



**U.S. Army Aviation Epidemiology Data Register:  
Prevalence of Refractive Error  
Among U.S. Aircrew Members**

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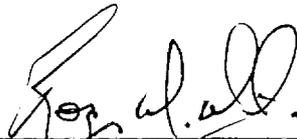
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<p>The U.S. Army aviation branch is making final funding and planning decisions on the fielding of a contact lens program for Army aircrew members. This report stratifies the prevalence of refractive error by aviation duty position, service component, and rank.</p> <p>There is an increasing prevalence of refractive error in the higher ranking aircrew members, paralleling increasing age with rank promotion. Comparing service components, the prevalence is higher in the reserve component and civilian forces than active duty forces. Within the aviator service component cohorts, there has been a significant upward trend in the annual period prevalence of refractive error from 1986 through 1992, especially in the Army Reserve and National Guard cohorts. This upward trend may be related to the observed upward trend in the average age of Army aircrew members as a group from 1986 through 1990.</p>					
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## Military relevance

The U.S. Army is at a critical juncture in the final planning and decision phases for fielding contact lenses to aircrew (Karney, 1991; Lattimore, 1991). The U.S. Army Aero-medical Research Laboratory (USAARL) studied 582 aircrew members (450 in the Desert Shield/Desert Storm operations) wearing contact lenses in the operational environment. The studies confirmed the contact lens option may solve partially the problems of spectacle incompatibility with certain aircraft and aircrew devices (Bachman, 1988; Lattimore and Cornum, 1992).

An element of planning is quantifying the requirements. How many aircrew members have refractive error and require vision correction to 20/20 by spectacles or contact lenses? One study partially answered this question (Schrimsher and Lattimore, 1990). The study was a descriptive analysis of spectacle wear by Army aviators, stratified by age and component.

The career cycle of aircrew members is linked to their rank more so than their age. The Office of Aviation Proponency, U.S. Army Aviation Branch, Fort Rucker, Alabama, requested an expeditious study of the requirement for vision correction stratified by rank and component for all classes of aircrew.

The U.S. Army Aviation Epidemiology Data Register (AEDR) was queried to answer the question. This report compiles the prevalence of refractive error among aircrew members by duty position, rank, and service component during the period 1 July 1991 to 30 June 1992. There are data tables for aviators, aeroscout observers, aerial fire support observers, flight surgeons, aeromedical physician assistants, and air traffic controllers.

Information on class 3 aircrew members (crew not at aircraft controls) is not entered into the AEDR at this time. Class 3 aeromedical records are reviewed at the local flight surgeon office level. The prevalence of refractive error in this group must be determined by medical record review in the field.

## Background

Spectacle wear is the traditional method of vision correction for aircrew members. There are problems with spectacle wear. The increasing design complexity of modern electro-optical and visionic systems may preclude spectacle wear. Contact lenses are used as an alternative method to correct vision. They now are fielded in many international military air forces. Contact lens wear is not free of problems. Table 1 compares the potential problems of spectacle and contact lens wear in the operational aviation environment.

Table 1.

Comparison of potential problems with spectacle and contact lens wear in aviation.

Category	Spectacle wear problem	Contact lens wear problem
Personal	Limit field-of-view Aberrations caused by optics Frame discomfort Facial injury in mishap or facial impact	Lens discomfort or lens lost Corneal and conjunctival infection Corneal injury in mishap
Environmental	Lenses fogged, dirty, or scratched Lens reflections	Dirt under lens Lens dehydration
Operational	Compatibility problems with: Chemical defense equipment Night vision goggles Laser/flash blindness protection devices Helmet mounted sighting systems Frame displacement by physical forces of flight or hostile action	Requires medical specialist and equipment support Lens displacement by physical forces of flight or hostile action

An essential element of planning for either spectacle wear or contact lens wear is understanding the prevalence of refractive error among aircrew members. For comparison with this study, Table 2 shows the prevalence of refractive error in other aircrew member cohorts found by literature review (adapted from data found in Schrimsher and Lattimore, 1990; Miller et al., 1989; Froom et al., 1992).

Table 2.

Prevalence of refractive error in other  
aircrew member cohorts.

Aircrew cohort	Year	Flying duty class	Prevalence of refractive error
U.S. Army, active duty	1989	Aviator	22%
U.S. Army Reserve	1989	Aviator	28%
U.S. Army National Guard	1989	Aviator	35%
U.S. Air Force	1989	Aviator	27%
U.S. Air Force	1989	Navigator/WSO	52%
U.S. Air Force	1989	Other aircrew	40%
Israel Air Force	1992	Aviator, on entry	9%
Israel Air Force	1992	Aviator, at 10-year career point	18%

The AEDR is a family of related databases storing demographic and medical findings of U.S. Army aircrew members. One component, the flying duty medical examination (FDME) file, is a VAX mainframe computer database. It has 178 physical parameter data fields and an additional, variable number of history data fields per record. The data elements of annual FDMEs for aviators, flight surgeons, aeromedical physician assistants, aeroscout observers, aerial fire support observers, and air traffic controllers are entered into the database. The database has over 275,000 FDMEs from 1986 to the present. The AEDR contains detailed information on aircrew vision parameters. Vision correction is required if the uncorrected visual acuity is not 20/20 with no more than one error on the 20/20 line by Snellen chart (Department of the Army, 1989). The manifest refraction of the correction is in the database.

## Methods

The AEDR was searched for all records for the period 1 July 1991 through 30 June 1992. We extracted only the first FDME record found since some aircrew members have two FDMEs submitted in one 12-month period for interim events such as aircraft mishap or serious illness. The extracted records were sorted by unaided visual acuity, aviation duty, service component, rank, and corrective lens flag. Thirteen records with no rank were removed from the data set. Student aviators, 275 records, were removed from the data set since they have an 18-month rather than a 12-month time period to accomplish a FDME. The final data set of 22,267 encounters was cross tabulated. Refractive error was defined as the finding of requiring corrective lenses to obtain a visual acuity of 20/20 with no more than one error on the Snellen chart 20/20 line.

## Results

Table 3 shows a summary of prevalence of refractive error during the period of 1 July 1991 through 30 June 1992, derived from the tables in Appendix A through Appendix D. There is a higher prevalence of refractive error among Army Reserve, Army National Guard, and civilian aircrew members than among the active duty force in all occupations except flight surgeons and aeromedical physician assistants.

Table 3.

Summary of prevalence of refractive error  
by service component and duty position.

Component	Active duty	Army Reserve	National Guard	Civilian
Aviator	23.5%	37.4%	39.2%	69.7%
Aeroscout	21.5%	50.0%*	33.2%	N/A
Flight surgeon	74.2%	73.3%	74.0%	N/A
ATC	29.6%	0.0%**	39.2%	67.2%

\* Number of encounters in this cell is small, N=4.

\*\* Number of encounters in this cell is small, N=4.

Appendixes A through D present the cross tabulations of the prevalence of refractive error by aviation occupation, service component, and rank. The tables show a consistent upward trend

in the need for refractive error correction with increasing rank in all groups, paralleling the observations of increasing prevalence with age by a previous study (Schrimsher and Lattimore, 1990). This is expected due to the correlation between increasing rank and increasing age.

Table 4 compares the annual period prevalence of refractive error in U.S. Army aviator service component cohorts between the 1990 aviator study (Schrimsher and Lattimore, 1990) and this study in 1992. An analysis of the variance in Table 4 shows there is a significant increase ( $p < 0.0001$ ) in the number of aviators requiring refractive error correction in all components from 1986 to 1992. A definite upward trend is seen in the Army Reserve and National Guard. The trend is less evident in the active duty cohort. This upward trend may be related to the appearance of a bimodal age distribution curve for Army aviators beginning in 1986. A marching cohort of older aviators emerged. By 1989, 50 percent of U.S. Army aviators exceeded the age of 38 (Mason, 1991). A larger proportion of middle-aged aviators would create a greater need for refractive error correction. With an older marching cohort now moving out of the Army since 1991 (Shannon, 1993), the upward trend in refractive error may level off or reverse, assuming entrance vision standards do not change.

Table 4.

Summary of prevalence of refractive error  
in U.S. Army aviator cohorts.

Component	1986	1987	1988	1989	1992
Active duty					
N=	13,410	14,237	12,038	14,352	11,399
Percent	21%	23%	23%	22%	23%
S.E.*	±0.69%	±0.69%	±0.75%	±0.63%	±0.77%
Army Reserve					
N=	1,949	2,578	2,211	2,237	1,867
Percent	25%	27%	28%	28%	37%
S.E.	±1.9%	±1.7%	±1.9%	±1.9%	±2.2%
Army National Guard					
N=	5,137	5,726	5,562	6,759	5,825
Percent	28%	32%	33%	35%	39%
S.E.	±1.2%	±1.2%	±1.2%	±1.1%	±1.3%

\* S.E. is the standard error of the percent

## Summary

The U.S. Army aviation command is making final funding and planning decisions on the fielding of a contact lens program for Army aircrew members. This report provides data requested by the planners. It stratifies the prevalence of refractive error by aviation duty position, service component, and rank.

There is an increasing prevalence of refractive error in the higher ranking aircrew members, paralleling increasing age with rank promotion. Comparing service components, the prevalence is higher in the reserve component and civilian forces than active duty forces. Within the aviator service component cohorts, there has been a significant upward trend in the annual period prevalence of refractive error from 1986 through 1992, especially in the Army Reserve and National Guard cohorts. This upward trend may be related to the observed upward trend in the average age of Army aircrew members as a group from 1986 through 1990.

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Appendix A

Prevalence of refractive error among aviators.

Table A-1.

Prevalence of refractive error by military rank  
for active duty aviators\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W1	1,229	1,180	49	4.0%
W2	2,360	2,130	230	9.8%
W3	1,364	1,088	276	20.2%
W4	1,048	468	580	55.3%
O1	395	356	39	9.9%
O2	783	688	95	12.1%
O3	2,245	1,795	450	20.0%
O4	1,132	749	383	33.8%
O5	670	247	423	63.1%
O6	162	20	142	87.7%
O7	3	0	3	100.0%
O8	6	0	6	100.0%
O9	2	0	2	100.0%
Total	11,399	8,721	2,678	23.5%

\* Prevalence period is 1 July 1991 to 30 June 1992

Table A-2.

Prevalence of refractive error by military rank  
for Army Reserve aviators\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W1	90	82	8	8.9%
W2	431	365	66	15.3%
W3	246	140	106	43.1%
W4	306	104	202	66.0%
O1	39	33	6	15.4%
O2	110	82	28	25.5%
O3	289	220	69	23.9%
O4	211	107	104	49.3%
O5	121	33	88	72.7%
O6	23	3	20	87.0%
O8	1	0	1	100.0%
Total	1,867	1,169	698	37.4%

\* Prevalence period is 1 July 1991 to 30 June 1992

Table A-3.

Prevalence of refractive error by military rank  
for Army National Guard aviators\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W1	311	295	16	5.1%
W2	1,527	1,070	457	29.9%
W3	830	417	413	49.8%
W4	1,078	372	706	65.5%
O1	167	148	19	11.4%
O2	543	463	80	14.7%
O3	703	537	166	23.6%
O4	360	181	179	49.7%
O5	219	54	165	75.3%
O6	78	5	73	93.6%
O7	7	0	7	100.0%
O8	2	0	2	100.0%
Total	5,825	3,542	2,283	39.2%

\* Prevalence period is 1 July 1991 to 30 June 1992

Table A-4.

Prevalence of refractive error for Department of the Army  
civilian and contract civilian aviators\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
Civ	621	188	433	69.7%

\* Prevalence period is 1 July 1991 to 30 June 1992

Appendix B.

Prevalence of refractive error among aeroscout observers  
and aerial fire support observers.

Table B-1.

Prevalence of refractive error by military rank  
for active duty aeroscout observers and  
aerial fire support observers\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
O2	1	1	0	0.0%
O3	1	1	0	0.0%
E1	3	3	0	0.0%
E2	9	7	2	22.2%
E3	44	37	7	15.9%
E4	172	142	30	17.4%
E5	104	80	24	23.1%
E6	50	34	16	32.0%
E7	11	5	6	54.6%
E8	1	1	0	0.0%
Total	396	311	85	21.5%

\* Prevalence period is 1 July 1991 to 30 June 1992.

Table B-2.

Prevalence of refractive error by military rank  
for Army Reserve aeroscout observers and  
aerial fire support observers\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
E4	2	1	1	50.0%
E5	2	1	1	50.0%
Total	4	2	2	50.0%

\* Prevalence period is 1 July 1991 to 30 June 1992

Table B-3.

Prevalence of refractive error by military rank  
for Army National Guard aeroscout observers  
and aerial fire support observers\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
O2	1	1	0	0.0%
E1	1	0	1	100.0%
E3	9	8	1	11.1%
E4	45	36	9	20.0%
E5	106	69	37	34.9%
E6	39	21	18	46.2%
E7	1	0	1	100.0%
Total	202	135	67	33.2%

\* Prevalence period is 1 July 1991 to 30 June 1992

Appendix C.

Prevalence of refractive error among flight surgeons  
and aeromedical physician assistants.

Table C-1.

Prevalence of refractive error by military rank  
for active duty flight surgeons and aeromedical  
physician assistants\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W2	6	3	3	50.0%
W3	10	5	5	50.0%
W4	2	1	1	50.0%
O1	4	1	3	75.0%
O3	73	18	55	75.3%
O4	61	19	42	68.9%
O5	26	4	22	84.6%
O6	16	0	16	100.0%
Total	198	51	147	74.2%

\* Prevalence period is 1 July 1991 to 30 June 1992

Table C-2.

Prevalence of refractive error by military rank  
for Army Reserve flight surgeons and aeromedical  
physician assistants\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W3	1	0	1	100.0%
O1	2	2	0	0.0%
O3	1	0	1	100.0%
O4	5	1	4	80.0%
O5	3	1	2	66.7%
O6	3	0	3	100.0%
Total	15	4	11	73.3%

\* Prevalence period is 1 July 1991 to 30 June 1992

Table C-3.

Prevalence of refractive error by military rank  
for Army National Guard flight surgeons and  
aeromedical physician assistants\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
W2	3	1	2	66.7%
W3	9	5	4	44.4%
W4	1	1	0	0.0%
O3	12	3	9	75.0%
O4	17	5	12	70.6%
O5	11	2	9	81.8%
O6	24	3	21	87.5%
Total	77	20	57	74.0%

\* Prevalence period is 1 July 1991 to 30 June 1992

Table D-3.

Prevalence of refractive error by military rank for  
Army National Guard air traffic controllers\*.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
O4	1	1	0	0.0%
W2	9	6	3	33.3%
W3	1	0	1	100.0%
W4	1	0	1	100.0%
E1	1	1	0	0.0%
E2	2	2	0	0.0%
E3	9	6	3	33.3%
E4	37	27	10	27.0%
E5	29	23	6	20.7%
E6	33	18	15	45.5%
E7	19	6	13	68.4%
E8	6	0	6	100.0%
Total	148	90	58	39.2%

\* Prevalence period is 1 July 1991 to 30 June 1992

Table D-4.

Prevalence of refractive error for Department of the Army  
civilian and contract civilian air traffic controllers.

Rank	Total	Refractive error?		Percent with refractive error
		No	Yes	
CIV	180	59	121	67.2%

\* Prevalence period is 1 July 1991 to 30 June 1992