Comparison of Hand-Arm Vibration (HAV) Vibration Between a chainsaw, Weed Eater, and Backpack Blower

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ABSTRACT

Background: Hand-arm vibration (HAV) is the vibration transmitted to the hand-arm system, typically produced by power hand tools. Long term, excessive exposure to HAV can lead to the development of hand -arm vibration syndrome (HAVS). Forestry workers heavily use power tools such as a weed eater, chainsaw, and backpack blower, and in Alabama, forestry is one of the largest industries.

Objective: The purpose of this study was to examine the vibration exposure levels when operating a weed eater, chainsaw and backpack blower and compare the results.

Methods: Chainsaw, weed eater, and blower vibration levels were determined through simulated laboratory use. Data was collected with Svantek SV2013 wearable palm dosimeters.

Results: Weed eater operation resulted in the highest vibration levels, ahv, followed by a chainsaw and a backpack blower, regardless of operator. Consistently higher a_{hv} were observed in the right-hand sampling data, regardless of operator and tool type. Dominant axis for a chainsaw and blower was y-axis while it was x-axis for a weed eater. Conclusion: In this study, we successfully examined the HAV levels of

three types of hand-held power tools, a chainsaw, weed eater, and

SITUATION/PROBLEM

- Many workers in forestry and groundskeeping industries use vibrating hand-held tools on a regular basis.
- Long-term, intense exposure to hand-arm vibration (HAV) can lead to vascular, neurological, and musculoskeletal health effects, collectively known as hand-arm vibration syndrome (HAVS). One of the most common symptoms is vibration induced white finger (VWF).
- The purpose of this study was to examine the vibration exposure levels when operating a weed eater, chainsaw and backpack blower.
- HAV level was evaluated with wearable palm dosimeters to better represent actual exposure to the tool operators.

METHODS

- Two researchers voluntarily participated in the study and informed consent (UAB IRB-approved) was obtained.
- Palm-strapped adaptors of vibration tri-axial dosimeters (SV103, Svantek, Warszawa, Poland) were worn by the participants to collect vibration total value, a_{hv} (i.e., root-sum-of squares of the three axial acceleration values) (Figure 1). General-purpose cowhide leather safety gloves were worn during the entire operations of the tools.
- The participants alternatively simulated the operation of the power tools for five minutes. Each operating procedure by a tool type was as follows:
- Chainsaw (Figure 2)
 - Hard wood logs cut into slices. Approximately, 1 slice per 10 seconds
- Weed Eater (Figure 3)
 - Swung side to side approximately 30 inches for 1 1.5 seconds each side.
- Backpack Blower (Figure 4)
 - Nozzle was swung side to side similar to weed eater.
- Two rounds (Round 1 & Round 2) of sampling per each tool type were conduced and the vibration total values were averaged.



Figure 1. Dosimeter Placement



Figure 3. Weed Eater Operation



Figure 2. Chainsaw Operation



Figure 3. Weed Eater Operation

RESULTS/DISCUSSION

- ullet Weed eater resulted in the highest acceleration levels, a_{hv} , followed by a chainsaw and a backpack blower, regardless of an operator (Figure 5 & Table 1).
- ullet Consistently higher a_{hv} were observed in the right-hand sampling data. This could be due to asymmetrical coupling forces between hand sides.
- The highest axial values were observed in the y-axis on the dominant right hand during chainsaw and blower operations while it was x-axis on the dominant right hand during weed eater operation (Figure 6, 7, & 8).

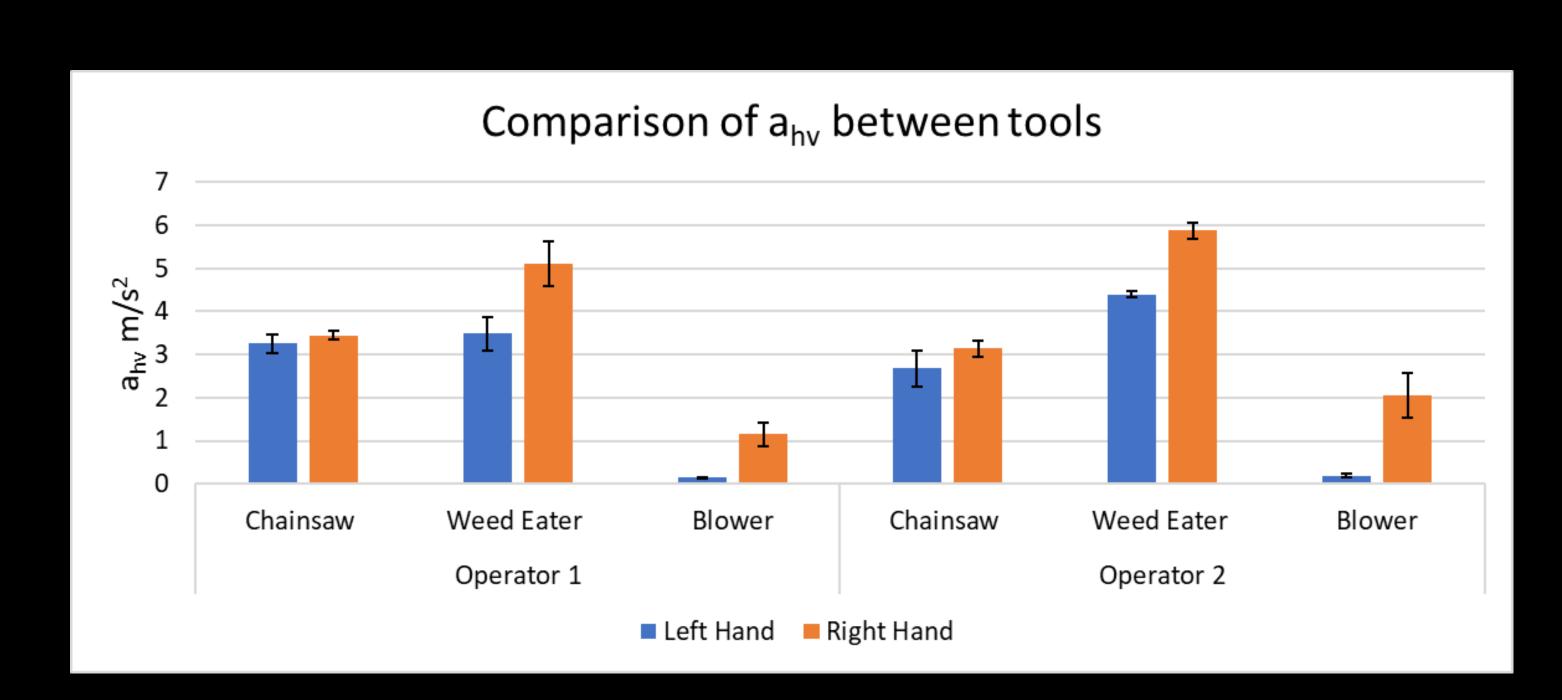
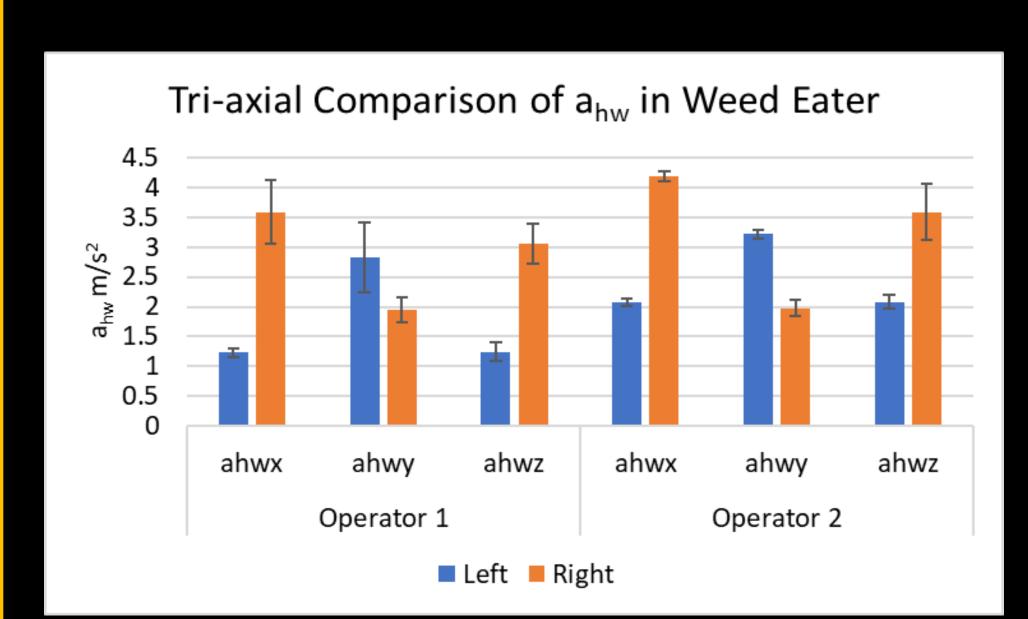


Figure 5 - a_{hv} between tools



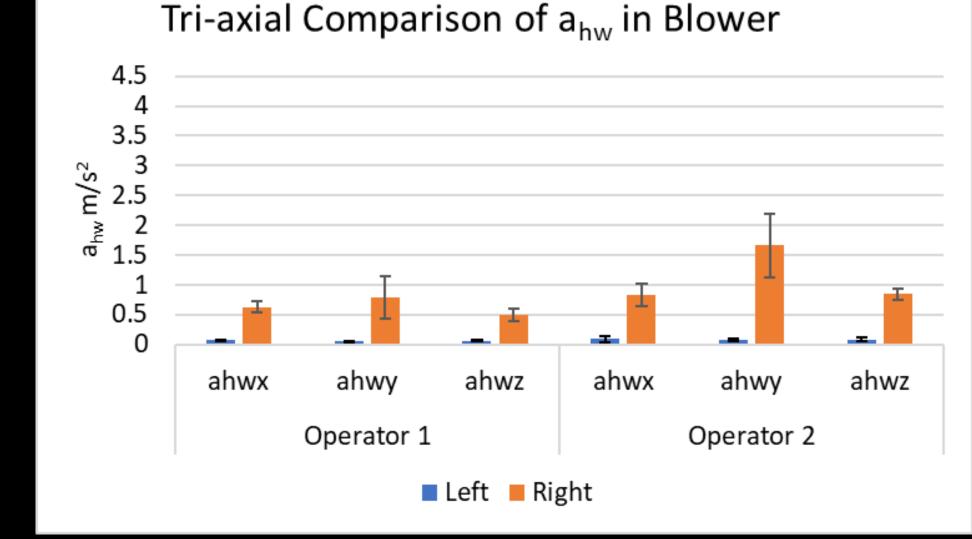


Figure 6 - triaxial values from weed eater operation

Figure 7 - triaxial values from blower operation

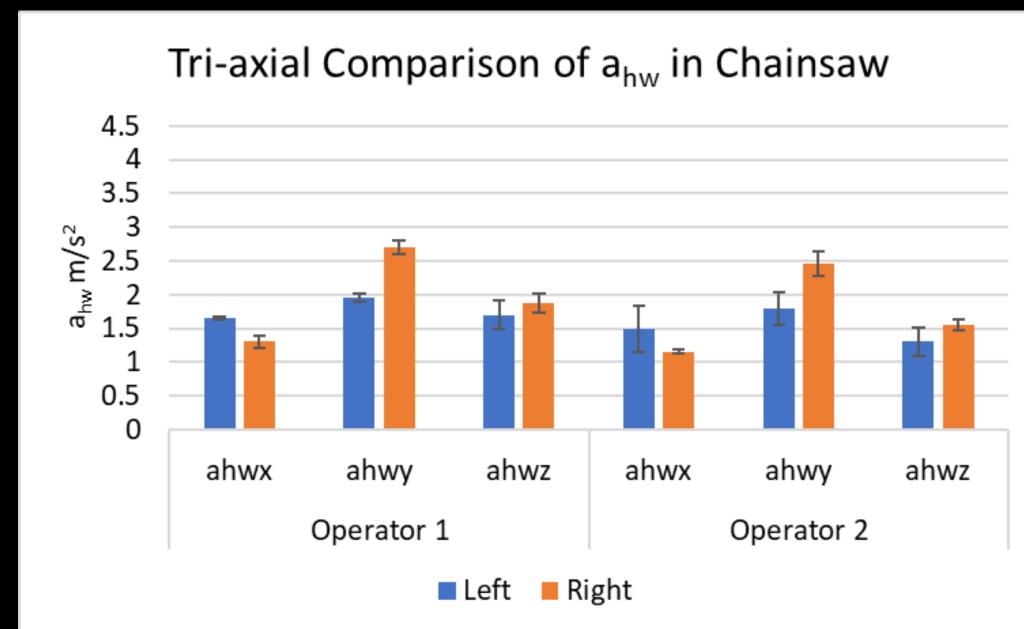


Figure 8 - triaxial values from chainsaw operation

		Round 1		Round 2		Round 3		Average		•	
Operator		$a_{hv}(m/s^2)$		$a_{hv} (m/s^2)$		$a_{hv} (m/s^2)$		$a_{hv} (m/s^2)$			
		Left	Right	Left	Right	Left	Right	Left	stdev.	Right	stdev.
Operator	Chainsaw	3.04	3.42	3.251	3.36	3.46	3.57	3.25	0.21	3.45	0.11
	Weed Ea	3.29	5.68	3.228	5	3.94	4.67	3.48	0.39	5.12	0.52
	Blower	0.15	1.45	0.17	1.04	0.16	0.96	0.16	0.01	1.15	0.26
Operator	Chainsaw	2.8	3.17	3.03	3.31	2.22	2.93	2.69	0.42	3.14	0.19
	Weed Ea	4.48	5.96	4.36	5.67	4.35	6.01	4.4	0.08	5.88	0.18
	Blower	0.24	1.56	0.16	2	0.18	2.6	0.19	0.04	2.05	0.52

Table 1. Average vibration total values (ahv) by tool type, operator, and hand

CONCLUSIONS

- In this study, we successfully examined the HAV levels of three types of hand-held power tools, a chainsaw, weed eater, and backpack blower, commonly used in forestry and grounds maintenance industries, using vibration dosimeters.
- ullet The operation of a weed eater resulted in the highest acceleration levels, a_{hv} , regardless of operator.
- Right hand was the dominant hand, regardless of tool type and operator.
- y-axis was the dominant axis during chainsaw and blower operations while x-axis was the dominant axis during weed eater operation.
- The effect of gloves was not considered in this study. Further investigations on the effects of individual factors (e.g., hand force and posture) and work-related factors (e.g., glove use and operation time) on the vibration magnitude are needed.

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