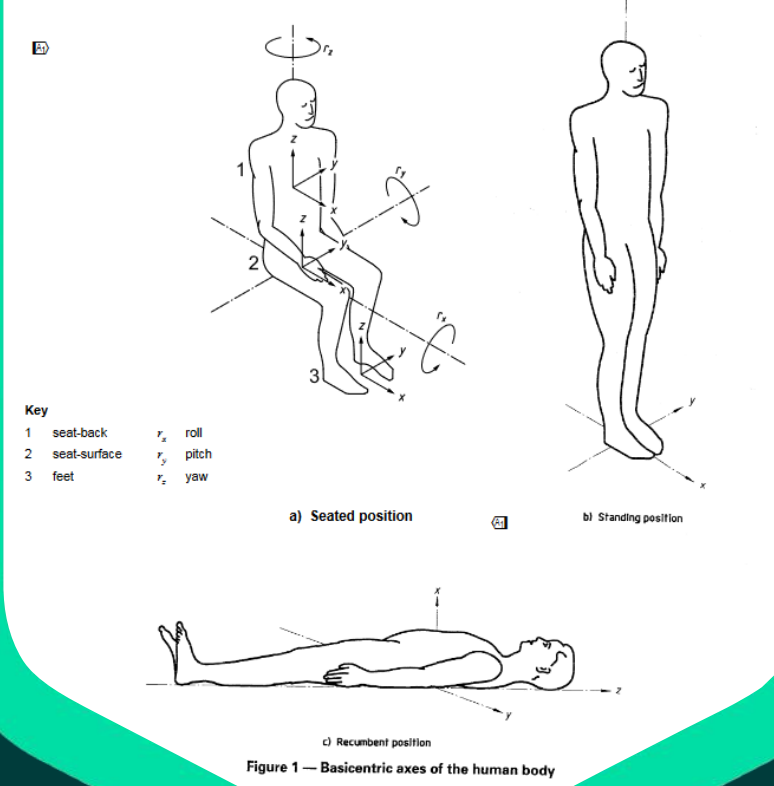

Figure 1 — Basicentric axes of the human body

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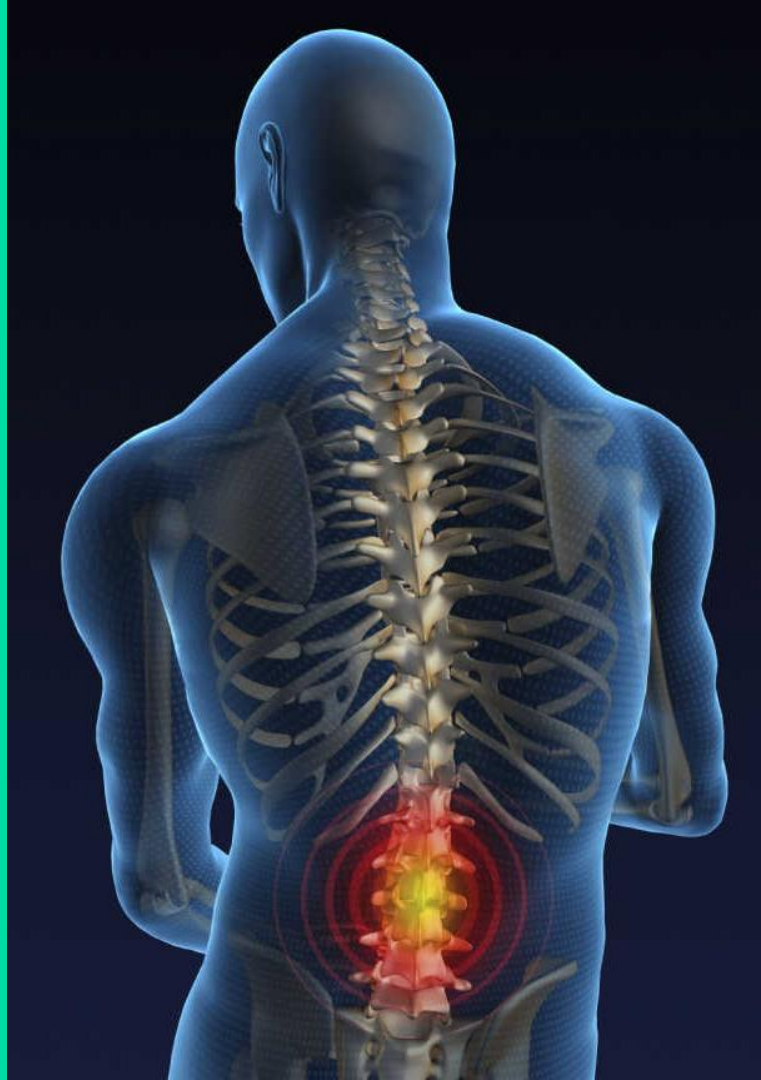
What are the risks of WBV?

- WBV increases low-back pain risk[1].
- Occupations with regular WBV exposure have higher low-back pain risk[2].



1. Burstrom, L., Nilsson, T., & Wahlstrom, J. (2015). Whole-body vibration and the risk of low back pain and sciatica: A systematic review and meta-analysis. International Archives of Occupational and Environmental Health, 88(4), 403–418.
2. Bovenzi, M. (2009). Metrics of whole-body vibration and exposure-response relationship for low back pain in professional drivers: A prospective cohort study. International Archives of Occupational and Environmental Health, 82 (7), 893–917.

Is WBV an issue in cycling?

TABLE 2
Location and Severity of Medical Attention Injuries (Number of Injuries)

	Normal Training and Racing	Reduced Performance	Could Not Ride Bicycle	Career Ending	Total
Lower leg/Achilles tendon	2	1	3	0	6
Knee	4	5	13	0	22
Thigh	1	4	1	0	6
Hip/groin	0	1	0	0	1
Lower back/pelvis/sacrum	20	19	3	1	43
Abdomen	1	1	0	0	2
Sternum/ribs/upper back	0	1	0	0	1
Hand/finger/thumb	1	0	0	0	1
Forearm	1	0	0	0	1
Shoulder/clavicle	1	0	0	0	1
Neck/cervical spine	6	2	2	0	10
Total	37	34	22	1	94

Adapted: Clarsen et al. "Overuse Injuries in Professional Road Cyclists," ***The American Journal of Sports Medicine***, vol. 3, pp. 176-179, 1997.

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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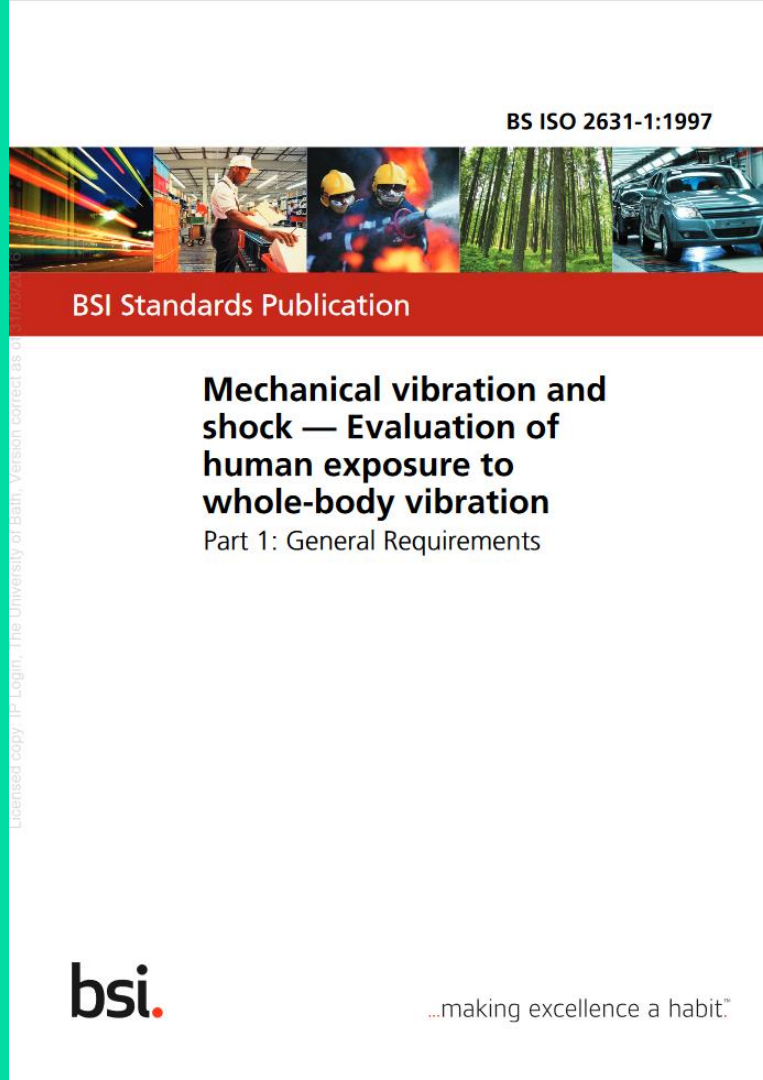
How is WBV evaluated?

- A(8) Value – Based on the average exposure for an eight-hour day
- VDV – Fourth power vibration dose value



British Standards Institution. (2011). BS ISO 2631-1:1997 - mechanical vibration and shock - evaluation of human exposure to whole-body vibration. Part 1: General requirements.

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What are the limits for WBV?

- Exposure Action Value (EAV)
- Exposure Limit Value (ELV)

	EAV	ELV
A(8)	$0.5\ ms^{-2}\ RMS$	$1.15\ ms^{-2}\ RMS$
VDV	$9.1\ ms^{-1.75}$	$21\ ms^{-1.75}$

EU Directive. (2002). Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration) (sixteenth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC): Official Journal of the European Communities, L 117/13, 6.7.2002. The European Parliament and The Council of the European Union.

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Aims and Objectives

Measure vibration in cycling on a set route to work out what effects WBV exposure

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Method

Variables Tested

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Wheelset

Hunt 48 (Carbon)
Hunt 34 (Alloy)

Tyre Pressure

60, 70, 80 ,90 PSI

Speed

20, 30, 40 KPH

How was the data collected?

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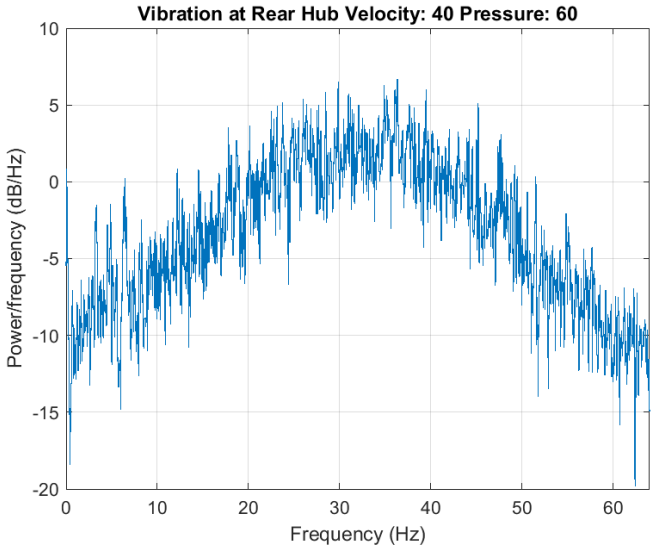
What was done with the data?

MATLAB script used to calculate:

- RMS values
- VDV and A(8)
- Power spectral density



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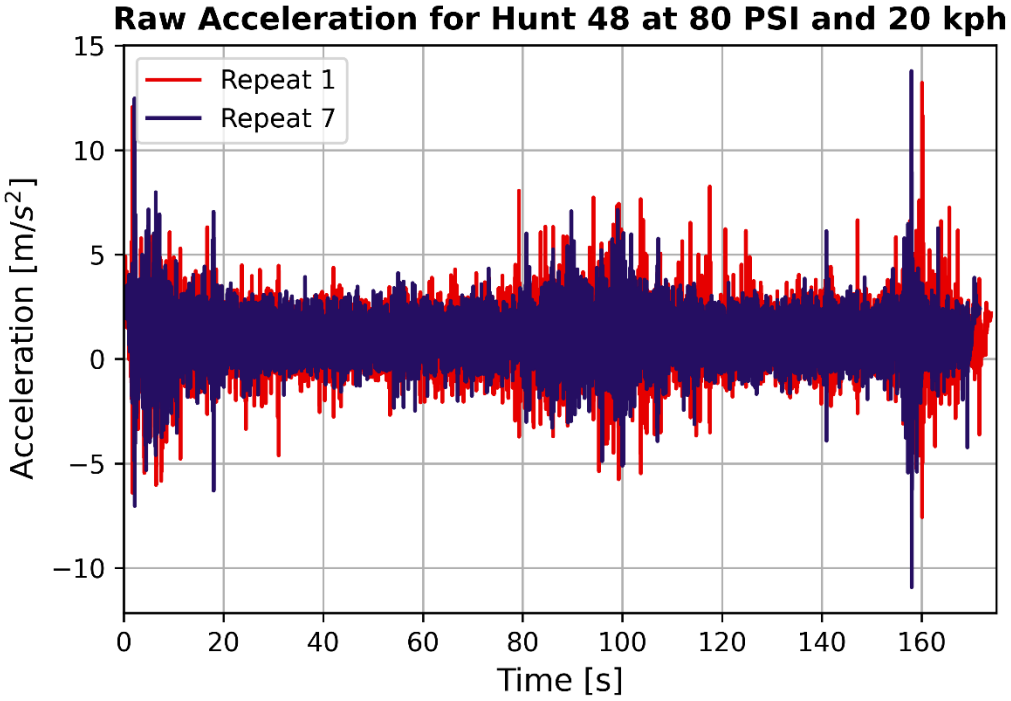
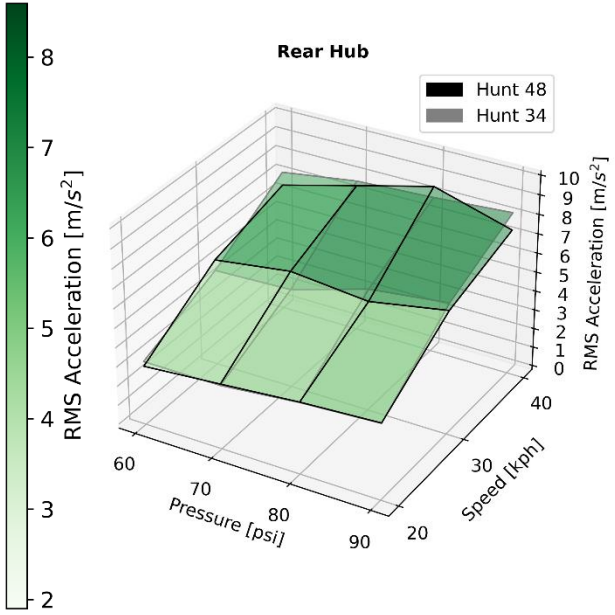
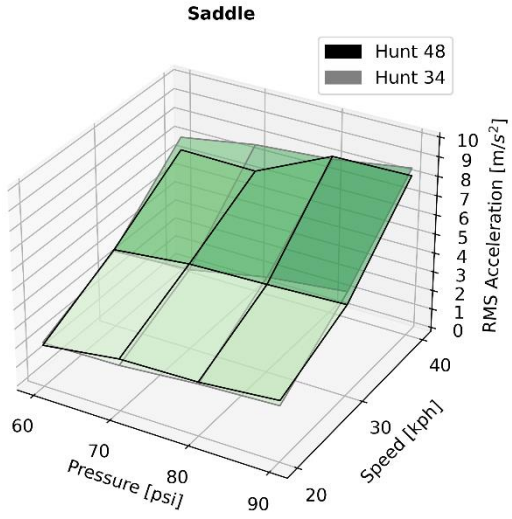
Results

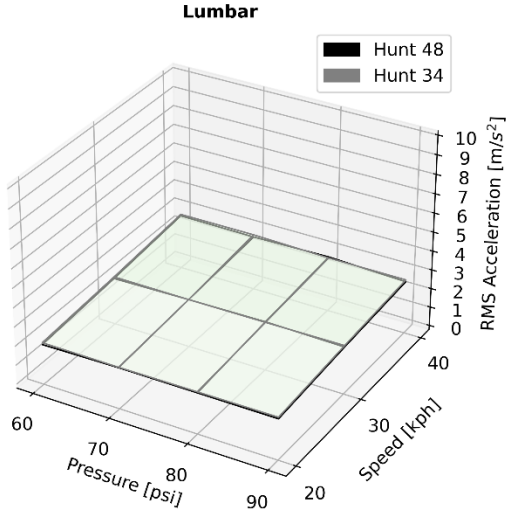
‘Roadbuzz’ and shocks!



Where is the vibration absorbed?







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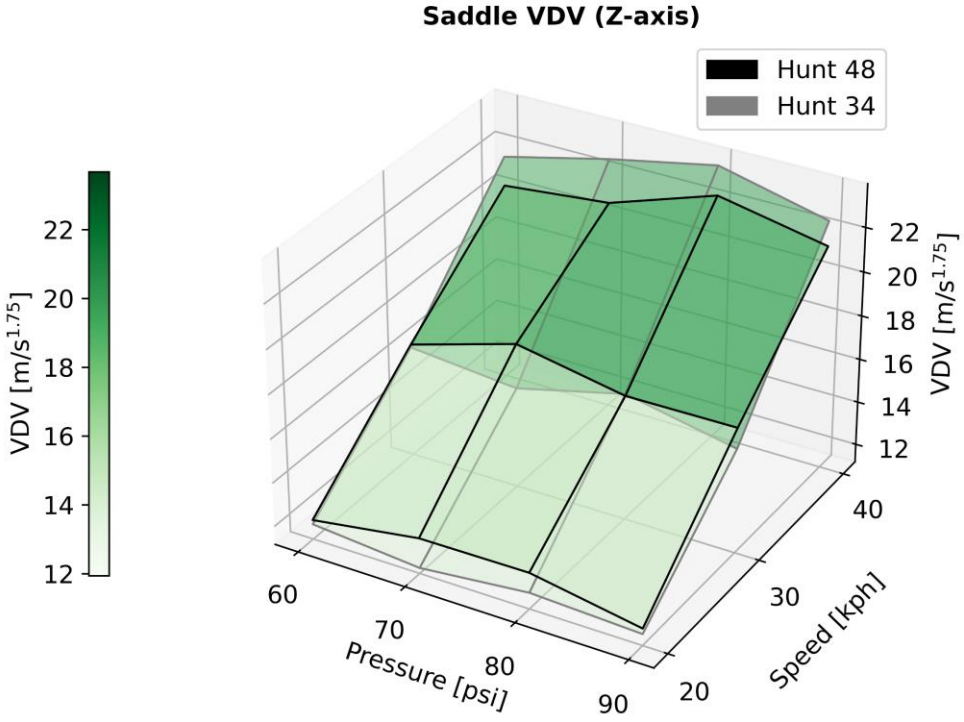
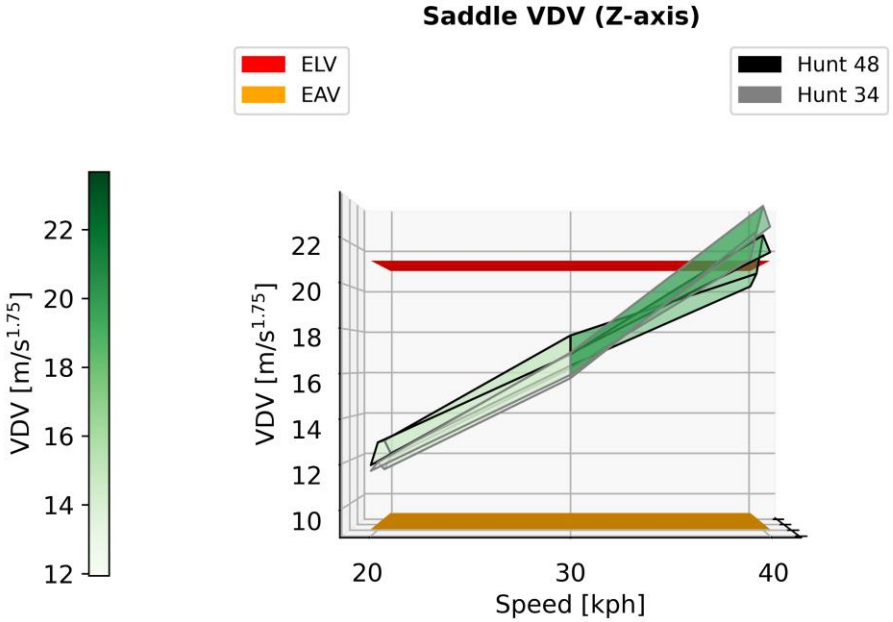
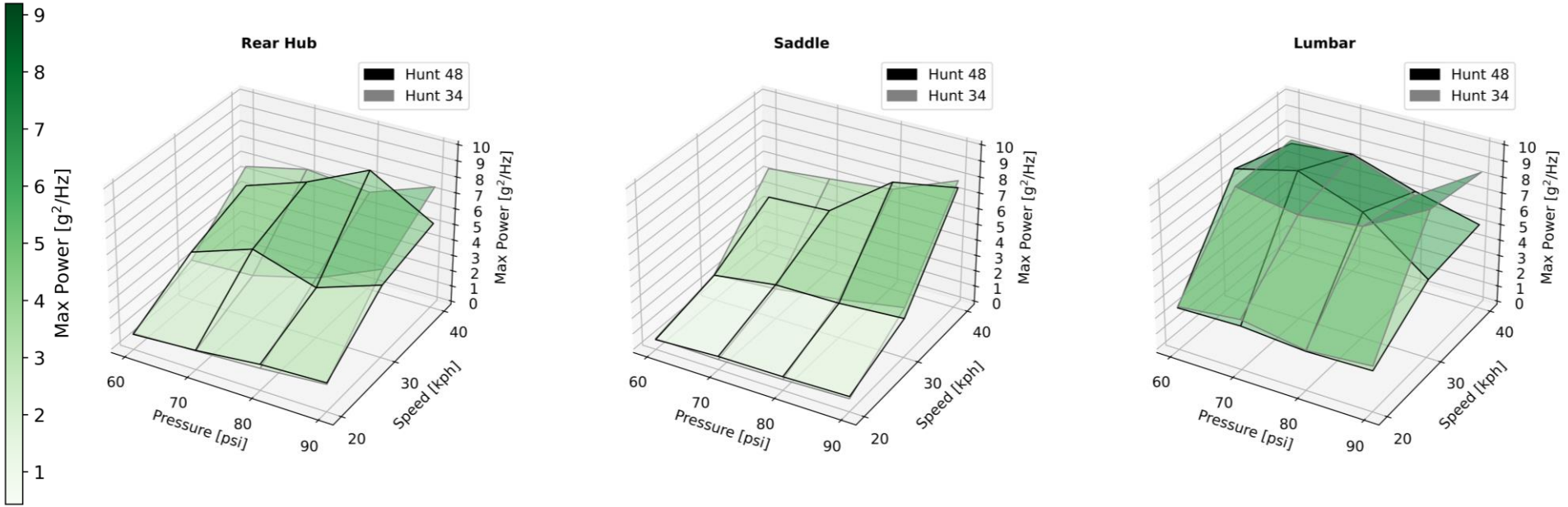
Do any of the variables influence WBV?



How does VDV compare to the EU limits?



What does the PSD analysis show?



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Impact and Future Research

1. VDV limits surpassed over short distance
2. Many factors contribute to vibration
3. Vibration reducing products should reduce shock, as well as ‘road buzz’

Thank you for your attention

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HUNT