
Pilot Ergonomic Work Assessment of Still and Video Photographers at Associated Press

Final Report

December 9, 2010

Prepared by

Manny Halpern, PhD, CPE

Ali Sheikhzadeh, PhD

Jangwhon Yoon, PhD

Rudi Hiebert, MA

Maneesha Kumar, MS

AP Pilot Ergonomic Work Assessment: Final Report

Table of Contents

Final Report	1
Results.....	2
Conclusion.....	3
Recommendations.....	4
Appendices	5
1. AP Photographers Study: Summary of general HR and injury data	6
2. Summary of AP 2009 Survey Comments.....	7
3. Profile of Job Demands: Physical Abilities & Work Conditions.....	15
4. Risk Summary Report.....	19
5. Usability.....	25
6. Safe Body Mechanics.....	28

Final Report

Associated Press has contracted the NYU Hospitals Center on behalf of the Occupational & Industrial Orthopaedic Center (OIOC) to conduct a Pilot Ergonomic Work Assessment of Still Photographers and Video Camera Operators at Associated Press. The purpose of the work was to 1) identify ergonomic issues specific to the photojournalism field that are related to musculoskeletal injuries, and 2) to develop injury control measures.

The SOW stated the consultant will review the injuries reported by the photographers of AP (Task 1) then perform an ergonomic assessment (Task 2) of job demands of the photographers using an on-line survey, focus groups and direct observations of selected tasks, measurement and analysis of physical load based on the data collected, such as videotapes, using biomechanical and physiological software where appropriate. A review of equipment was to be conducted by Associated Press with OIOC providing comments or some additional testing (Task 3). The OIOC was also to develop material for training to control risk factors for musculoskeletal injuries identified through the biomechanical analysis (Task 4).

This is a final report summarizing the findings reported in the various deliverables of the study and contains some recommendations for further action.

Results

Injury Patterns (Task 1 and 2.1)

The review of injury records (Appendix 1) revealed that in the period 2004-2008, the average annual prevalence of OSHA-recordable injuries among AP photographers was 9%; 65% of the 51 injuries in this time period occurred on field assignment. About 7 of the 15 injuries of the upper extremities were attributed to repetitive motions while all 7 back injuries were classified as overexertion. We concluded that the ergonomic intervention should address field assignment tasks and that an attempt to prevent musculoskeletal injuries may well focus on overexertion of the back.

The photographers survey conducted in 2009 (Task 2.1 – see Appendix 2) revealed that while more incidents go unreported, the trends are similar to the filed cases: 30% of respondents filed for WC as a result of their injury while 39% did not; none reported they were dissuaded by managers to report an injury. Of 60 responses, 49 mentioned back pain that went unreported; 6 of them were constant pain.

Job Analysis (Task 2.2)

Three focus groups yielded profiles of occupational demands for the combined job of still and video photographers (Task 2.2 – see Appendix 3). The profiles identified 29 tasks classified under 14 musculoskeletal abilities. These tasks were scored by the amount of physical ability required, the frequency and importance of the task. A statistical analysis revealed that the highly demanding tasks were not necessarily performed most often.

Four of the most demanding tasks were selected for biomechanical analysis:

1. *Stamina* – Carrying gear, run and shoot long events –golf event
2. *Static/Explosive/Trunk Strength* tasks – loading and unloading car trunk – simulated with several types of cars but standardized equipment
3. *Extend Flexibility* – Kneeling or sitting cross legged while twisting the trunk to shoot moving objects – basket ball game

4. *Arm-Hand Steadiness* – Keeping hands & arms steady while walking/running with hand-held cameras and shooting at a distance in low light – White House press conference.

In-depth analysis (Task 2.3-2.4)

The in-depth analysis relied on videotapes of the four most physically demanding tasks identified in the structured focus group interviews. Several tapes were prepared for OIOC and frames were selected for further analysis using software that predicts static strength requirements for activities involving lifts, presses, pushes, and pulls. The program provides an approximate job simulation that includes posture data, force parameters and male/ female anthropometry. In addition to the biomechanical analysis, an estimation of energy consumption has been added, using another software simulation (see Appendix 4).

The analysis focused on 1) peak disc compression forces acting on the spine and 2) tolerance of moments of various joints, 3) stamina required in terms of energy consumption:

1. *Disc compression.* The loading and unloading of backpack and wheeled bag from a sedan are the most demanding task. With forces between 795-1210 lbs, they exceed NIOSH safety limits and pose a risk for the lower spine of the large male as well as the smaller female (see Figure 1).
2. *Moments.* The unloading of backpack and wheeled bag from a sedan car pose risks to the lower extremities (hip, knee ankle) of both the male and female population. For example, bending to unload a 20 lbs backpack from the trunk of a sedan car keeping both knees straight close to the bumper generates moments around the knees that may not be possible for about 80% of the male population and a third of the smaller females.
3. *Stamina.* Covering the golf events has been mentioned as a high stamina task and its elements were described in a detailed interview with a photographer. The risk was assessed by comparing the average energy expended for a task element against a maximum work capacity estimated for the individual and against a maximal expenditure allowable for continuous work time. While the metabolic demand of the assignment as a whole is acceptable, some specific elements are of concern: carrying and running (particularly dashing for 30 yards) and transporting gear to the car. The energy expended during carrying would require of females 4.5 - 5.4 kcal/min and 5.4 - 6.1 kcal/min for males. These demands are considered ‘heavy’ for the whole body and ‘very heavy’ for the upper body if carried out for more than 2 hours continuously.

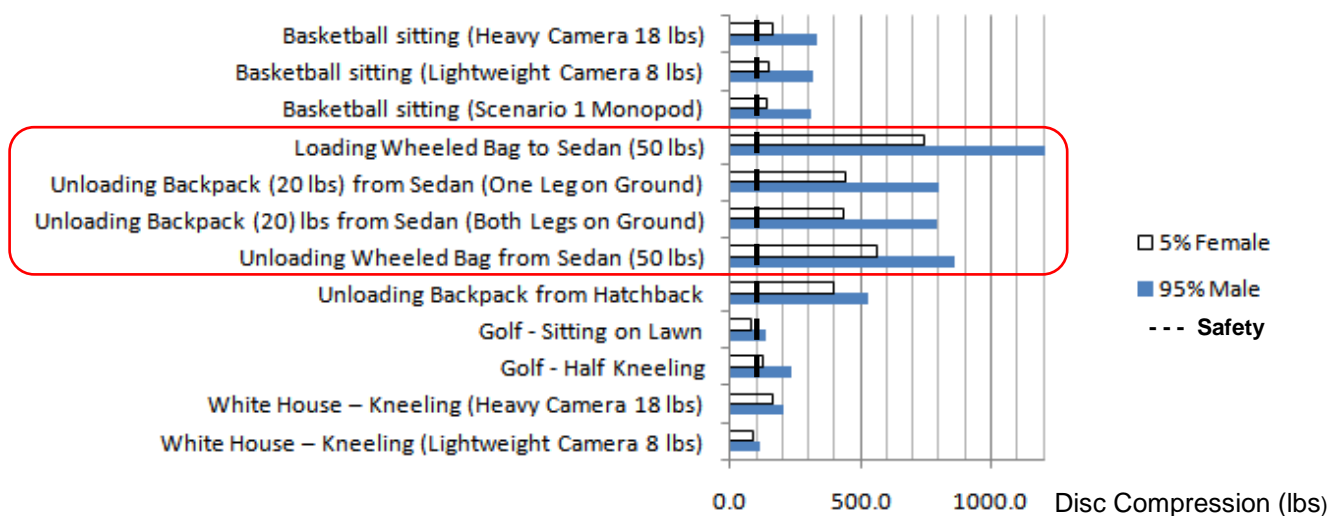


Figure 1. Spinal disc compression forces (lbs) acting on males and females during the performance of various tasks (see Appendix 4 - Table 4-1)

Review of equipment (Task 3)

The task focused on *usability features* of equipment selected by a focus group of two photographers and one video-journalist. This corresponded to some of the recommendations in the survey (Task 2.1 above) to create a list of recommended gear based on input from the photographers that would be used for procurement and assignment decisions.

The focus group generated a list of equipment used by photographers and the features expected from it considering the assignment and gender of the user. The list was compiled into a table counting the frequency of occurrence of the features (see Appendix 5):

1. The *features most commonly required* are: variable sizes, light weight materials and sturdy handles.
2. The *equipment with the most complex requirements* (highest number of features to consider): backpack, sling bag and rolling case.
3. The *most complex event* in terms of the equipment required: sporting events, followed by natural disasters and the 'day to day regular assignments'.
4. The *equipment with most varied use* (highest number of assignments where the equipment is in use): backpacks, followed by mono/tri-pods, fanny/waist packs, belt/harness/vest systems.

This type of review can guide us in focusing future efforts for selecting of equipment.

Training material (Task 4)

Based on the biomechanical analysis, safe body mechanics recommendations targeted the following (see Appendix 6):

1. Loading to and unloading from sedan/hatchback trunk
2. Photographing
3. Carrying gear
4. Pulling gear
5. Joint-specific recommendations (neck/shoulder, back, knees/legs)

To improve comfort, the safe biomechanics recommendations also addressed equipment and gear. Specifically, it suggested targeting lighter cameras for press conferences as well as pods to reduce kneeling. It further suggested targeting the coverage of long sports events for *engineering* solutions - lighter gear that is easier to handle - as well *administrative* solutions - assigning more than one photographer to an event and promoting general aerobic fitness.

Conclusion

A review of OSHA logs filed by AP photographers in 2004-2008 revealed a need to prevent back injuries due to overexertion. A survey conducted in 2009 further revealed that many cases of back pain go unreported. Focus groups of photographers acted as subject matter experts and generated a profile of job demands based on the physical abilities required for various tasks. Compared to the DOL O*NET database, the news photographers reported much higher amounts of physical ability required for the job than Camera Operators, TV, Video, and Motion Picture photographers (code 27-4031.00), except for multi-limb coordination and manual dexterity. News photographers are also exposed to different work conditions. Four physically demanding tasks were selected as targets for in-depth analysis.

Several limitations should be noted while assessing the risks involved in these tasks, such as a selection bias - the analysis was based on video clips demonstrating selected activities by a single photographer in each case where others may behave differently - and software limitation, resulting in either overestimation or underestimation of the physical demands. Furthermore, this project focused as stated earlier on overexertion injuries that are the result of peak forces. Some of the problems may be the result of cumulative exposure to forces. These effects cannot be assessed with this study design.

Overexertion of the back was found while loading and unloading bags and backpacks (20-50 lbs) from the trunk of a sedan car. These activities generated high compression forces on the disc of the lower spine. These tasks are also expected to generate high forces acting on the lower extremities of both males and females, mainly the hips and knees.

Shoulder forces may be the limiting factor while kneeling using heavy cameras (18 lbs) for photographing events such as press conferences.

The focus groups claimed that high stamina is required for covering of long sports events such as golf tournaments. Further analysis confirmed that high energy needs to be expended mainly during intermittent carrying and running with about 39 lbs of gear and cameras for more than 4 hrs a day and the transporting of the gear to and from the car.

The review of the usability features of the equipment and gear can guide us in focusing future efforts for selecting of equipment. Several strategies can be deployed. One can use backpacks as a starting point for a review, looking for products that are light in weight, come in various sizes and have sturdy handles. This strategy is the most complex but one which will have the largest impact. This should follow by rolling cases and folding carts, two items the usability focus group pointed out are a serious concern for those who travel a great deal; it also takes into account the needs of video-journalists. Another approach is to start solving the simpler cases first such features of hatchback cars, rotating floor seats and mono/tripods.

Recommendations

1. Create a formal process for reviewing usability of market innovations. The review could be part of the activities of a safety committee.
2. Consider using an ergonomic consultant to help the safety committee in addressing the usability of equipment in a systematic periodic review. The OIOC would be interested in providing the consultation as a service agreement.

Two additional recommendations emerged from the latest survey and were reinforced by this study:

3. Consider using an outside consultant for the development of a wellness program with strength and aerobic fitness as the key building block for such a program.
4. Develop comprehensive training and proactive injury prevention program, which would coordinate the wellness with the safety and comfort issues.

Appendices

1. AP Photographers Study: Summary of general HR and injury data
2. Summary of AP 2009 Survey Comments
3. Profile of Job Demands: Physical Abilities & Work Conditions
4. Risk Summary Report
5. Usability
6. Safe Body Mechanics

Appendix 1
AP Photographers Study:
Summary of general HR and injury data

Prepared by
 Manny Halpern, PhD

September 30, 2009

In the years 2004-2009, AP employed 108-119 photographers, about 85% of them are males. The data do not distinguish between video and still photographers.

In this time period, the average annual prevalence of OSHA-recordable injuries among photographers was 9%. The records do not systematically state what body part was injured, the nature of the injury or the event associated with it. We attempted to recode the data using these terms.

Here are highlights of the recoded data supplied by AP:

- There were 51 injuries reported in 2004-2008
- 65% of the injuries occurred on field assignment.
- The average time away from work was 9 days.
- The most prevalent injuries (see Table 1) occurred in the upper extremities (15), followed by the lower extremities (12). There were 7 back and 7 head injuries. (*Note:* In 23% of the records, no body part is mentioned.)
- The most common events (see Table 1) could be classified as overexertion injuries and slips & falls (13 each). There were 7 events that have been classified as repetitive motion injuries, and 7 ‘struck by’. In some cases, multiple body parts were recorded.
- All back injuries were classified as overexertion. About 86% of the head injuries were the result of being struck by an object. About 66% of the lower extremity injuries were due to slips & fall. Half of the upper extremity injuries were due to repetitive motions.

Table 1-1. Summary of the number of injuries recorded 2004-2008 by body part and event associated with the injury

body part		event	
upper extremity	15	overexertion	13
lower extremity	12	slip & fall	13
multiple	7	repetitive motion	7
head	7	struck by	7
back	7	laceration	5
n.d.	12	n.d.	3

Conclusion

The ergonomic intervention should address tasks on field assignment. An attempt to prevent musculoskeletal injuries may well focus on overexertion of the back. It is not clear yet to what extent these interventions will affect the upper extremities or prevent slips & falls.

Appendix 2**Summary of AP 2009 Survey Comments**

Prepared by
Hilda Auguste
Compiled by
Manny Halpern, PhD

February 10, 2010

The following three items yielded numerous comments:

- Is there anything you wish to add related to your use of work equipment?
- Examples of any situation(s) you have encountered where you felt inadequately equipped.
- Do you know of any lighter job-related gear or equipment that can be used?

The comments were compiled into several categories and summarized below.

Management:

- Create a list of recommended gear based on input from the photographers that would be used for procurement and assignment decisions
- Allow flexibility in selection of gear for assignment - choosing the gear that fits the person and the job
- Allocation of gear varies by region, where some local management is responsive
- Photographers provide their own equipment when management is not responsive
- Gear should be determined for sporting events, riots, storms (snow, hurricane), wild fires, epidemics, terror
- Gear is constantly evolving so selection of equipment should be on-going

Equipment:

- Smaller and lighter laptops, considering the field requirements rather than computing power
- 15" Mac
- Rain gear for cameras
- Safety gear
- Riot gear (facial mask?)
- Protection in epidemics (facial mask?)
- Bullet proof vests, body armor
- Telephoto lens
- Gas mask, filters
- Fire-retardant clothing
- 4-wheel drive
- Satellite telephones
- **Cameras:**
 - Canon 7D; Canon 5D
 - Leica M9 digital camera
 - Nikon
- **Lenses:** Lighter lenses for sporting events
 - Nikon 200-400
 - Canon 70-200mm f/4 IS, Canon 300mm f/4 IS
 - 28-300 zoom lens
 - 70-200 f/4, 400 f/4 DO for daylight sporting events

- **Mounts:**
 - shoulder mounts for EX1 and EX3
 - Thinktank sports shooter belt and harness
 - carbon fiber monopod
- **Cases:**
 - Lightware RMF-1629

Training:

- On-going training on developments in digital photography
- Training in how to use the gear

Services:

- Massage therapy/physical
-

SELECTED QUOTATIONS FROM THE 2009 SURVEY

Is there anything you wish to add related to your use of work equipment?

1. Our jobs require us to carry heavy gear, move in awkward positions, and work under stressful conditions. However, what AP can do it to help us deal with those conditions. Pay for **massage therapy/physical therapy and other non-medical services** that can help us recover after working hard to deliver quality content for the AP. We are a team. Just like the football players get iced down after a game, we need to be taken care of so that we can get out there and compete.
2. It would be helpful to have **standardized lists of equipment that photographers have found that work especially well (portable laptop tables, wheeled bags, security systems, etc.) that could be shared with everyone**, rather than all of us trying to invent the wheel on our own.
3. Definitely would be good if there were **recommended gear** and managers would be prepared to authorize the expense to purchase it.
4. I understand that we can't be upgraded every time a new piece of gear comes out, but some of us are using very old equipment, producing a inferior product and heavier to boot. Also, **management does not seem to listen to our ideas for what gear might work**. We ask for **smaller computer**, but they are more interested in computing power. Most photogs would gladly trade computing power for less weight. This is one of many examples. I don't know a single photog that does not suffer from bad backs, shoulders, legs, etc. because of too much gear.
5. I have requested additional training, better equipment, a good computer (I can not say enough good things about the local Photo Editor and Chief of Bureau) but my requests fell on totally deaf ears in NY. I was promised a replacement Mac computer (I was using my personal computer) for eight months but **was finally given a PC** -- ironically the three oldest photographers in the state were given PC computers while the four younger ones were given Macs, given video training and out of state assignments. I have talked to NY Photo Editor and HR but nothing. Sad!
6. It would be nice to be able to **pick the lenses we feel we need** to best do the job rather than everyone be outfitted with the same basic kit.
7. While I'm happy with the bulk of my gear, I don't think we've received **training** on how to use it to its maximum capabilities. While I know some have a problem getting proper gear, I think not being **trained as digital equipment develops** is also a concern.
8. I love the AP and I love being a photojournalist. It can be physically demanding work but it is also the work I have chosen. If money were no object, then I would make choices to use certain kinds of gear that is lighter weight (sometimes this is the latest and greatest and most expensive stuff). It is possible to do but the **policy of insisting that most everyone use the same gear**, albeit excellent gear, **precludes the concept of choosing the gear that fits the person and the job**. When I started at the AP, I could fit ALL of my cameras and lenses in a standard shoulder bag like the well-known Domke bag. But it is a moot point. Today's **digital gear is twice as big, heavier, and less ergonomic than when we used film cameras**. I prefer and love doing digital photography but its just a fact that the stuff is more of a load. I think that if there is a good reason for a shooter to have equipment that is different than the standard kit, then it ought to be considered. I have just finished my 2nd total knee replacement. No doubt, the debt owed for the work I love. -- Scott Applewhite
9. Equipment is part of the job but realistic expectations from managers would help, as would **proper training** and replacement of gear with lighter models as they become available.
10. Photographers working 10 years or more will have neck/back/shoulder/knee problems due to the physical nature of our assignments. **Therapeutic massage** should be covered in our health plan.

Examples of any situation(s) you have encountered where you felt inadequately equipped.

1. Some in the past, but local AP management has mostly been responsive to requests to correct that.
2. G20 Protests in Pittsburgh. Pittsburgh bureau staffers were given safety equipment and briefings in advance. I was not even told in advance I was covering protests.
3. Day sporting assignments, when I am using long lenses that are designed for low light and are very heavy. I could be using lighter lenses to do the same work and less strain.
4. sports and weather events where we provide our own Gore Tex gear.
5. We are routinely in harms way with no method of protection, especially with regard to medical exposure to various diseases, like waiting for a plane to arrive in the US from Mexico on the first day of the swine flu pandemic.
6. any shooting event, gunman trapped, etc...no bullet proof vest
7. snowstorms...a 4 wheel drive vehicle
8. For wildfire coverage, I have my own Nomex equipment, including an out-dated fire shelter, rather than company-provided equipment.
9. Mainly hurricanes...each is different.
10. There is no rain gear for my camera. This is a constant issue: trying to keep the camera dry in wet conditions.
I also would like a shoulder mount and telephoto lens to shoot things happening very far away, for example the perp walk of Yale killing suspect, 100 yards away in the back of a hotel. It was hard to get the shot, especially with police forbidding the use of tripods. I needed a shoulder mount and telephoto lens to get that shot properly.
11. Riots-Did not have any safety gear
12. Covered fires without sufficient equipment. Covered military assignments where body armor had to be borrowed from military. Covered hurricanes with personal PFD and waterproof gear.
13. Working in NY, photogs should be equipped to deal with terror attacks, esp if we are expected to photograph them. We have one mask for our department, and its sitting in the office. A total joke.
14. My gas mask was used five years ago, the filters have never been replaced. No bullet proof vests
15. I've covered hurricanes, wildfires and floods and the issue of safety equipment meant appealing to govt. agencies and fire departments for equipment necessary to do the assignment and fire retardent clothing almost always had to be returned. Was never trained to use or issued Sat phones for hurricanes/floods, where cell phone use was sketchy at best. Budget concerns force us to use phone service with bad coverage in general, let alone working in an area with compromised wireless phone service.
16. I believe the AP and my AP managers take my health and safety seriously. I've NEVER been denied access to supplies when covering hazardous jobs. Most of the wear and tear on our bodies comes from the routine, day-in and day-out work.
The amount of weight we carry increased when going digital and when we began to be a one-man-band doing the photography and editing that demanded the use of computers and transmitting equipment which are required to be with us at all times. I understand that AP provides pretty much the same equipment to everyone and with good intentions. Though, I do think there should be more PERSONAL OPTIONS tailored to the kind of assignments we cover regularly. A photog who works in low light situations at the Capitol might use different gear than a sports or general assignment shooter. OVERALL I believe my managers equip me with high quality professional gear that is top quality for the assignment. There's just a lot of it!
17. Sent into riots at GOP Convention with no riot gear...not even a mask.
18. In the past, generally AP has always taken longer than the competition, incorporating the latest photo, computer equipment, and communication upgrades needed to compete in this

technology driven field. Many times I had to purchase my own gear: laptops, lighter smaller cameras, lighting gear, smarter phone and software solutions to catch up with the competition on daily bases.

19. I have supplied myself with or without AP's help. When I've encountered a manager that is uncooperative I have gone ahead and got what I needed.
20. riots-at that time had no safety gear available
21. Tropical storms and flooding situations I don't have enough rain gear to adequately protect the cameras and have been concerned about getting my car into/out of dangerous areas. Office clothing requirements (shoes and pants) have made spot news outside in cold, hot, flood, etc conditions dangerous (inadequate clothing/footwear). I think office clothing is typically inappropriate for the work photographers do but managers seem not to appreciate this.
22. We are not properly equipped to cover wildfires
23. I have no wildfire gear. I was ordered some rain gear for hurricane season but it has not been delivered to me.

Do you know of any lighter job-related gear or equipment that can be used?

1. Gear is constantly evolving. There is always lighter, better and more durable equipment on the market.
2. Camera: Canon 7D; Canon 5D
Lenses: Canon 70-200mm f/4 IS, Canon 300mm f/4 IS
Cases: Lightware RMF-1629
3. The Leica M9 digital camera system weighs approximately one half of Canon digital equipment
4. The Nikon bodies are lighter, they also make a long lens zoom, the 200-400, that is much lighter and more useful than the long glass we carry.
5. roller bags, carbon fiber monopods/tripods
6. 28-300 zoom lens
7. A 400 f/4 lens weighs about 1/3 as much as the 2.8 and could, on occasion, substitute for the f/2.8.
There may be lighter roller bags available, which could help for lifting them, especially into overhead compartments.
8. A 15 inch Mac instead of a 17 inch.
9. There are smaller MacBook pro computers. As for the long telephoto lenses used in sports photography, there are some, but they might be compromises.
10. newer Canon 7D cameras, newer think tank sports shooter belt and harness.
11. I think any shoulder-mounted camera, including an accessory shoulder mount for the EX1 or the shoulder-mount that comes with the EX3 should be standard.
12. THE VIDEO CAMERA IS THE MAIN ISSUE. A GOOD BROADCAST QUALITY CAMERA WILL ALWAYS BE HEAVY. THERE ARE SMALLER PRO-SUMER CAMS THAT VJ'S AND REPORTERS USE, BUT QUALITY IS NOT AS GOOD.
13. YES! Smaller computers, newer cameras have are lighter and have smaller batteries.
14. Yes- lighter tripods are available.
15. For the most part no, but there are some lighter lenses that could be used for daytime sports assignments. This would include lenses like the 70-200 f/4, 400 f/4 DO
16. some lenses for daytime sports, news and events are lighter but useless for nighttime or low light use
17. lighter laptops, lighter cameras, fixed lenses weigh less than zoom lenses.
18. No. But we must be provided with up-to-date roller bags to carry the stuff. Job not possible otherwise.
19. Yes, we need E-SAPI plates for ALL body armor, they will save a total of 8 lbs.

20. Professional photo bags and rolling cases e.g. <http://www.thinktankphoto.com/>
Lighter, smaller Computers, PDA: Sony, Apple
Lighter Flashes: Profoto
Lighter Tripod Monopod made of Carbon composite materials.
Photo vests and Belts.
21. lighter camera's/lenses for non-sporting events
22. The 5D Mark II is the lighter body, a second 5D would lighten some of the load. A lighter midrange lens is also available. I am considering a lighter beltback as well.
23. No. But, the rolling case I have for travel was purchased with my own money.
24. yes. netbooks
25. Most of the gear is pretty light -- the Z1 is fairly light, i have a carbon tripod and boom pole. The problem is the assemblage of all the material at once. I got a cart last year which has helped, and perhaps a backpack and a carbon fiber monopod would help in some situations.
26. I think Nikon gear is lighter...not sure.
27. yes, Canon 5d Mark 2, or Canon 7D
28. SMALLER LAPTOPS
29. Rolling cases

List of equipment and weight carriage

NMG survey:		2004:	2009:
weight carried in lbs	avg	33	35
	sd	20	16
	mode	25	20
	median	30	30
	max	50	180

Video Journalist :

<u>camera:</u>	<u>mount</u>	<u>weight lbs</u>	<u>location</u>
Sony PDW-F355	shoulder	25	DC
Sony DSR-570	shoulder	24	NY, CA
Sony PMW-EX3	shoulder?	12	Atlanta, Dallas, Chicago
Sony PMW-EX1	hand	12	NY, LA, SF NY, Nashville, DC, Miami,
Sony HVR-Z1U	hand	11	LA
Sony PD150/70	hand	10	NY
Canon HV20/30	hand	4	various

Video journalist issued gear (weight):	lbs	DC, NY, Chicago, Dallas, Atlanta, LA, SF and Miami
light kits	40	
video tape recorders	20	
satellite phones & data transmission	30	
cables and accessories	50	

Travel - video journalist

2 square hard-sided cases weighing approx 50 lbs each,
 1 long, round hard-sided case weighing approx 30 lbs,
 1 rolling camera case weighing approx 30 lbs,
 1 laptop backpack weighing approx 20 lbs.
 a 250 lb capacity rolling cart to transport these items through airports, rental car locations, hotels, etc.

Survey 2010: List of equipment mentioned

Canon Mark III	35	Canon III
2- 5d's	13	Canon II
Canon 1D Mark II	8	Sony
Canon 1D N		
Canon 5D Mark II (with vertical grip applied and two batteries, and the Canon Mark II.		
Canon 5D Mark II and Canon 1D Mark II		
Canon 7D and 5D		
Canon D5, Canon D20		
Canon Digital EOS-1 Mark III		
Canon digitals		
Canon DSLR		
Canon Eos 1D Mark II & III		
Canon EOS Mark III Digital SLR		

Canon EOS-1D Mark III Digital Still
 Cameras
 Canon Mark III, Sony EX1 EXDCAM (video), Canon 5D (video, still)
 Canon Mark 3, Still Camera
 Canon Mark EOS 1D Mark III camera
 canon mark III and 5D it would be better two have at least two mark III's for sports
 Canon Mark III and 5d Mark II
 Canon Mark III, Canon MarkIII5D, Canon Video camera XHA1
 Canon still cameras
 mark3 and ex1 Sony
 Nikon D3
 Nikon D300s, Canon MarK 3
 numerous Canon digital cameras
 Sony EX1
 Sony PMW EX3
 Sony PMW-EX2
 SONY XD CAM 355 PDW-F-355
 Sony Z1U, Sony ZUI

Camera lenses ()		Popular cameras		
Canon EF lenses	lbs		oz	lbs
EF16-35 mm f/2.8L USM	1.3	Canon III	42.5	2.6
EF24-70 mm f/2.8L USM	2.1	Canon II		
EF70-200mm f/2.8L IS USM	3.2	Canon 7D	31	1.9
EF 300 mm f/2.8L IS USM	5.6	Canon 57Mark II	30.7	1.9
EF 300 mm f/4L IS USM	2.6	Nikon D3/D3s	45.9	2.8
EF 400mm f/2.8L IS USM	11.7	Nikon D700	37.2	2.3
EF 500 mm f/4L IS USM	8.5			incl batteries
EF 600mm f/4L IS USM	11.8			incl batteries
Extenders EF 1.4x II	7.8			
Extenders EF 2x II	9.3			
Nikon Nikkor lenses	lbs		oz	
14-24mm f2.8	2.2		35.3	
24-70mm f2.8	3.2		31.7	
300mm f2.8	6.3		51.9	
400mm f2.8	10.1		148.54	
500mm f4	8.5		136.8	
600mm f4	11.1		179.2	

Appendix 3

AP Profile of Job Demands

Prepared by
Manny Halpern, PhD

March 31, 2010

TITLE: AP Photographers/ Videographers

PHYSICAL ABILITIES

Ability	#	Task			Frequency	Importance
Far Visual Acuity:	1	Select a target for a shoot			Several times/hr	100%
Near Visual Acuity:	2	Looking at the very fine print on the view finders of the camera			Several times/hr	100%
	3	Editing image and video on a computer			Hourly	100%
Visual Color Discrimination:	4	Estimate color temperature to set color balance in camera			Daily	100%
	5	Using photo graphic editors on a computer			Hourly	100%
Hearing-Quiet:	6	Listening to audio while editing video recording			Weekly	83%
Hearing-Noise:	7	Interviewing people in a crowd			Daily	77%
	8	Listening to instructions on a loudspeaker or phone in a crowd			Daily	83%
	9	Eavesdrop on your competition in the field			Weekly	77%
Hearing - Location:	10	Use the ears to sense approaching danger			Weekly	94%
	11	Use the ears to select targets for a shoot			Daily	89%
Hearing Discriminate:	12	Determine whether an unusual sound presents a danger			Monthly	97%
	13	Determine whether a sound is important to selecting a target for a shoot			Daily	91%

Ability	#	Task	Amount		Frequency	Importance
			Mean	S.D		
Stamina:	14	Carrying gear (2-3 cameras, lenses, pack and pods), run and shoot long events (rallies, football games, following the president)	71%	10%	Weekly	94%
	15	Walk 1-2 miles through wooded areas or other difficult terrain while carrying gear	63%	16%	Monthly	86%
	16	Set up lights and backdrop for video interview in 1/2 -1 hour of sustained effort	31%	16%	Monthly	54%
Static Strength:	17	Pushing/pulling wheeled gear cases (up to 50 lbs)	64%	8%	Daily	89%
	18	Lifting gear in and out of car trunks (loading and unloading)	75%	7%	Daily	100%

	19	Carrying camera gear for over 4 hours alone in a football game or golf tournament	75%	21%	Weekly	100%
Explosive strength:	20	Lifting gear in and out of car trunks (loading and unloading)	61%	18%	Daily	93%
	21	Pick up gear (camera with lens and pod) in less than 10 seconds to shoot during stake outs, breaking news events and some sports events	68%	14%	Hourly	100%
	22	Sprint/maneuver quickly into position while carrying gear (cameras and monopod)	61%	18%	Hourly	100%
Dynamic Strength:	23	Holding a camera in place for a shoot with hands unsupported	57%	0%	Several times/hr	100%
	24	Holding the body in standing, squatting, or cross-legged positions during a shoot	54%	18%	Hourly	96%
Trunk Strength:	26	Lifting gear in and out of car trunks (loading and unloading)	61%	18%	Daily	93%
	27	Leaning over barricade or a crowd to get photograph	61%	18%	Daily	93%
	28	Twisting the trunk while carrying wide gear packs through crowds	54%	21%	Hourly	82%
Extent Flexibility:	29	Holding cameras up above head to shoot over the crowd ("Hail Mary")	51%	13%	Daily	74%
	30	Kneeling or sitting cross legged while twisting the trunk to shoot moving objects, i.e. basketball	60%	19%	Daily	83%
Dynamic Flexibility:	31	Rapidly and repeatedly change cameras and aim while following sport events	61%	14%	Several times/hr	100%
	32	Move video camera in horizontal sweeping motion	43%	0%	Several times/hr	86%
Speed of Limb Movement:	33	Move video camera in horizontal sweeping motion	43%	0%	Several times/hr	86%
	34	Ejecting quickly camera from tri-pod to get a better angle or catch a moving object	57%	0%	Daily	86%
	35	Rapidly change camera lenses, tripods	54%	29%	Hourly	79%
Whole Body Coordination:	36	Shooting while running forward	57%	14%	Weekly	86%
	37	Shooting while running backwards	77%	16%	Weekly	89%
	38	Running through a crowd with equipment, balancing bags and cameras, maneuvering through narrow spaces	66%	8%	Weekly	86%
Whole Body Equilibrium:	39	Balancing on a ladder with a camera while shooting	51%	13%	Daily	83%
	40	Climbing trees, steps, benches to get a picture	54%	12%	Weekly	80%
	41	Walking/running on slippery and unstable surfaces like ice, flood or storms	60%	12%	Weekly	83%
Arm-Hand Steadiness:	42	Move video camera in horizontal sweeping motion	57%	0%	Several times/hr	100%
	42	Keeping hands and arms steady while walking/running with hand-held cameras and shooting at a distance in low light	77%	8%	Daily	94%

Multi-Limb Coordination:	44	Talking on the phone while shooting	46%	12%	Daily	66%
	45	Using computer while in jostling vehicle	61%	7%	Weekly	64%
Manual Dexterity:	46	Doing quick lens and camera switches	57%	23%	Hourly	86%
	47	Screwing the camera on a pod	43%	20%	Daily	74%
	48	Zooming camera with one hand and adjusting buttons with the other hand	69%	19%	Several times/hr	97%
Finger Dexterity:	49	Editing image and video on a computer	69%	6%	Hourly	97%
	50	Texting on a smart phone (e.g. Blackberry)	60%	16%	Daily	69%
	51	Controlling with either hand various buttons on the camera without looking	71%	0%	Several times/hr	94%

TITLE: AP Photographers/ Videographers
**WORK
CONDITION**

	Work Condition	EXPOSURE			Frequency/ Duration	
		Rate	S.D.	Description	Description	Rate
Climate	Inside			Protected from weather	5-7 Hrs/Day	76%
	Outside			Exposed to weather	5-7 Hrs/Day	76%
	Low temperature	84%	8%	Average temp. between 15-25°F	5-7 Hrs/Day	72%
	High temperature	80%	13%	Hard manual labor above 80°F	5-7 Hrs/Day	88%
	Sudden temperature changes	44%	20%	Temp. changes of more than 40°F	3-5 Hrs/Day	64%
	High humidity	72%	16%	Very, very wet humid, muggy	5-7 Hrs/Day	84%
	Low humidity	65%	9%	Dry	5-7 Hrs/Day	75%
Chemical Substance	Wetness, rain or snow			Arms and hands immersed	5-7 Hrs/Day	72%
	Non-ionizing radiation			Exposed to ultraviolet light	5-7 Hrs/Day	80%
Safety	Infections	47%	19%	Requires some precautions	3-5 Hrs/Day	60%
	Heights	92%	16%	Work at at height above 16 feet	1-3 Hrs/Day	36%
	Altitude (air pressure)	48%	20%	Elevation up to 8000 feet	0-1 Hrs/Day	20%
	Noise			Steady wide frequency noise (Very loud)	3-5 Hrs/Day	68%
	Body injuries	56%	29%	Severe cuts, broken bones	1-3 Hrs/Day	20%
	Electrical hazards			Contact with electrical hazards		40%
	Slippery surfaces	68%	32%	Moderately hard to traverse	3-5 Hrs/Day	60%
	Moving objects	48%	24%	Extraordinary safety required	3-5 Hrs/Day	64%
Psychosocial	Awkward body position	76%	32%	Moderately cramped (Limited flex)	Weekly	64%
	Job complexity	84%	20%	On-The-Job Training Required		
	Working alone			Physical isolation from others	5-7 Hrs/Day	20%
	Working with others	72%	20%	Frequent and necessary		
	Role ambiguity	56%	15%	The job is fairly routine		
Others	Irregular work hours	64%	8%	Occasional overtime and schedule changes		
	Driving			Operation of motor vehicle	3-5 Hrs/Day	55%
	Video display terminals			Work within six feet of CRT	3-5 Hrs/Day	68%

Appendix 4

Risk Summary Report

Prepared by
Manny Halpern, PhD, CPE
Ali Sheikhzadeh, PhD
Jangwhon Yoon, PhD
Rudi Hiebert, MA
Maneesha Kumar, MS

September 7, 2010

The Statement of Work for this project covers the tasks needed to identify ergonomic issues specific to the photojournalism field that are related to musculoskeletal injuries, and to develop injury control measures.

The SOW states the consultant will review the injuries reported by the photographers of AP then perform an ergonomic assessment of job demands of the photographers using an on-line survey (Task 1), focus groups (Task 2) and direct observations of selected tasks, measurement and analysis of physical load based on the data collected, such as videotapes, using biomechanical and physiological software where appropriate (Task 3).

This is a risk summary report based on the results of the psychometric and biomechanical analyses and survey results.

Results

OSHA logs¹

The review of injury records revealed that in the period 2004-2008, the average annual prevalence of OSHA-recordable injuries among AP photographers was 9%; 65% of the 51 injuries in this time period occurred on field assignment. About 7 of the 15 injuries of the upper extremities were attributed to repetitive motions while all 7 back injuries were classified as overexertion. We concluded that the ergonomic intervention should address tasks on field assignment and that an attempt to prevent musculoskeletal injuries may well focus on overexertion of the back.

Survey²

The photographers survey conducted in 2009 (Task 1) revealed that while more incidents go unreported, the trends are similar to the filed cases: 30% of respondents filed for WC as a result of their injury while 39% did not; none reported they were dissuaded by managers to report an injury. Of 60 responses, 49 mentioned back pain that went unreported; 6 of them were constant pain.

¹ Results prepared by Hilda August 8/25/09 and summarized by OIOC 9/30/09.

² Results prepared by Hilda August and reviewed 2/2/10.

Focus Groups³

The focus groups (Task 2) identified 29 tasks classified under 14 musculoskeletal abilities⁴. These tasks were scored by amount of physical ability required, the frequency and importance of the task. The frequency and amount showed a weak negative correlation (-0.2), i.e., the highly demanding tasks were not necessarily performed most often. Four of the most demanding tasks were selected for biomechanical analysis:

1. *Stamina* – Carrying gear, run and shoot long events –golf event
2. *Static/Explosive/Trunk Strength* tasks – loading and unloading car trunk – simulated with several types of cars but standardized equipment
3. *Extend Flexibility* – Kneeling or sitting cross legged while twisting the trunk to shoot moving objects –basket ball game
4. *Arm-Hand Steadiness* – Keeping hands & arms steady while walking/running with hand-held cameras and shooting at a distance in low light – White House press conference.

Video Analysis

Task 3 of the ergonomic assessment entailed an in-depth analysis of videotapes of the four most physically demanding tasks identified in the structured focus group interviews. Based on instructions provided to NMG, several tapes were prepared for OIOC. The videotapes were viewed and frames were selected for further analysis. The selected frames were analyzed using the 3D Static Strength Prediction Program (Center for Ergonomics, University of Michigan: Ann Arbor, MI). The software predicts static strength requirements for tasks such as lifts, presses, pushes, and pulls. The program provides an approximate job simulation that includes posture data, force parameters and male/ female anthropometry. Output includes the percentage of men and women who have the strength to perform the described job, spinal compression forces, and data comparisons to NIOSH guidelines. The energy expenditure was assessed for a task requiring stamina, using the Modified Garg Tool (available from ErgoWeb).

Spinal disc compression

Excessive spinal disc compression is one measure of risk of low back injury. Using the video clips of several photographers performing the four tasks, we analyzed the postures these individuals adopted for the task they demonstrated and used an anthropometric database to project the findings to a range of the populations (5% of females shorter than the small woman and only 5% of the males are taller than the large man). The compression of the discs at the lower back (L5/S1) are provided below as forces (pounds lbs). The closer the load is to a safe limit, the higher the risk of injury. The National Institute of Occupational Safety and Health (NIOSH) states that the safe limit for L5/S1 disc compression force is 765 lbs.

³ AP job profiles were emailed 3/31/10

⁴ Compared to the DOL O*NET database, the news photographers reported much higher amounts of physical ability required for the job than Camera Operators, TV, Video, and Motion Picture photographers (code 27-4031.00), except for multi-limb coordination and manual dexterity. News photographers are also exposed to different work condition.

Table 4-1. Lower back disc compression exerted by large males and small females during the performance of physically demanding news photography tasks

Task	L5 S1 Disc Compression (lbs)	
	95% Male	5% Female
White House – Kneeling (Lightweight Camera 8 lbs)	117.988	89.0795
White House – Kneeling (Heavy Camera 18 lbs)	206.802	166.122
Golf - Half Kneeling	233.246	128.297
Golf - Sitting on Lawn	134.311	84.2324
Unloading Backpack from Hatchback	526.807	393.278
Unloading Wheeled Bag from Sedan (50 lbs)**	859.926*	560.304
Unloading Backpack (20 lbs) from Sedan (Both Legs on Ground)	795.85*	435.848
Unloading Backpack (20 lbs) from Sedan (One Leg on Ground)	803.194*	438.819
Loading Wheeled Bag to Sedan (50 lbs)	1210.69*	742.458*
Basketball sitting (Scenario 1 Monopod)	308.306	139.436
Basketball sitting (Lightweight Camera 8 lbs)	316.291	146.902
Basketball sitting (Heavy Camera 18 lbs)	336.234	165.557

* Close or exceed safe L5/S1 disc compression force of 3400 Newtons (N) (765 pounds-force) for any single job activity according to NIOSH.

** The software indicates that the posture as analyzed is unstable. However, observation of the videotape suggests that the knees may be supported by the car bumper, which the software does not recognize. Consequently the results for disc compression as well as moments acting on the joints may not be reliable.

We conclude that the loading and unloading of backpack and wheeled bag from a sedan are the most demanding tasks and pose a risk for the lower spine of the large male as well as the smaller female.

Tolerance of moments of various joint

Using the posture data derived from the videotapes, the software estimates the moments acting around different joints and compares them against those in an anthropometric database. The following table shows the percentage of the larger male and smaller female population tolerating the moments generated around various joints. Thus, kneeling and using a light camera of 8 lbs in an event like the White House press conference can be tolerated by the larger males but only about half of the knees of the smaller females. Similarly, about a quarter of the larger males and two-thirds of the smaller females may not be able to tolerate the same task using a heavy camera (18 lbs). On the other hand, males may be more limited than females in the unloading of gear from sedan cars since they have to bend lower to pick up the equipment.

Table 4-2. Capabilities of large males and small females to sustain torques acting on various joint during the performance of physically demanding news photography tasks (joints where 95% or less of the population group is capable of sustaining the calculated forces)

Task	Capabilities	
	95% Male	5% Female
White House – Kneeling (Lightweight Camera 8 lbs)		L shoulder 94% Knees 46%
White House – Kneeling (Heavy Camera 18 lbs)	L shoulder 76%	L shoulder 34%
Golf - Half Kneeling	L hip 54% R hip 72% R knee 36%	L hip 75% R hip 93% R knee 84%
Unloading Backpack from Hatchback	R shoulder 91% Hip, knee, ankle 91% -95% Back flexion 91%	R shoulder 71% Hip, knee, ankle 93% -95% Back flexion 91%
Unloading Wheeled Bag from Sedan (50 lbs)*	Hip 71% Knee 42% Ankle 33% Back flexion 71%	Hip 82% Knee 77% Ankle 74% Back flexion 84%
Unloading Backpack (20) lbs from Sedan (Both Legs on Ground)	L hip 29% L knee 18% L ankle 63% Back flexion 89%	L hip 51% L knee 68% L ankle 84% Back flexion 94%
Unloading Backpack (20 lbs) from Sedan (One Leg on Ground)	L hip 31% L knee 21% L ankle 68% Back flexion 89%	L hip 53% L knee 70% L ankle 95% Back flexion 94%
Loading Wheeled Bag to Sedan (50 lbs)	Hip 84% Knee 95% Back flexion 91%	Hip 84% Back flexion 92%

Note: 1) Tolerances by more than 95% of the population have been dropped from the summary; 2) Due to limitation of the software, loads on the lower extremities in various sitting positions, such as those demonstrated in the golf tournament, are not reliable and have been dropped from the summary; 3) Height of the trunk of the sedan car has been estimated at 23” above ground.

* The software indicates that the posture as analyzed is unstable. However, observation of the videotape suggests that the knees may be supported by the car bumper, which the software does not recognize. Consequently the results for moments acting on the lower extremity joints may not be reliable.

We conclude that the unloading of backpack and wheeled bag from a sedan car poses risks to the lower extremities (hip, knee ankle) of both the large male and small females. For example, bending to unload a 20 lbs backpack from the trunk of a sedan car, while keeping both knees straight and close to the bumper, generates moments around the knees that may not be possible for about 80% of the male population and a third of the smaller females.

Energy Expenditure

Covering the golf events have been mentioned as a task requiring high stamina. Several task elements –were described in a detailed interview by a photographer and entered into a software program - Modified Garg Tool. The program calculates the stamina requirements in terms of energy expenditure. If the model total metabolism calculation (based on the specific job analysis) exceeds the physical work capacity (given the age, gender, and time duration selected), the job will likely produce physical fatigue. The risk is assessed by

comparing the average energy expended for a task element against a maximum work capacity estimated for the individual and against a maximal expenditure allowable for continuous work time⁵.

The stamina required for covering a golf tournament is high. The calculations are based on close to 8 hours per assignment, where about one hour is spent transporting about 39 lbs of gear and cameras between the car and clubhouse, carrying the equipment and running. While the metabolic demand of the assignment as a whole is acceptable, some specific tasks are of concern: carrying and running (particularly dashing for 30 yards) and transporting gear to the car. As shown in Table 3, the energy expended during carrying would require of females 4.5 to 5.4 kcal/min and 5.4 to 6.1 kcal/min for males. These demands are considered ‘heavy’ for the whole body and ‘very heavy’ for the upper body if carried out for more than 2 hours continuously⁶.

We confirmed that the stamina demands for covering a golf tournament are high, mainly due to the need to carry about 39 lbs of gear and cameras. As the carrying is intermittent, the holding of the cameras for shooting may be considered a break for the cardio-pulmonary system. Careful consideration should be given to the duration of activities that may provide rest period.

Table 4-3. Energy expended on several tasks during golf tournament (kcal/min) by males and females ages 35 and 65

Task	Task Duration (min)	Energy Expended (kcal/min)			
		35 yrs		65 yrs	
		F	M	F	M
General	(8 hrs)	2.7	3.1	2.8	3.3
Carrying and running 150 yards	50	5.1	6	5.4	6.1
Carrying and running 30 yards	4	4.5	5.4	4.8	5.5
Picking up/loading gear (to car)	7	4	4.5	4.2	4.6
Sitting and shooting	180	3.1	3.4	3.2	3.5
Walking back on course	20	2.5	3	2.7	3.0
Walking off the course to file photos	20	2.5	3	2.7	3.0
Filing photos in clubhouse	180	1.6	1.9	1.7	2.2
Remove gear from trunk (to clubhouse)	5	1.6	1.9	1.7	1.4

Note: Highlighted values indicate energy levels exceeding maximal physical work capacity for respective gender and age.

⁵ The Physical Work Capacity (PWC) for normal, healthy, 35-year-old males is 16 kcal/ and 12 kcal/min for females. The maximum aerobic power for eight hours of continuous work is 33% of PWC. Therefore, the capacity limit is approximately 5.2 kcal/min for a 35 year old, healthy male and 4.0 kcal/min for a female.

⁶ Assuming the task is similar to mail delivery while walking. See table 1.21 in Kodak’s Ergonomic Design for People at Work, 2nd ed 2004.

Conclusion

A review of OSHA logs filed by AP photographers in 2004-2008 revealed a need to prevent back injuries due to overexertion. A survey conducted in 2009 further revealed that many cases of back pain go unreported. Focus groups of photographers acted as subject matter experts and generated a profile of job demands based on the physical abilities required for various tasks. Four physically demanding tasks were selected as targets for in-depth analysis.

Several limitations should be noted while assessing the risks involved in these tasks, such as a selection bias - the analysis was based on video clips demonstrating selected activities by a single photographer in each case where others may behave differently - and software limitation, resulting in either overestimation or underestimation of the physical demands. Furthermore, this project focused as stated earlier on overexertion injuries that are the result of peak forces. Some of the problems may be the result of cumulative exposure to forces. These effects cannot be assessed with this study design.

Overexertion of the back was found while loading and unloading bags and backpacks (20-50 lbs) from the trunk of a sedan car. These activities generated high compression forces on the disc of the lower spine. These tasks are also expected to generate high forces acting on the lower extremities of both males and females, mainly the hips and knees.

Shoulder forces may be the limiting factor while kneeling using heavy cameras (18 lbs) for photographing events such as press conferences.

The focus groups claimed that high stamina is required for covering of long sports events such as golf tournament. Further analysis confirmed that high energy needs to be expended mainly during intermittent carrying and running with about 39 lbs of gear and cameras for more than 4 hrs a day and the transporting of the gear to the car.

Recommendations

1. Target the loading and unloading bags and backpacks from the trunk of a sedan car for training in safe body mechanics as well as selection of cars and gear (wheeled bags and backpacks).
2. Target lighter cameras for press conferences as well as pods to reduce kneeling.
3. Target the coverage of long sports events for lighter gear that is easier to handle (engineering solutions) as well as assigning more than one photographer (administrative solutions) and for promoting general aerobic fitness.

Appendix 5

Usability

Prepared by
Manny Halpern, PhD

December 5, 2010

Table.5-1. Usability features by assignment

Assignment	Backpack	Sling Bag	Fanny/Waist Packs	Belt/Harness/Vest System	Rolling Case	Rolling Cart	Hard Case	Folding Cart	Monopod	Tripod	Floor Chair	Car	Rain protection	Σ
Natural disasters	x	x	x	x					x	x			x	7
Quick moving assignments - civic disturbances, breaking news, presidential travel, campaigns	x	x	x	x					x	x			x	6
Day-to-day regular assignments, lighter duty, i.e. press conferences, feature stories, interviews, etc.	x	x	x	x	x				x	x			x	7
Sporting events	x	x	x	x	x	x		x	x	x	x		x	11
Travel	x				x	x	x	x				x		6
Count (Σ)	5	3	4	4	3	2	1	2	4	4	1	1	4	

Table.5-2. Usability of gear by features

Feature	Backpack	Sling Bag	Fanny/Waist Packs	Belt/Harness and Vest System	Rolling Case	Folding Cart	Monopod	Tripod	Floor Chair	Car	Σ
Gender specific if available	x	x		x							3
Varied sizes	x	x	x	x	x	x		x		x	8
Monopod/tripod attachment	x			x				x			4
Padded and well ventilated lumbar and back support	x	x	x	x							4
Padded and well ventilated waist strap	x	x	x	x							4
Adjustable Straps	x	x	x	x							4
Sturdy Handles	x	x	x		x			x			5
Waterproof/Rain Cover	x	x	x								3
See-through interior pockets	x	x			x						3
Multiple pockets, inside and out	x	x	x	x	x						5
Light weight materials	x	x	x	x	x	x	Carbon Fiber	Carbon Fiber			8
Carrying adaptability (left/right shoulder, backpack mode)		x									1
Accessibility while carrying		x	x	x							3
Shoulder and waist straps	x	x	x	x							4
Exterior compartments of various sizes.	x	x			x						3
Modular, adjustable interior system	x	x	x		x						4
Airline carry-on compatibility	x				x	x					3
Airline travel case for stowing						x		x			2
Large, sturdy wheels					x	x					2
Sturdy exterior					x						1
Telescopic handles					x	x					2
Smooth padded handles for pulling					x	x					2
Fold up small size						x					1
2 and 4 wheel positioning						x					1
Sturdy					x	x	x	x			5

Feature	Backpack	Sling Bag	Fanny/Waist Packs	Belt/Harness and Vest System	Rolling Case	Folding Cart	Monopod	Tripod	Floor Chair	Car	Σ
Extend high enough for tall person					x	x	x				3
Carry case, hard/soft, with sturdy handle(s)						x		x			2
360 degree rotation									x		1
Hatchback										x	1
Variety of sizes suited to equipment and assignment needs (more for rental cars)										x	1
Count (Σ)	15	15	11	10	14	12	4	7	2	3	

[Appendix 6](#)

Safe Body Mechanics

Prepared by
Jangwhon Yoon, PhD
Maneesha Kumar, MS

November 29, 2010

Loading to and Unloading from Sedan/Hatchback Trunk:

- Hatchback is better for your back.
You can keep better posture for your back.



	<ul style="list-style-type: none">• For Loading: Make sure there is adequate space for the object in the trunk prior to lifting. Plan ahead.	
	 	 
	<ul style="list-style-type: none">• Pull the object toward you as close as possible. You can minimize the mechanical load on your body.	
	 	 

	<ul style="list-style-type: none">• Bend your knees instead of your back so your back maintains its posture as erect as possible.	
		
	<ul style="list-style-type: none">• Lift slowly so your body can be prepared to the weight; avoid jerky motions.	

Photographing:

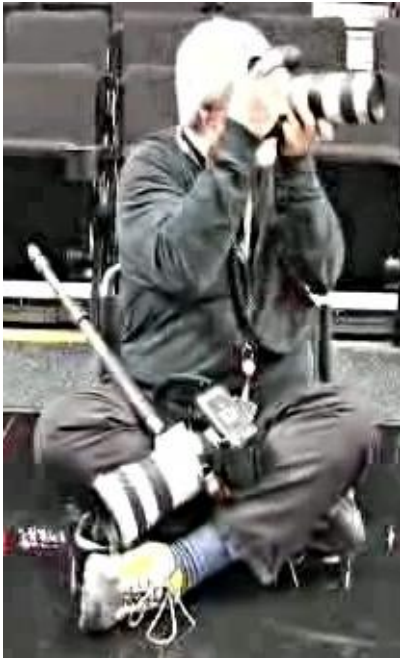
- **Priority of picture taking postures:**
 1. **Sitting on chair**
 2. **Standing**
 3. **Sitting on floor**
 4. **Half-kneeling**
 5. **Kneeling**
 6. **Squatting**





- **Avoid static postures for extended periods of time.**





- **Use a pod whenever possible (e.g. monopod). It makes huge difference in the mechanical load on the body.**



- **Avoid neck and trunk twisting; use swivel seat cushion instead.**



	<ul style="list-style-type: none">• Assume half-kneeling posture instead of full kneeling, and switch supporting legs as often as you can. Use knee pad.	
	 	 
	<ul style="list-style-type: none">• Keep your head as straight as possible; avoid bending your neck forward. Prolonged use of viewfinder may bring static stress to neck and shoulder.	

	<ul style="list-style-type: none">• Keep elbows close to your body.	
	 	 
	<ul style="list-style-type: none">• Change leg posture as often as you can while sitting, standing and kneeling.	

Carrying gear:

- Carry only the essential equipment for today.
- Use wheeled bag or case.
- Use telescopic handles and adjust them to elbow level when pulling the case to avoid bending the back.



	<ul style="list-style-type: none">• Use back or waist pack instead of duffel bag.
	

	<ul style="list-style-type: none">• Carry or hold objects considering point of balance. It minimizes the mechanical load on the body.
	

Joint Specific Recommendations:

Neck/Shoulder	
	Use mount whenever possible (e.g. monopod)
	Avoid neck twisting
	Keep your head as straight as possible; avoid bending your neck forward. Prolonged use of viewfinder may stress neck and shoulder
	Keep elbows close to your body
	Avoid static postures for extended periods of time
	Carry or hold objects considering point of balance. It minimize the mechanical load on the body
Back	
	Hatchback is better for your back
	Pull the object toward you as close as possible
	Bend your knees instead of your back so your back maintains its posture as erect as possible
	Lift slowly so your body can be prepared to the weight; avoid jerky motions
	Avoid trunk twisting
	Use wheeled bag or case
	Use back or waist pack instead of duffel bag
	Carry objects considering point of balance
	Avoid static postures for extended periods of time
Knees/Legs	
	Assume half-kneeling posture instead of full kneeling, and switch supporting legs as often as you can. Use knee pad
	Change leg posture as often as you can while sitting, standing and kneeling
	Carry only the essential equipment for today
	Use wheeled bag or case