

SIMULATIONS OF STUMPING IN COASTAL DOUGLAS-FIR INFECTED WITH PHELLINUS ROOT ROT

C O N T R A C T # 6 9 1 9 8

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A U G U S T 8 T H , 1 9 9 1

INTRODUCTION

This report examines the effects of stumping in coastal Douglas-fir infected with *Phellinus* root rot through simulation with the TASS-ROTSIM model described in a previous report (W.J.Bloomberg, Incorporation of *Phellinus* root rot impacts in the tree and stand simulator (TASS), Progress Report, Contract #49782, March 31, 1991). The latter report examined the effects of inoculum level (number, size, and spatial distribution of infected stumps). A second report dealt with effects of stand density and site index on root rot (W.J. Bloomberg, Preliminary yield tables for coastal Douglas-fir infected with *Phellinus* root rot, Contract #69198, June 10, 1991).

Stumping refers to the extraction after harvest of infected stumps with attached roots as a means of reducing or eliminating infection of the succeeding stand. Using equipment such as a D8 bulldozer with a toothed blade, or a backhoe with a hydraulic thumb, infected roots are pulled from the soil with varying amounts of breakage. Effectiveness of stumping increases as fewer broken roots remain in the soil.

Stumping trials were first established 20 years ago. Results so far have shown promise in controlling the disease, but owing to the relatively slow rate of symptom appearance up to stand age 40, it is premature to draw firm conclusions as to the effectiveness of the treatment. Simulation of stumping has been incorporated into TASS—ROTSIM to project treatment effects up to rotation age. Factors such as inoculum level, stand density, and level of effectiveness can be evaluated.

METHODS

Stumping is simulated in TASS-ROTSIM by removing specified percentages of stump root systems from the infection process. The tendency of roots to break off during extraction is simulated by retaining a percentage of roots at the outer extent of root systems. For example, 75% effectiveness would leave the outer 25% of roots surrounding the stump while removing the inner 75%. Different percentages can be specified at each of four soil levels.

To test effectiveness of stumping, 50% and 75% effectiveness levels were used, plus the highest level necessary to prevent infection. For testing purposes, effectiveness levels were the same for all soil levels, although in practice, effectiveness decreases with soil depth. Post—treatment planting densities were set at

500, 1000, and 2000/ha. Inoculum levels were represented by five root rot classes: very light, light, moderate, heavy, and very heavy as defined in the above reports. All stands had a site index of 35m, corresponding to a good site.

Methods for simulating root rot in stands and calculating and volume (cu. rn/ha) are described in effects on stocking (stems/ha) the above reports.

RESULTS

Results are shown as selected graphs for comparisons of stocking and volume over age in stumped and unstumped stands, and as a table of impacts (percent of healthy) in stands with heavy root rot. Scatter plots for each combination of root rot class, initial stand density and stumping regime are shown in Appendix 1 for the following parameters; stems/ha, volume/ha, impact on stocking, and impact on volume.

A minimum of 90% effectiveness in stumping was necessary to prevent infection and spread of root rot in the succeeding stand regardless of inoculum level or initial stand density. In stands with heavy root rot. a 50% effectiveness level caused no practical reduction in disease impact on either stocking or volume at rotation age, but a level of 75% reduced volume impact appreciably at 1000 and 2000 stems/ha (Table 1). However, impact at all effectiveness levels less than 90% would render cost/benefits of treatments unacceptable.

T A B L E 1 .

EFFECT OF STUMPING REGIME ON IMPACT OF HEAVY ROOT ROT IN DIFFERENT STAND DENSITIES

	Unstumped		Stumped with effectiveness of:					
			50%		75%		90-100%	
	Stocking	Volume	Stocking	Volume	Stocking	Volume	Stocking	Volume
Initial stems/ha	Impact (% of healthy) at stand age 90							
500	82.9	85.0	90.0	57.4	94.6	60.2	100.0	100.0
1000	65.5	67.4	63.9	67.8	75.1	78.1	100.0	100.0
2000	56.2	58.0	63.9	66.5	70.8	74.8	100.0	100.0

At moderate to light inoculum levels and 1000 stems/ha, volumes at rotation are ranged from 82.1 to 90.2% of healthy after 50% effective stumping, compared with 90.4 to 93.9% after 75% effective stumping. Comparable impacts for 2000 stems/ha were 74.8 to 92.1% and 80.6 to 96.3%. Untreated stands with light to moderate root rot had volumes of 70 to 90% of healthy stands.

The large difference in impacts between heavy and light/moderate inoculum levels results from both the number and size of roots remaining in the soil after stumping. Heavy/very heavy inoculum results from a high proportion of stumps 75 - 100 cm diameter bearing many more and longer roots than those of light/moderate inoculum which have a higher proportion of stumps 20 - 75 cm diameter. Even after 75% effective stumping of heavy inoculum, sufficient infected roots remain in the soil to trigger a rapid spread of root rot.

Volumes in unstumped stands exceeded those of stumped stands until about stand age 70 when they decreased. In the model, the large inoculum loads in unstumped stands caused rapid mortality of small trees during the first 10 years. The fungus in the small root systems quickly died out and tree-to-tree infection was delayed until the peripheral live trees made root contact with the stump roots.

In stumped stands, the remaining inoculum was smaller and more diffuse, resulting in lower infection levels and longer survival of infected trees. Tree-to-tree infection was not interrupted and spread more rapid than in unstumped stands. Therefore volumes were less in unstumped stands until late in the rotation.

The phenomenon of an epidemic temporarily limiting itself by an initial virulent phase is referred to as “burn-out”. No field data is available for *Phellinus* root rot, but observational evidence suggests that it occurs. However, the effect of incomplete stumping in accelerating spread is speculative.

CONCLUSION

In field trials, a large backhoe, a D8 Cat and a small backhoe, all removed from the soil more than 90% of estimated pretreatment root volumes, but only 56, 48 and 28% respectively, of estimated root length (W.J. Bloomberg and G. Reynolds, Equipment trials for uprooting root-rot-infected stumps, *West. J. Appl. For.* 3:80—82, 1988). The root biomass remaining in the soil was in the form of slender roots of considerable length but little mass. Such roots can harbor and transmit infection. Root-raking following stumping has reduced infection, but observations extend only for 20 years from planting. The results from simulation with TASS-ROTSIM suggest that root extraction must be very thorough to ensure elimination of root rot from a heavily infected site.

A P P E N D I X 1

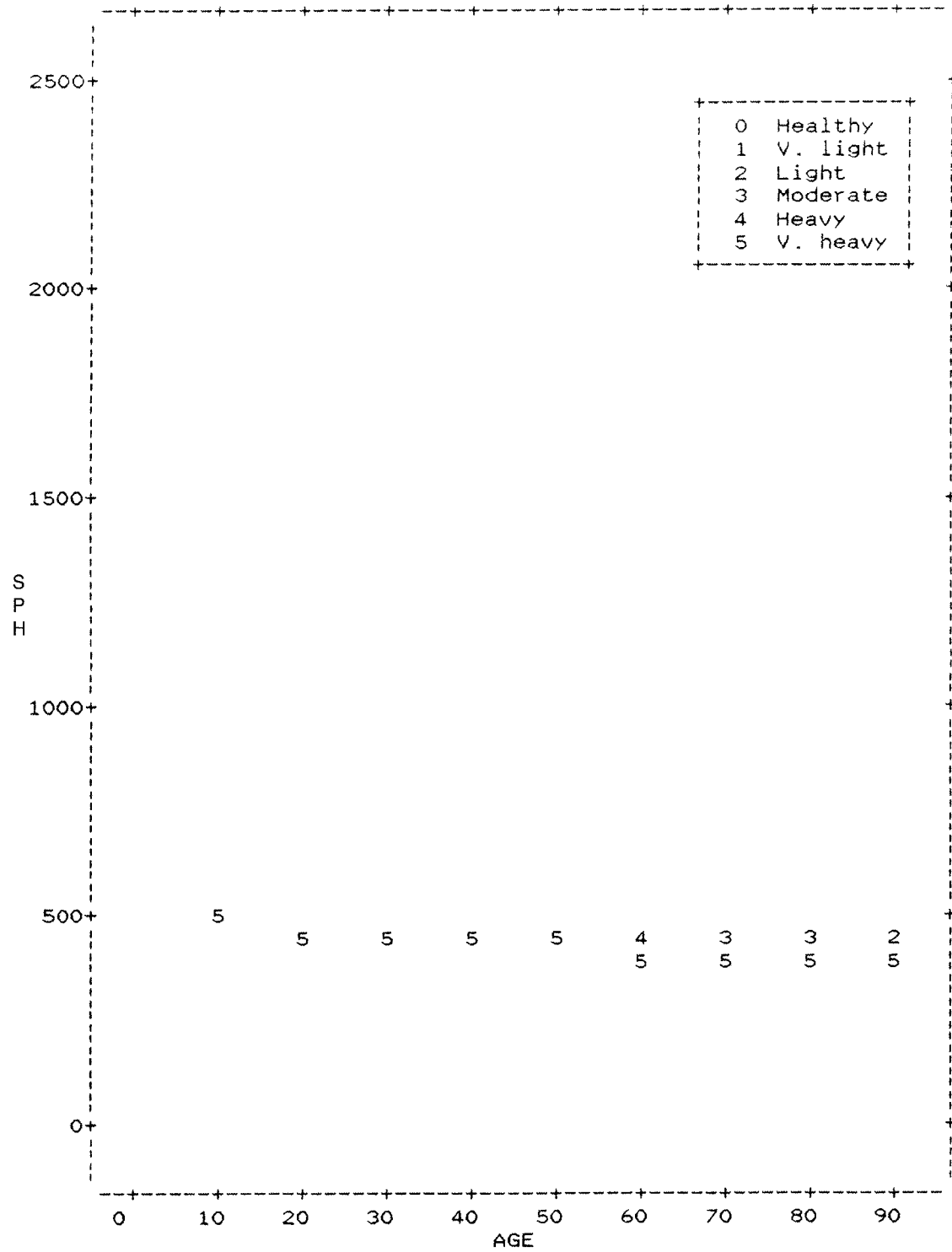
SCATTER PLOTS OF EACH COMBINATION OF ROOT ROT
SEVERITY CLASS, INITIAL STOCKING LEVEL, AND
STUMPING REGIME. PLOTS ARE GROUPED AS FOLLOWS:

STEMS/HA, VOLUME/HA, IMPACT ON STOCKING, IMPACT
ON VOLUME.

STEMS/HA FOR ROOT DISEASE CLASSES SIMULATED BY TASS

Initial Stocking 500 sph, Site Index 35

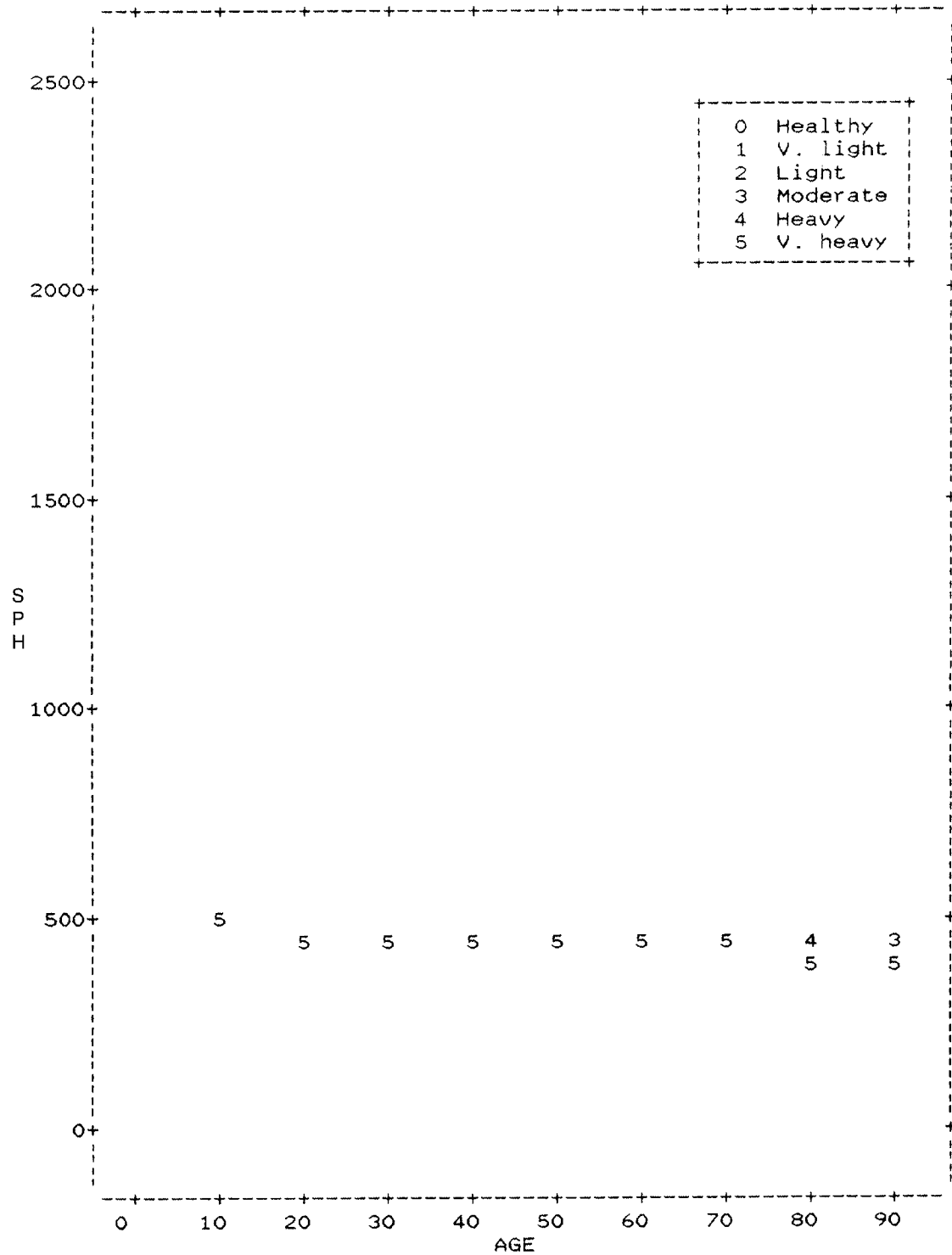
Stumped with 50% Effectiveness



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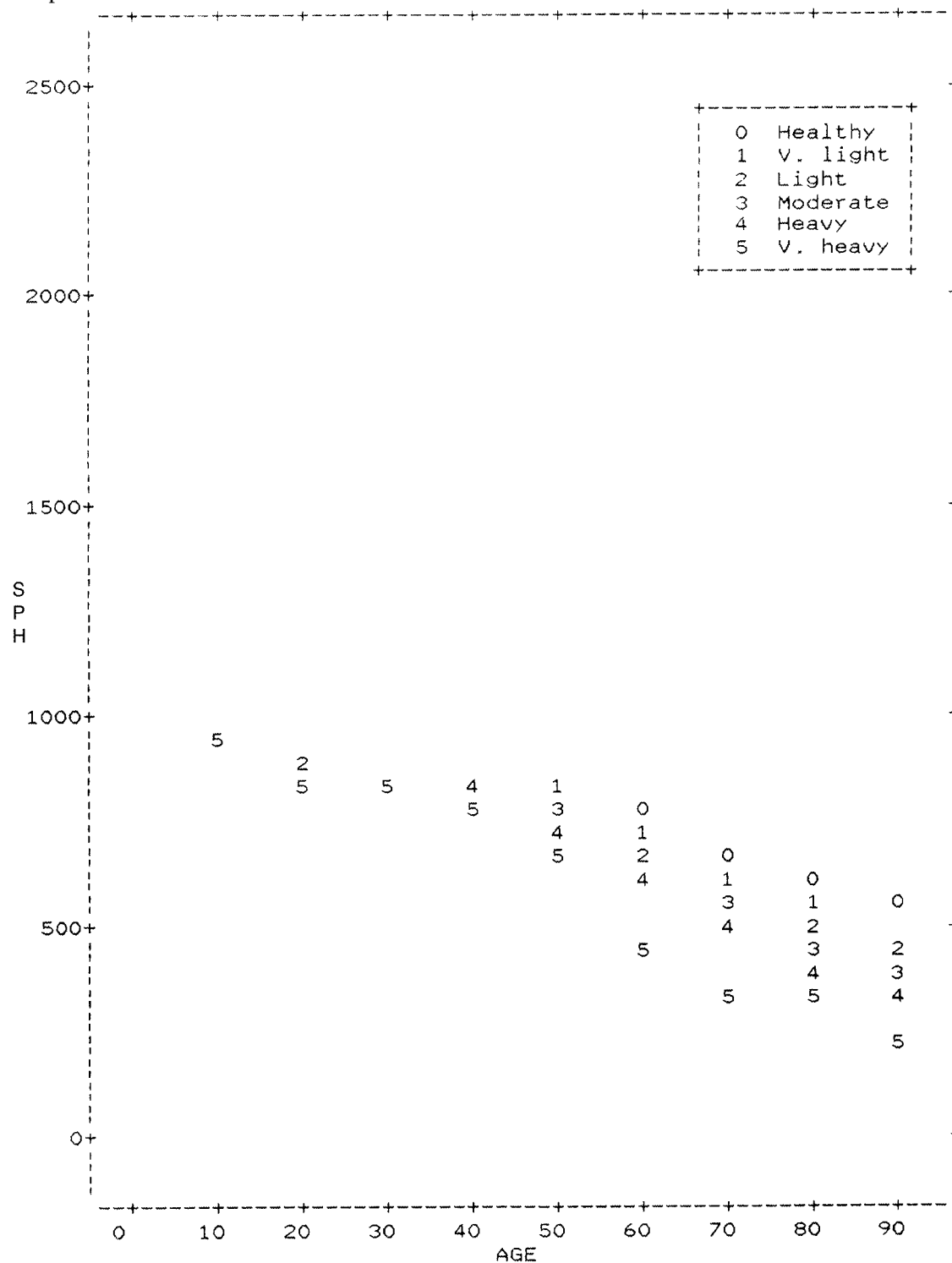
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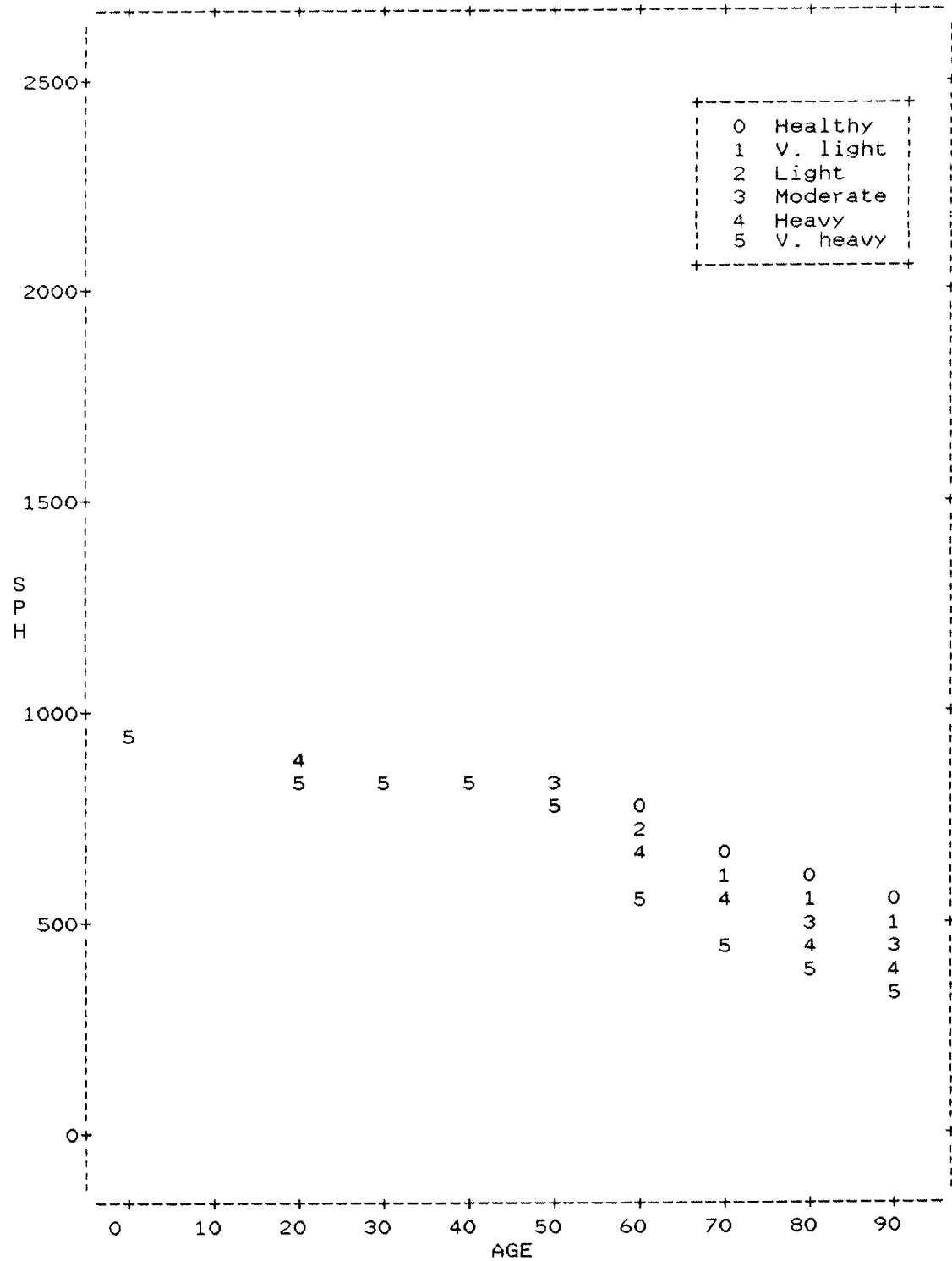
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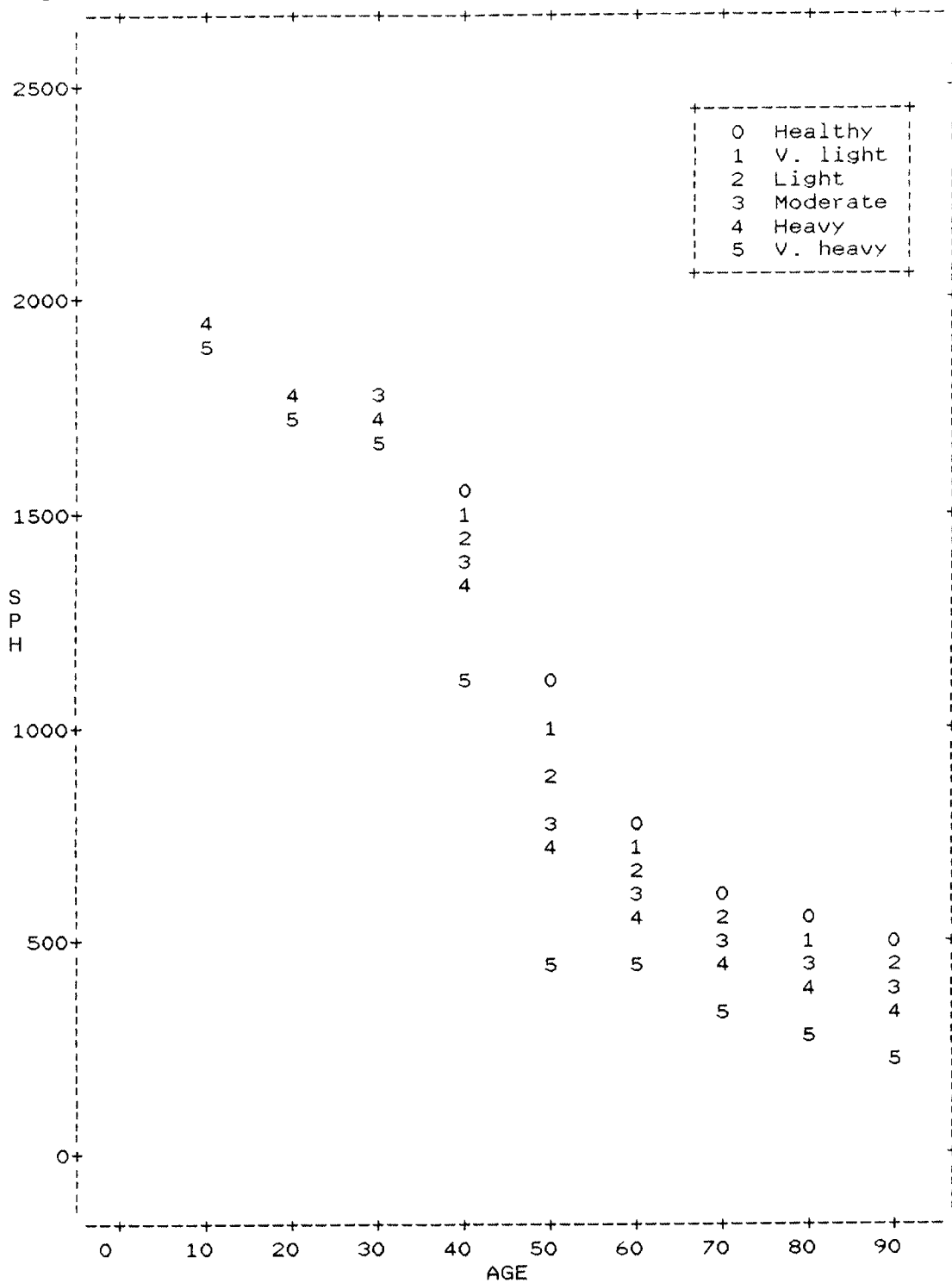
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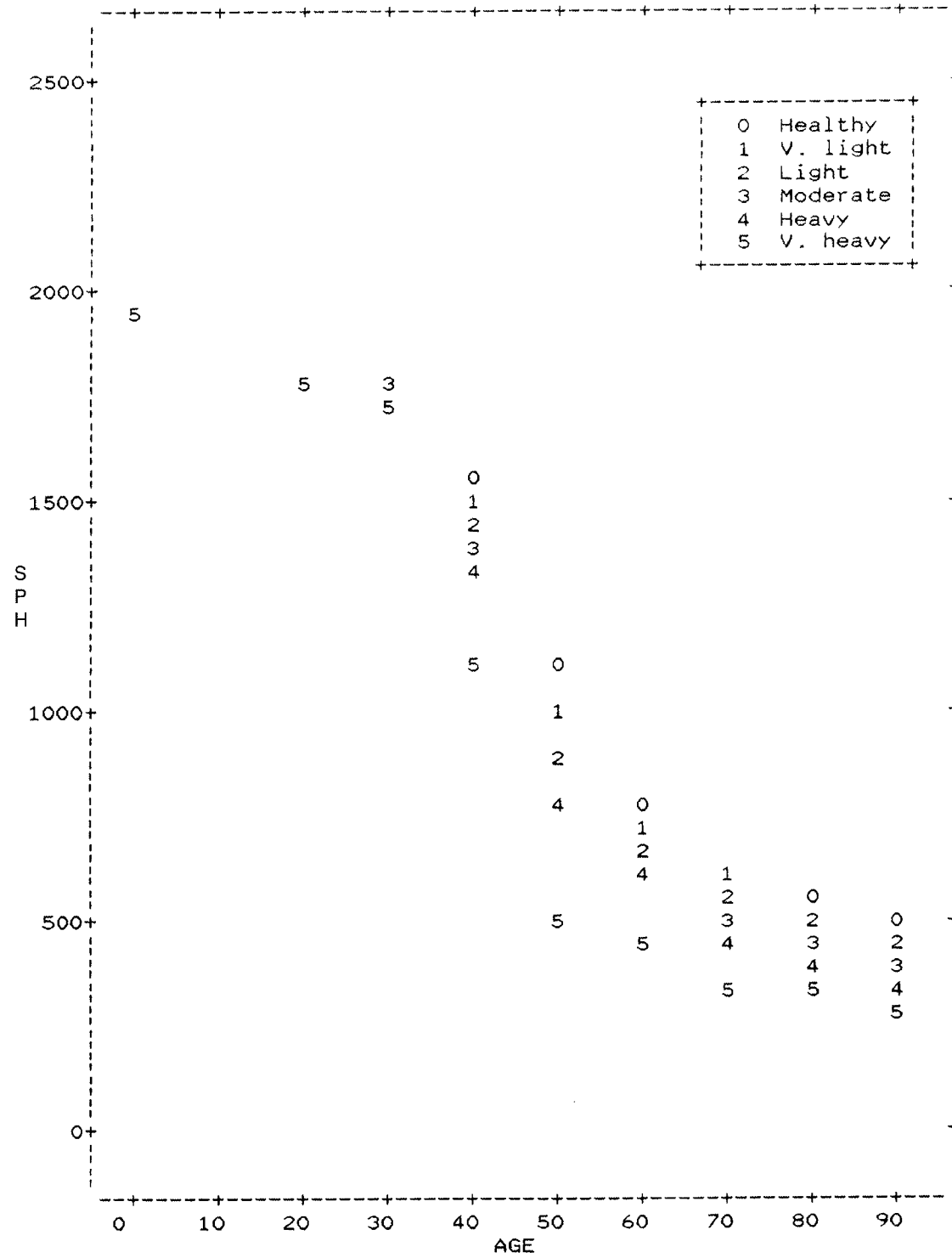
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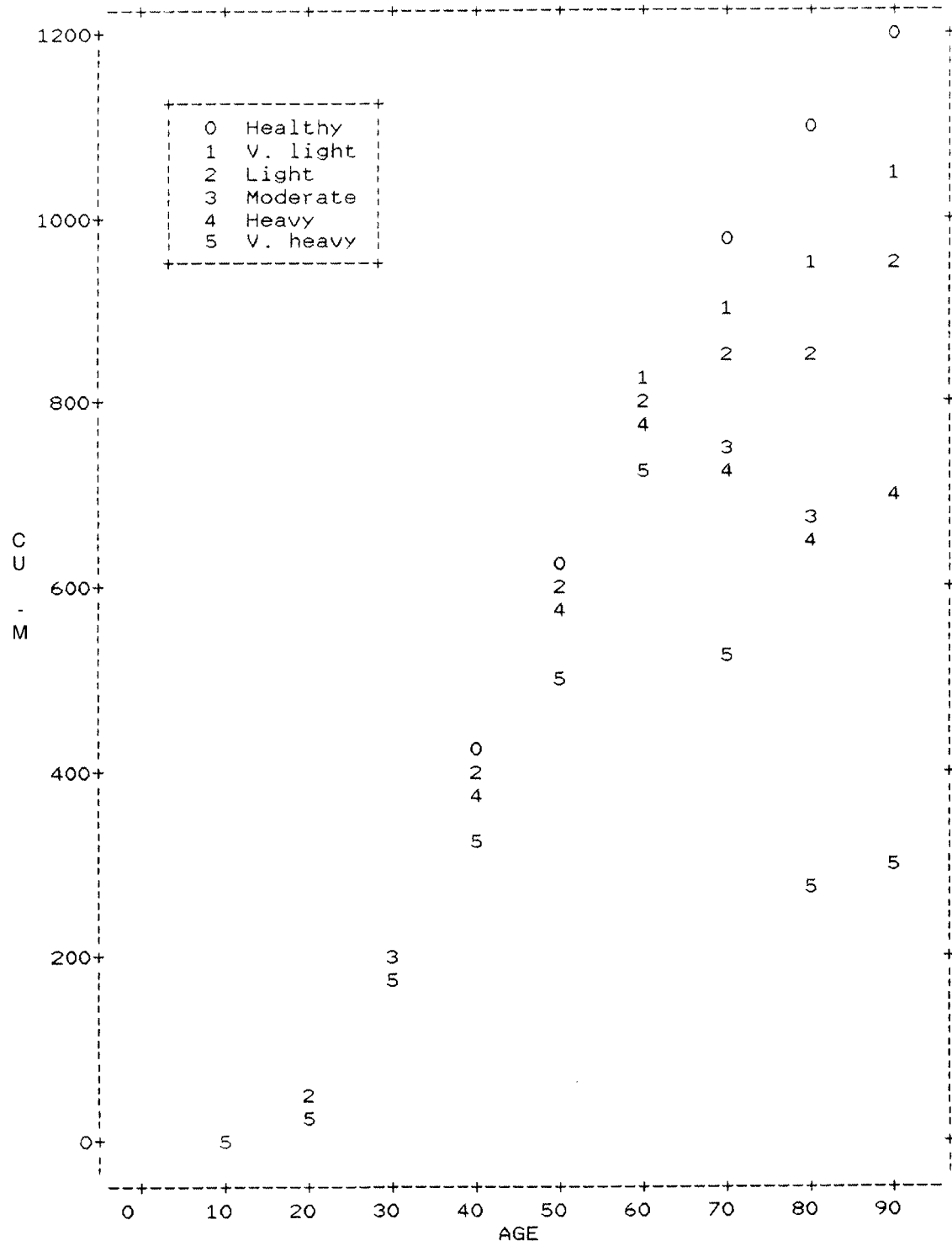
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TOTAL STAND VOLUME OF ROOT DISEASE CLASSES

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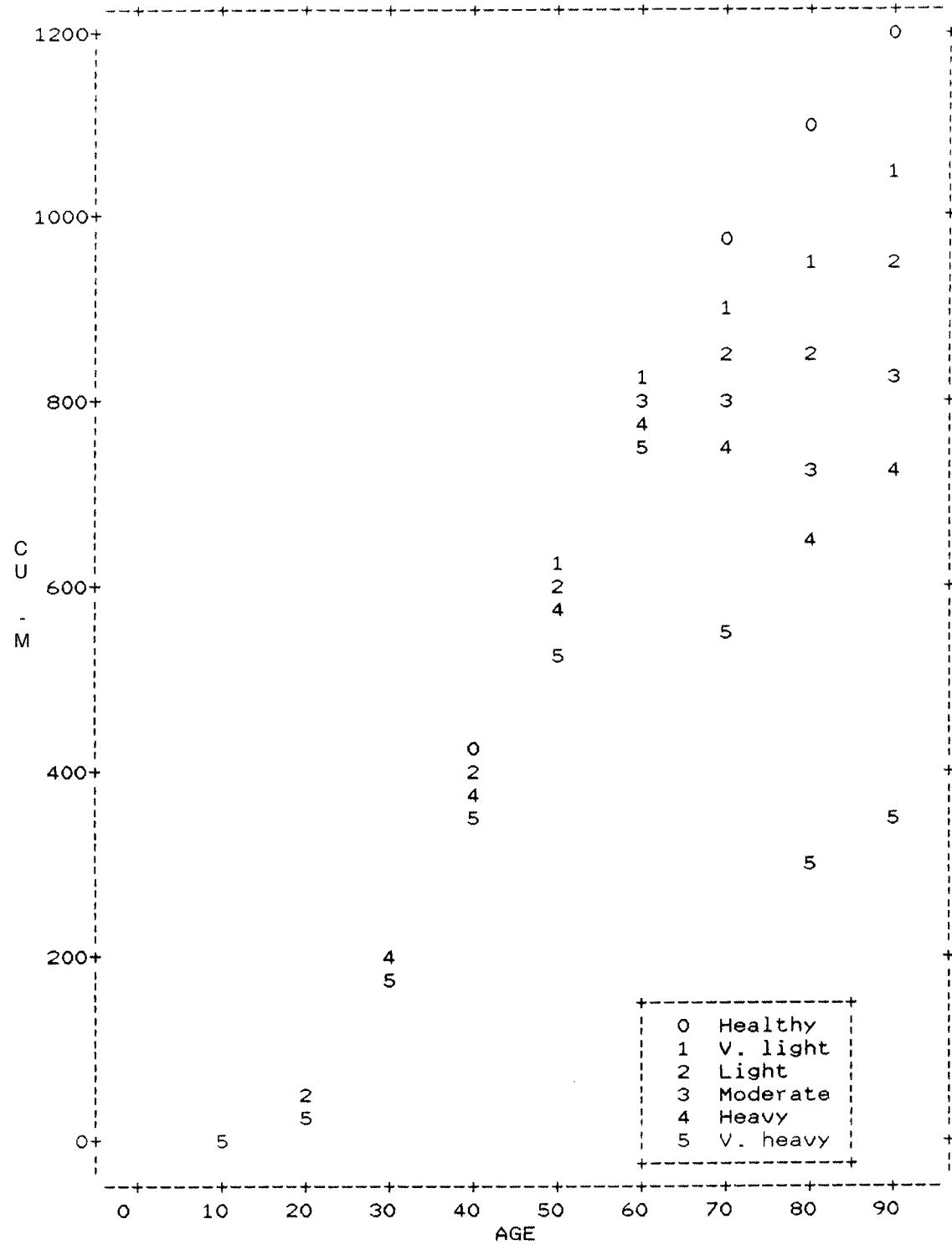
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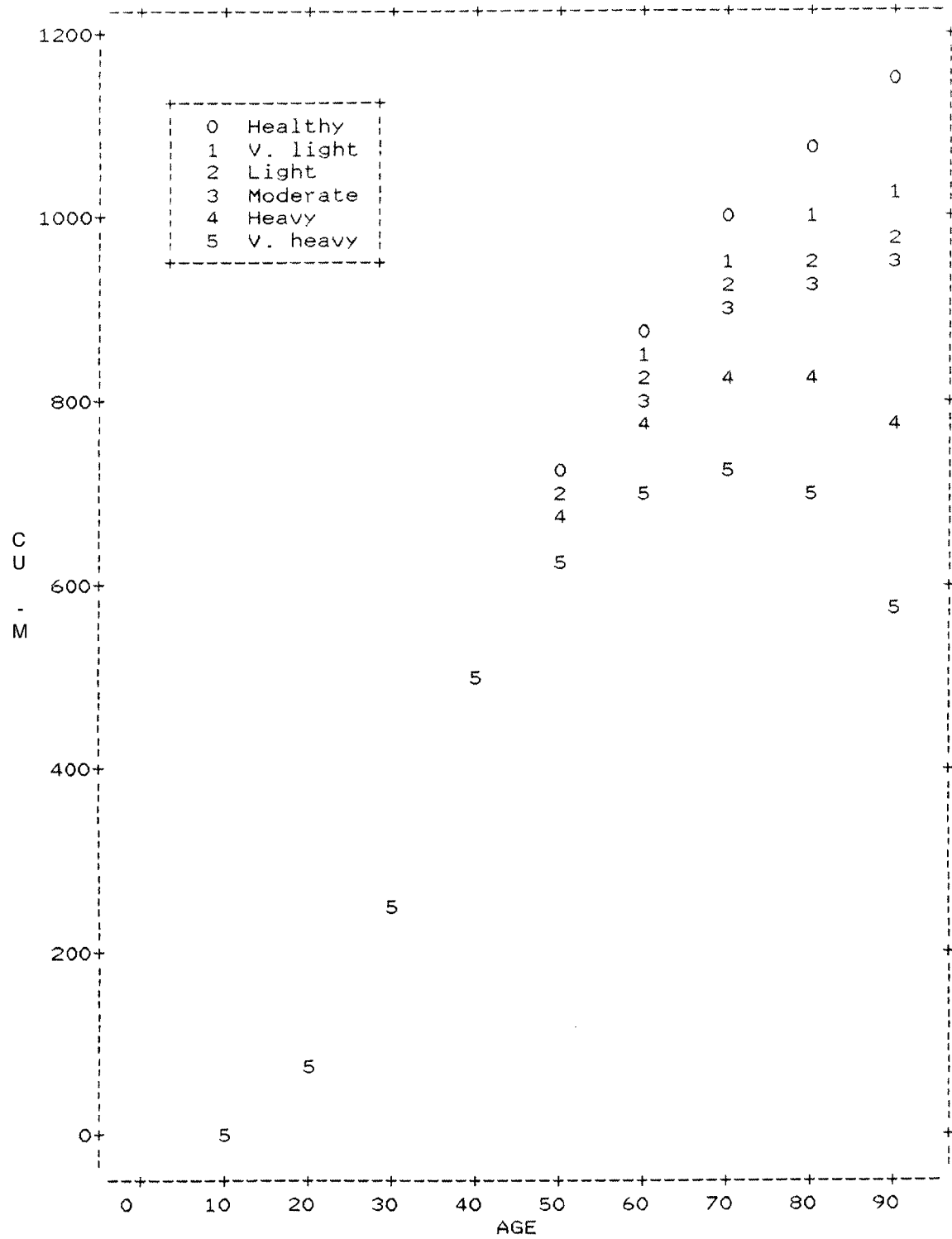
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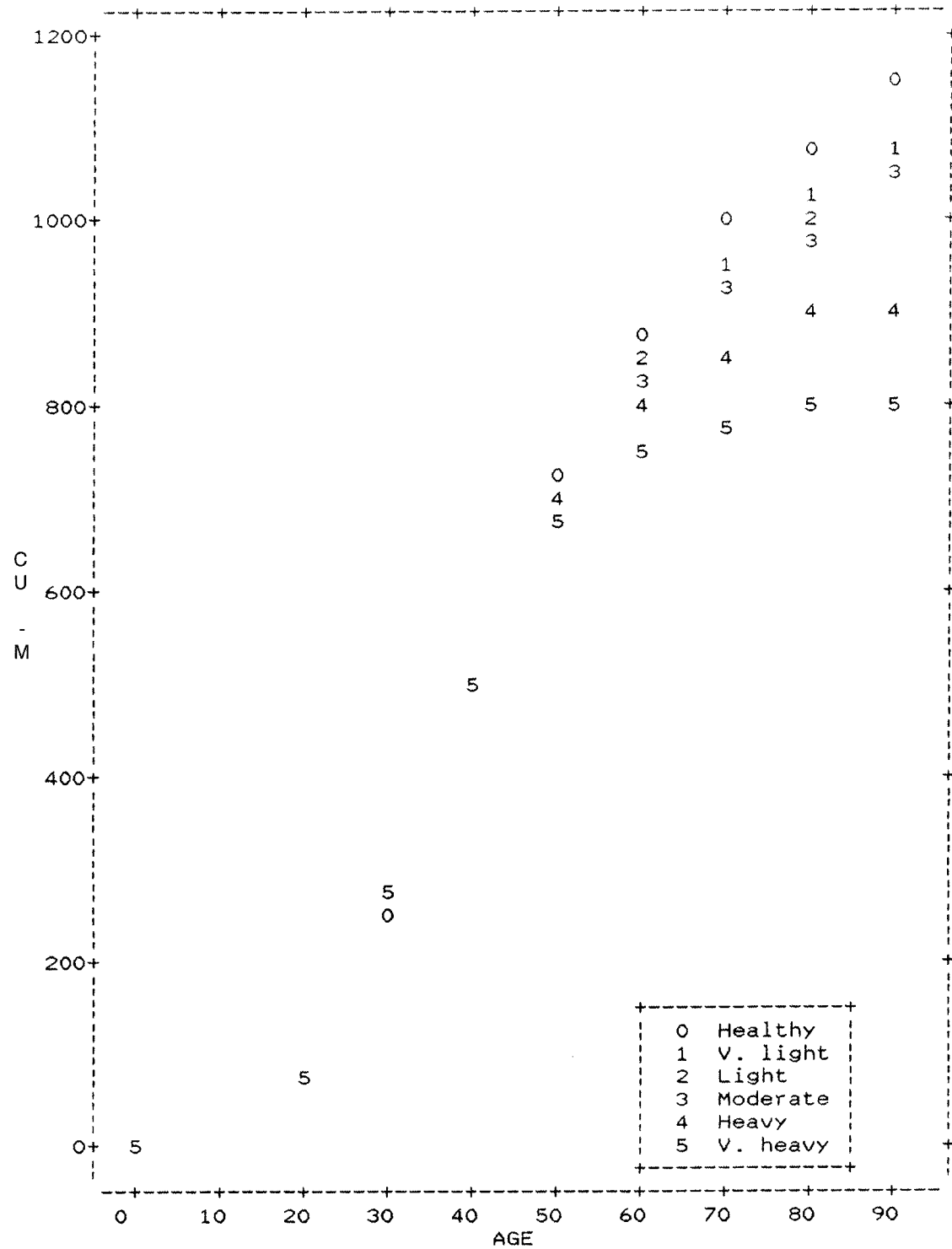
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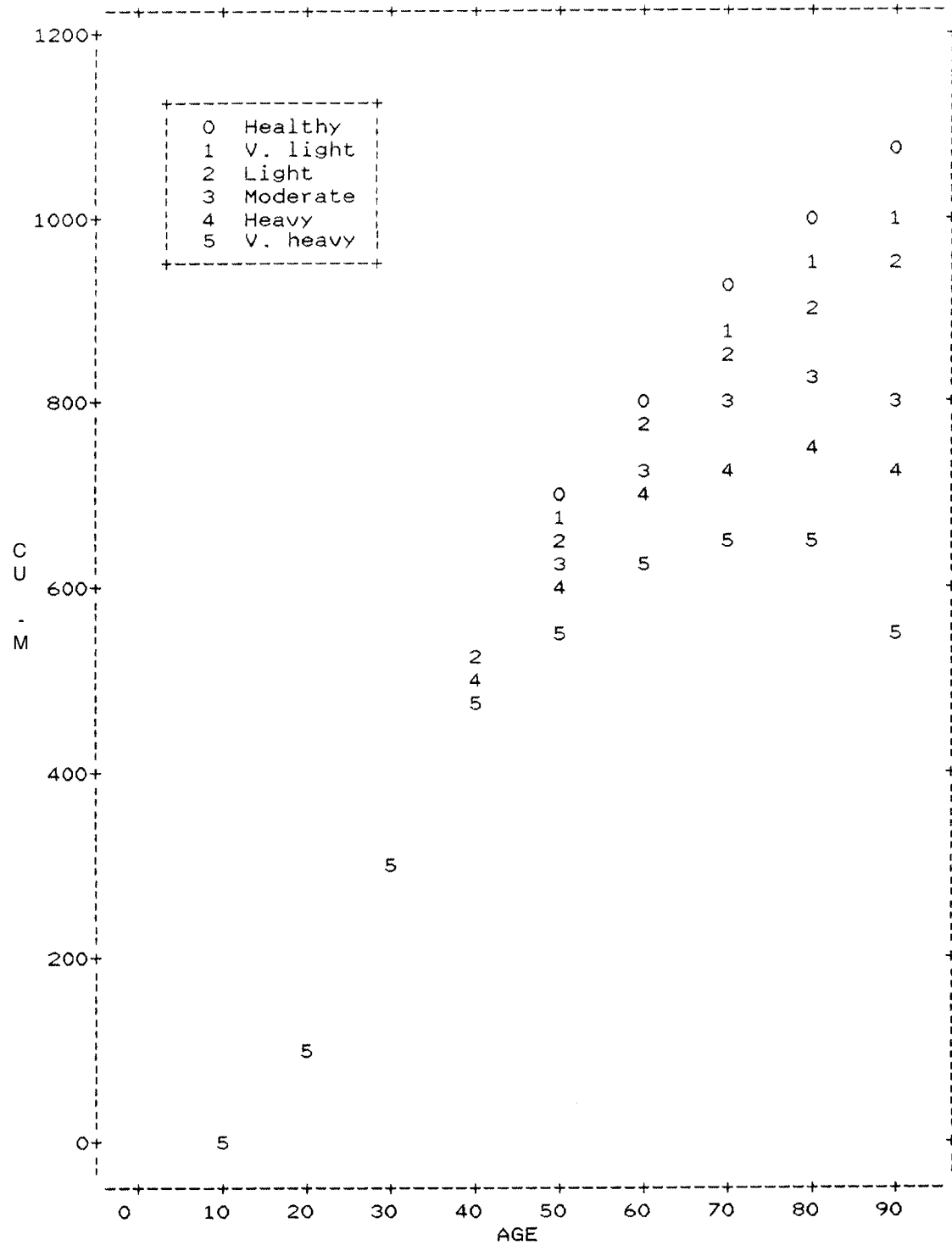
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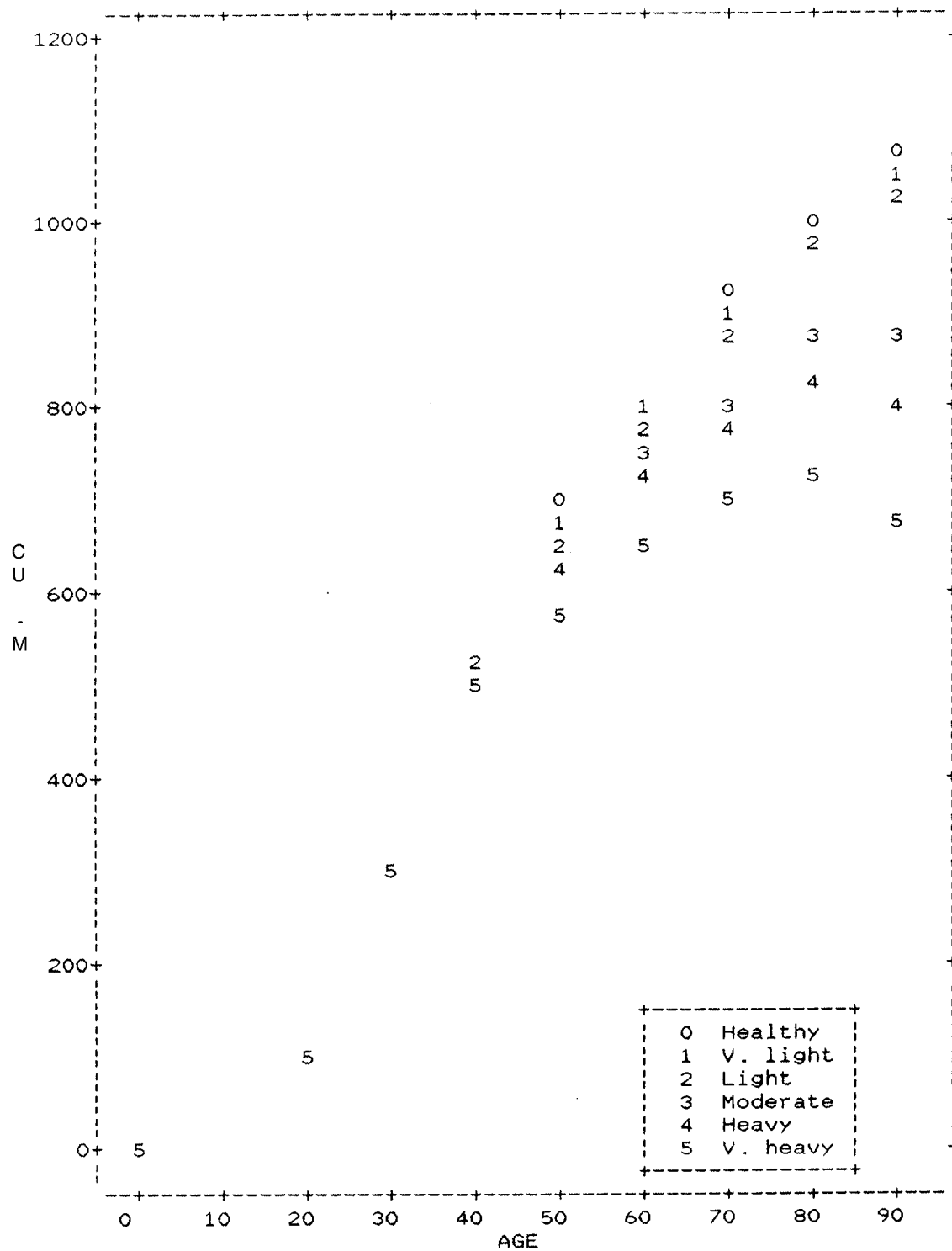
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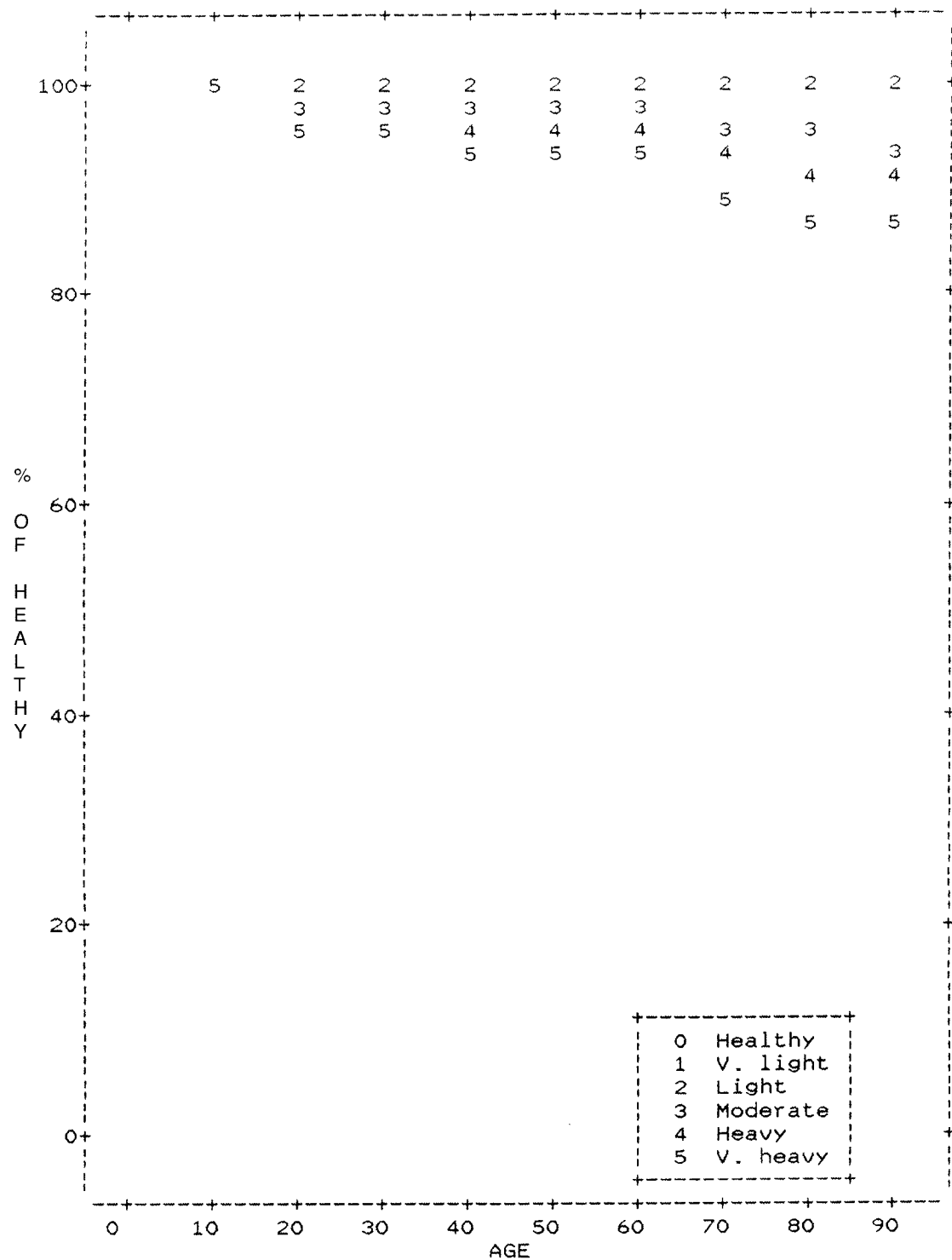
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IMPACT OF ROOT ROT ON STEMS/HA AS PERCENT OF HEALTHY

Initial Stocking 500 sph, Site Index 35

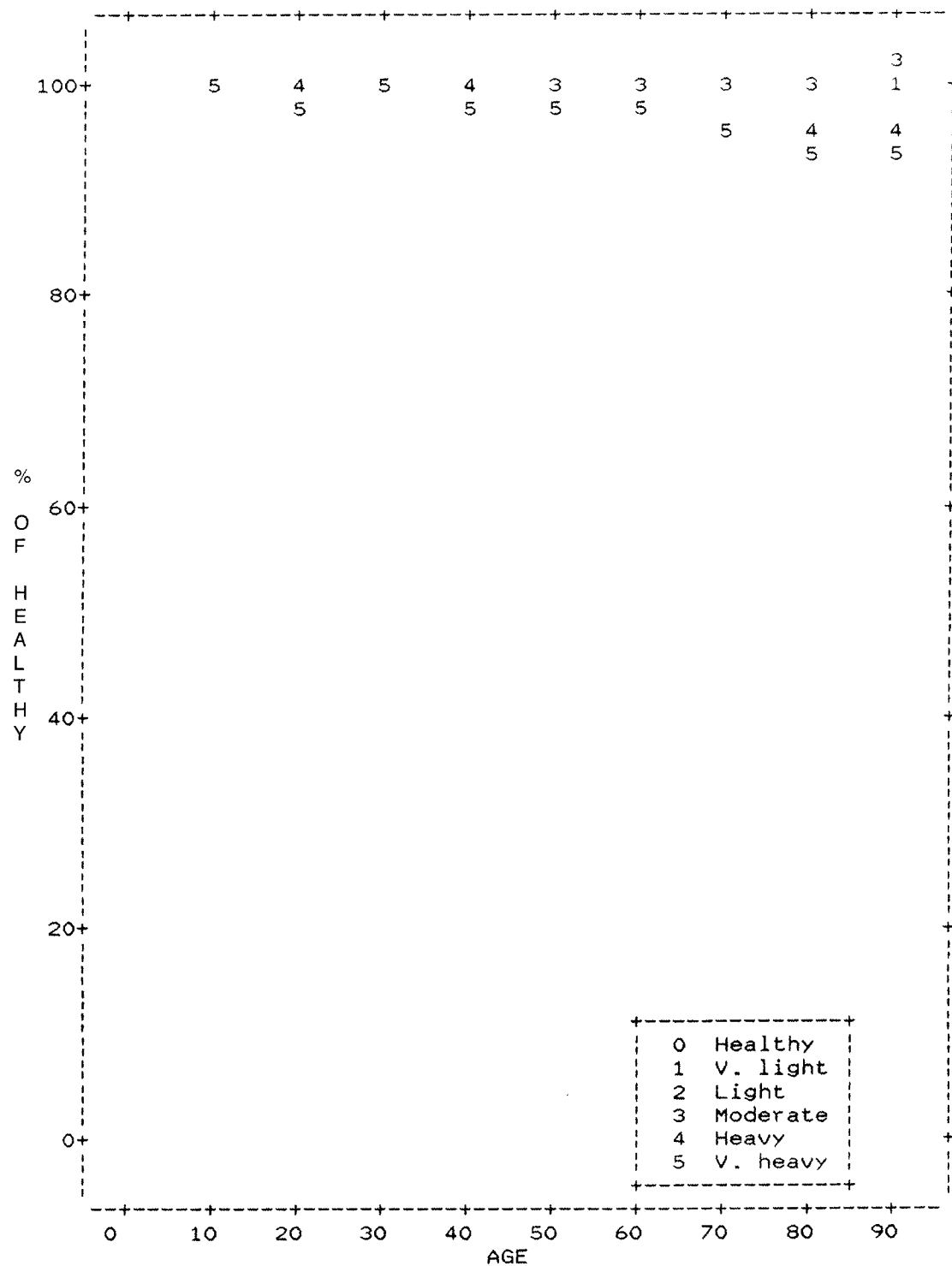
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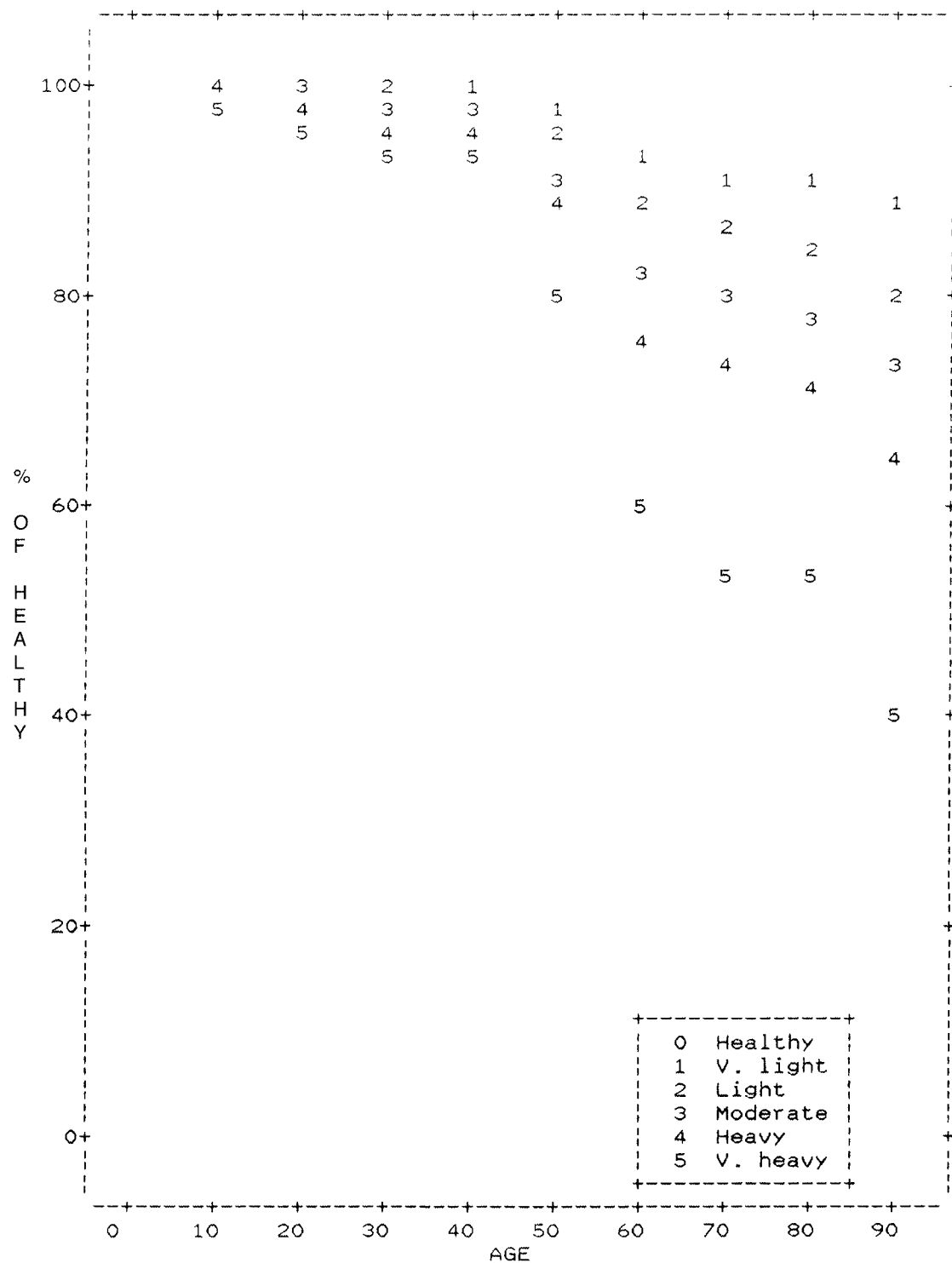
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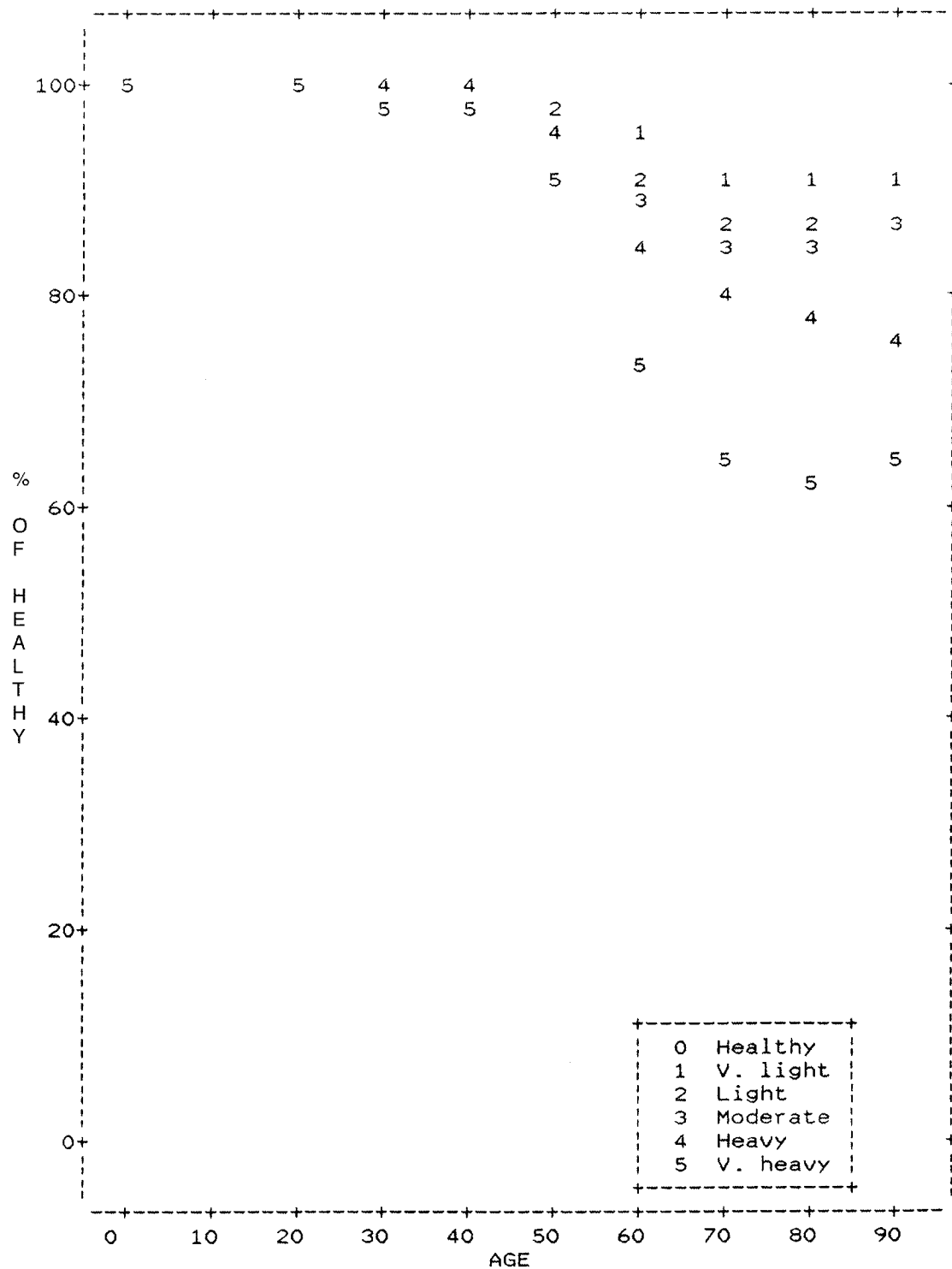
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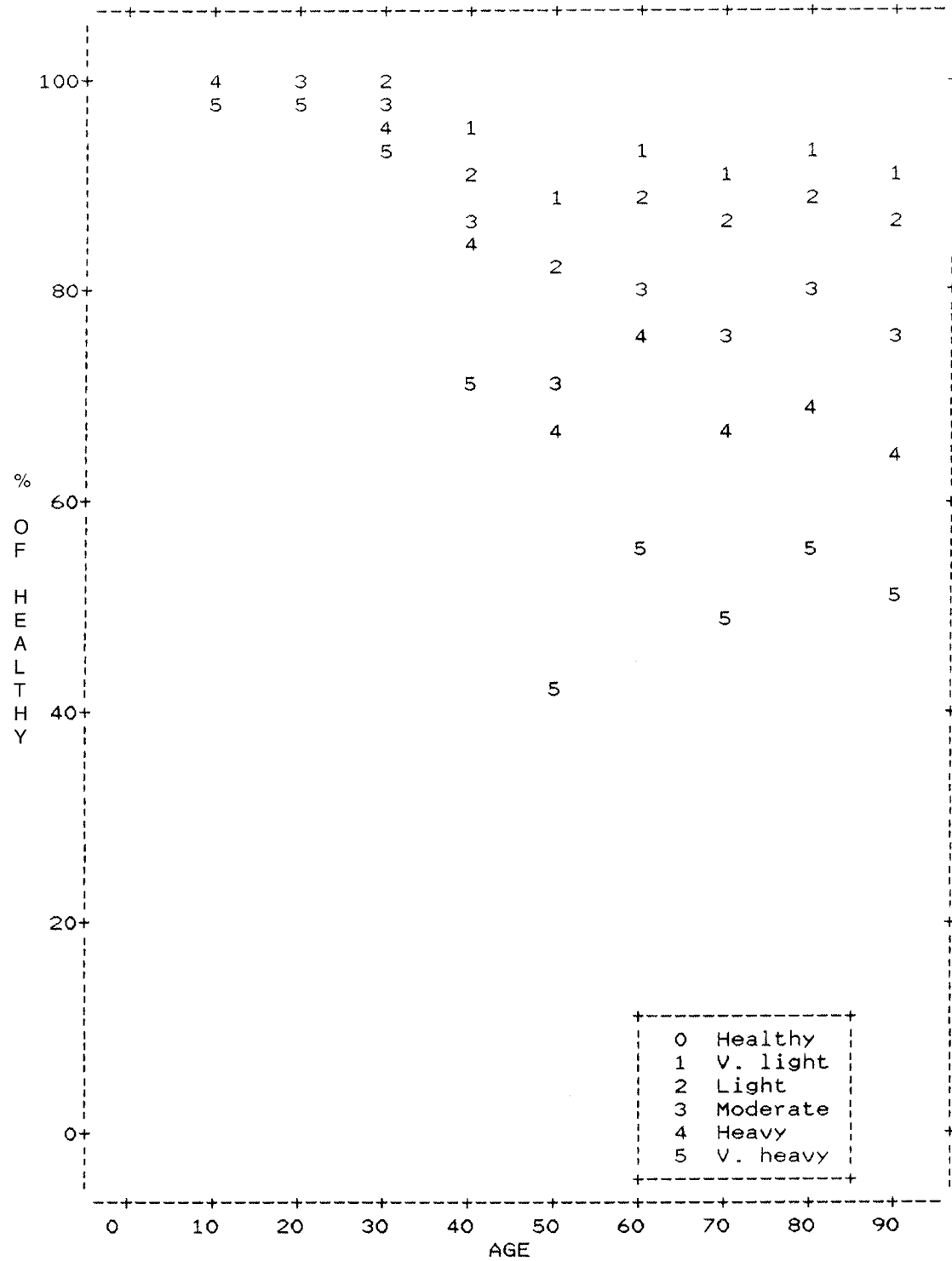
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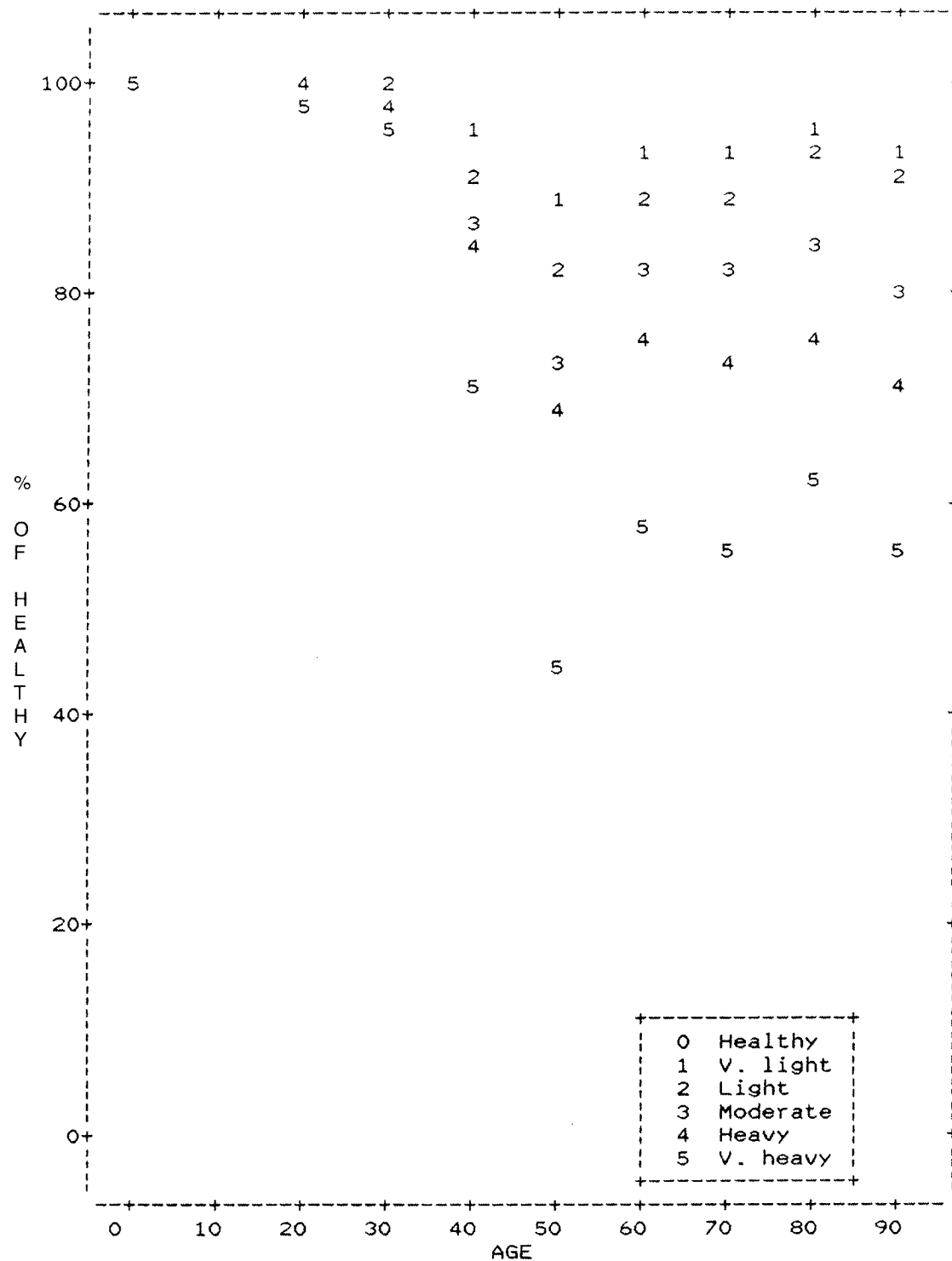
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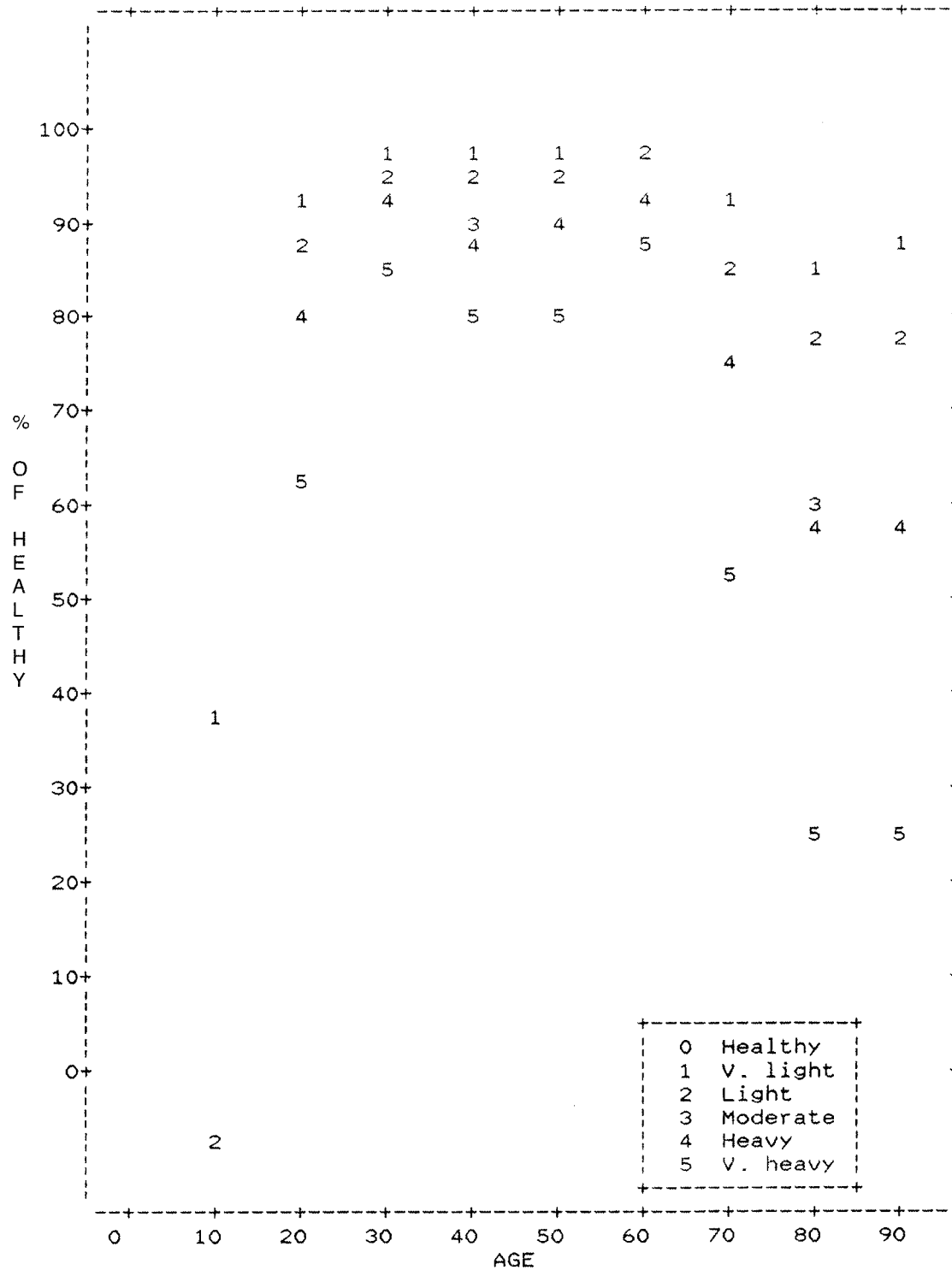
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IMPACT OF ROOT ROT ON VOLUME AS PERCENT OF HEALTHY

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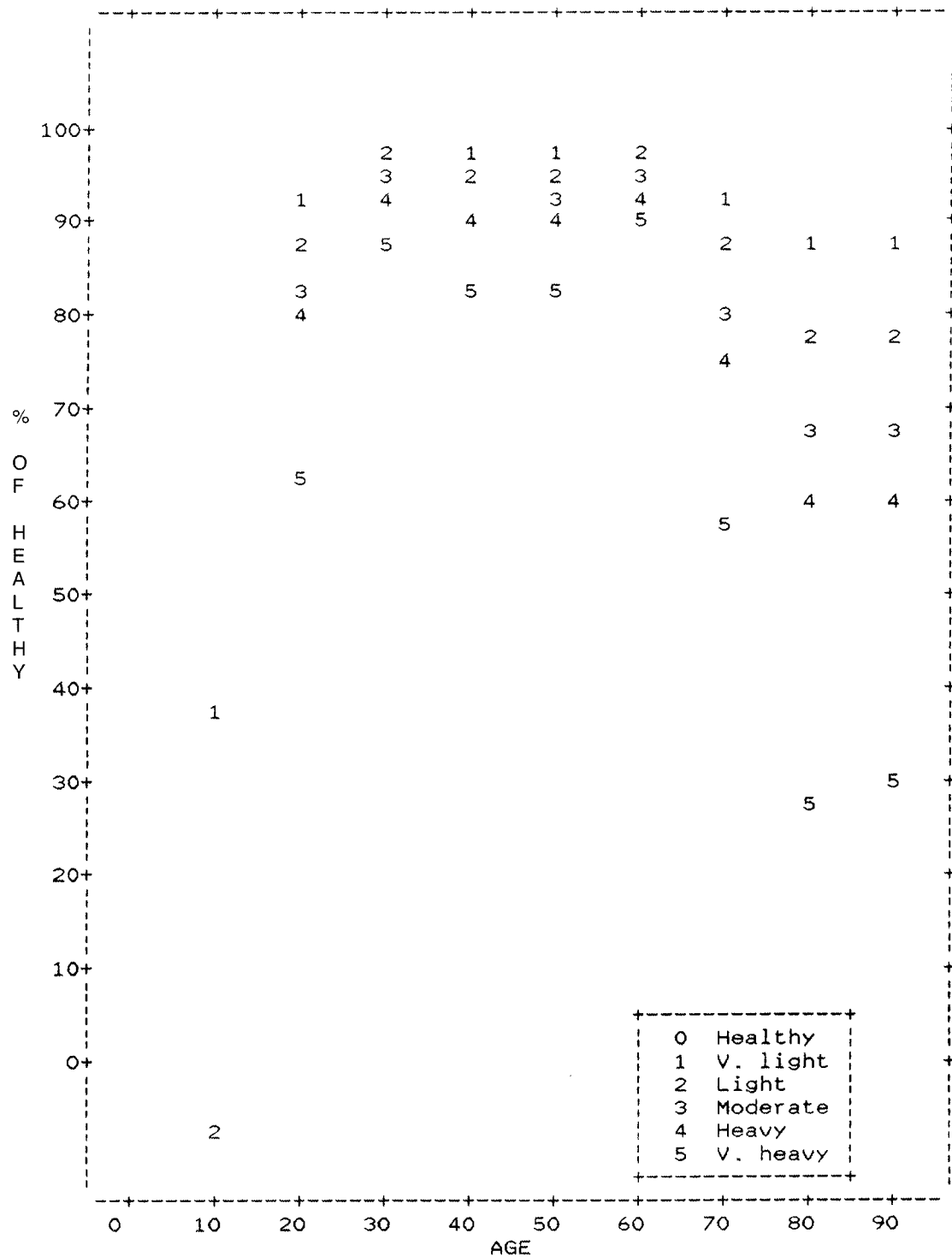
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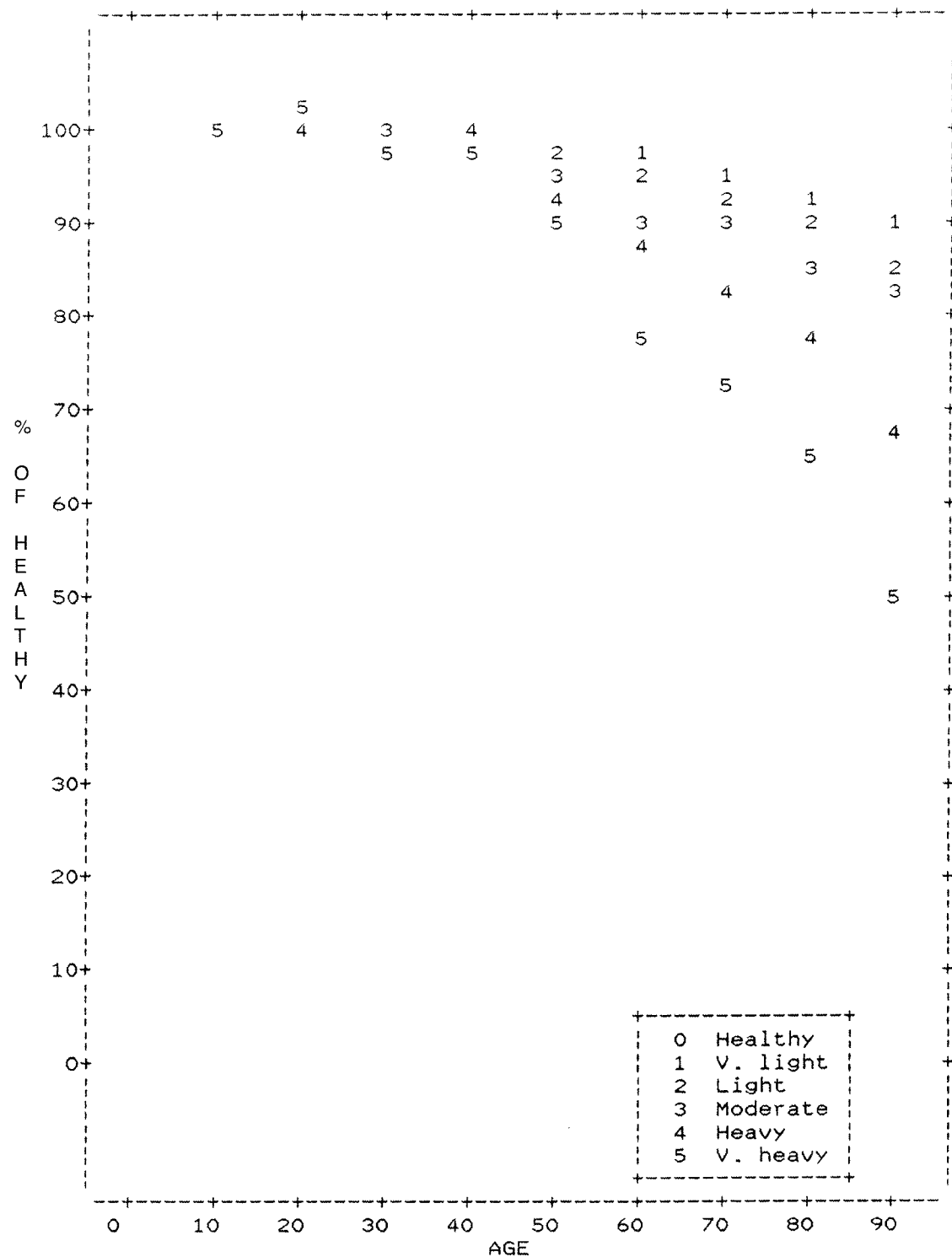
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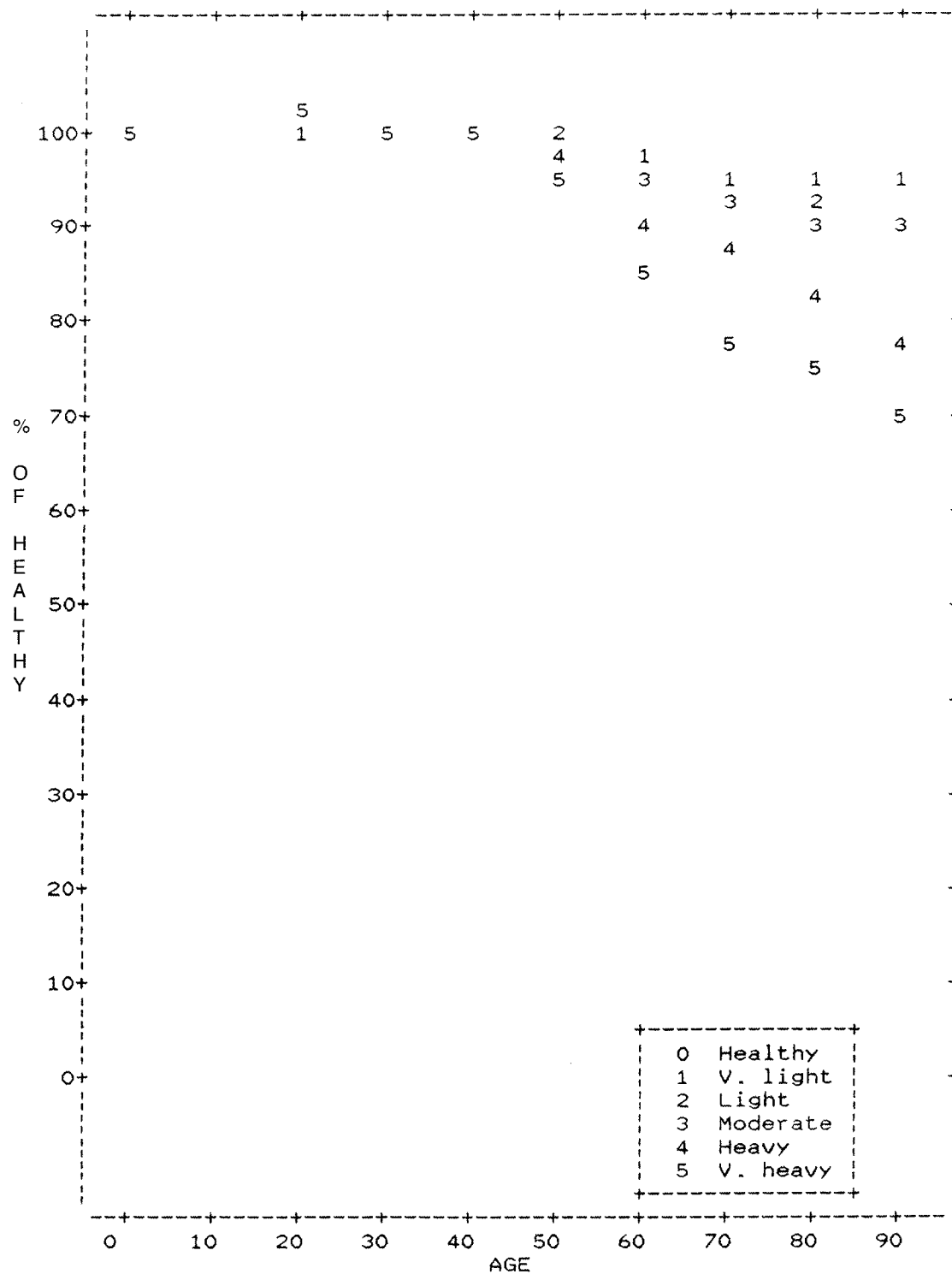
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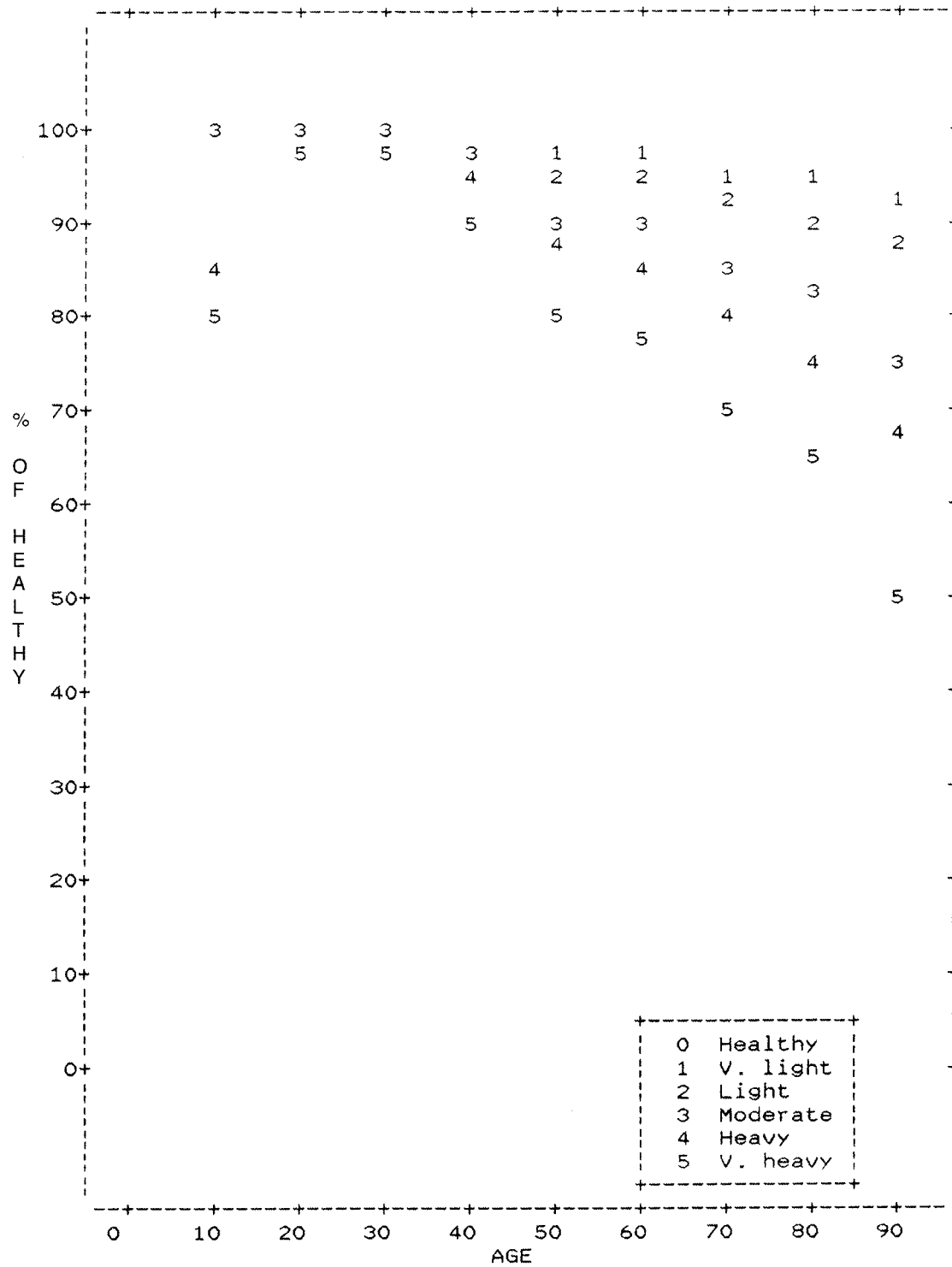
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