

---

[Skip to main content](#)

```
function initSelector(element){ $(' .skiptocontent').removeAttr("href"); $( element ).parent().before( "" );
window.location.hash = '#top'; $(window).scrollTop($("#top").offset().top-100);
window.location.hash=""; } $('#skiptocontent').keydown(function (e) { var code; try { code =
(window.event) ? window.event.keyCode : event.which; } catch(err) { code = e.keyCode || e.which; }
//click Enter if(code == 13){ var mainPagelId=$("#main-page-content").text(); if(mainPagelId){
initSelector('#main-page-content'); }else{ var firstH1=$('#h1:first').text(); if(firstH1){
initSelector('h1:first'); }else{ $('#skiptocontent').css('display','none'); } } } });
```

showDfpAd(0)

---

\$(document).on("ready", sageQuickSearch.init('chpc'));

## MENU

- [Browse](#)
- [Resources](#)
  - [Authors](#)
  - [Librarians](#)
  - [Editors](#)
  - [Societies](#)
- [Advanced Search](#)

---

## IN THIS JOURNAL

- [Journal Home](#)
- [Browse Journal](#)
  - [All Articles](#)
  - [Browse by Year](#)
- [Submit Paper](#)
- [About](#)
  - [More Information](#)
  - [Editorial Board](#)
  - [Email Alerts](#)
  - [Feedback](#)
  - [Recommend to Library](#)
  - [Advertise](#)
  - [Reprints](#)
  - [RSS](#)

[Advanced Search](#)

- 
- [Browse](#)
  - [Resources](#)
    - [Authors](#)
    - [Librarians](#)
    - [Editors](#)
    - [Societies](#)
  - [Advanced Search](#)

```
$(document).on("ready", sageQuickSearch.init('chpc'));
```

[Advanced](#)

---

Sign In

National Science Library

Society

```
addClass('enhancedLoginPanel', 'doNotShow'); function initLoginBox() { if (hasPersonIdentity())  
$$('#profileContainerMobile img.loggedInArrow').show(); else { $$('#profileContainerMobile  
img.loggedInArrow').hide(); //$$('#myprofile-label').text("Sign In"); }; $$('#portalLoginBar .sage-login-  
widget').attr('tabindex', '0'); $$('#sage-login-widget img.user-logo').each(function(){  
//console.log($(this).attr('src')); if($(this).attr('src').indexOf('templates')===-1)
```

---

```
$(this).addClass('bannerImage'); else $(this).removeClass('bannerImage'); }); initMyProfileInfo();  
initInstitutionInfo(); initSocietyInfo(); if (inPbEditorMode()) $('sage-login-widget').attr('onclick',  
'toggleLoginPopup(true);return false;'); if (isIE()) { $("img.user-logo").each(function () { let imgUrl =  
$(this).prop("src"); if (imgUrl) { $(this).css("backgroundImage", 'url(' + imgUrl + ')').addClass("ie-object-  
fit"); $(this).prop("src", ""); } }); } }
```

## Access Options

You can be signed in via any or all of the methods shown below at the same time.

My Profile

Sign in here to access free tools such as favourites and alerts, or to access personal subscriptions

---

Email (required)  
Password (required)  
Remember me

[Forgotten your password?](#)

I don't have a profile

[Create Profile](#)

I am signed in as:

[View My Account](#)

[Logout](#)

---

---

```
function initMyProfileInfo() { $('<div id=person-activated>img.user-logo').attr('title', 'You are signed in via
your profile'); $('<div id=person-deactivated>img.user-logo').attr('title', 'You are not signed in via your
profile'); $('#frmLogin br').hide(); $('#user-login-form #passwordReminder').insertBefore('#user-login-
form #frmLogin tr:last-child'); $('
Set new password
').appendTo('#user-login-form #passwordReminder'); $('#ru-user').attr('href',
'/action/doLogout?redirectUri='+window.location.href); $('#user-login-form .loginForm
label[for="password"]').append(':'); if (hasPersonIdentity()) { $('#user-info').show(); $('#user-login-
form').hide(); } else { $('#user-info').hide(); $('#user-login-form').show(); } let $user=$('#portalLoginBar
.my-profile-col.id-person-activated'); if ($user && $user.attr('name') && $user.attr('name').length>0) {
$('
'+$user.attr('name')+
').appendTo('#user-name'); } }
```

With my free profile I can:

- Set up [favourite journals](#) and register for [email alerts](#)
- List [saved searches](#)
- [Edit account details](#)
- [Activate personal subscriptions](#) and [access content](#)

Institution

If you have access to journal content via a university, library or employer, sign in here



---

[Shibboleth](#)

[Open Athens](#)

I am signed in via:

National Science Library

```
function setInstitutionLoginStatus() { let samlExists=($('.access-via-saml').length)>0; let  
appendTag=""; if (samlExists) { appendTag+='
```

Signed in via: **a federated identity**

```
'; } else { appendTag+='
```

Sign in via: [Shibboleth](#)

```
'; appendTag+='
```

Sign in via: [Open Athens](#)

```
'; } $('#inst-login-status').append(appendTag); } function setRedirectUrl() { let currentUrl =  
window.location.pathname; $('.Shibboleth').attr("href", $('.Shibboleth').attr('href') + currentUrl);  
$('.OpenAthens').attr("href", $('.OpenAthens').attr('href') + currentUrl); } function initInstitutionInfo() {  
setInstitutionLoginStatus(); setRedirectUrl(); if ($('#id-institution-activated>img.user-  
logo').attr('title')===undefined) $('#id-institution-activated>img.user-logo').attr('title', 'You are signed in
```

---

via your institution'); \$('#id-institution-deactivated>img.user-logo').attr('title', 'You are not signed in via an institution'); \$('#institution-info .portalInstitutionalButton').after('

## my institutional subscription

```
'); //if ($('#institution-info .portalInstitutionalButton a').length) $('#institution-info .portalInstitutionalButton a').text(); if (hasInstitutionIdentity()) { $('#institution-info').show(); $('#institution-login-form').hide(); } else { $('#institution-info').hide(); $('#institution-login-form').show(); } }
```

With institutional access I can:

- View or download all content the institution has subscribed to.

## Society

If you have access to journal via a society or associations, read the instructions below

---

Members of \_ can log in with their society credentials below

Username (required)

Password (required)

Society (required)

Access to society journal content varies across our titles.

If you have access to a journal via a society or association membership, please browse to your society journal, select an article to view, and follow the instructions in this box.

Contact us if you experience any difficulty logging in.

Some society journals require you to create a personal profile, then activate your society account

[Activate my Society Account](#)

I am signed in via:

```
function getYmCount() { let rv=0; try{ rv=Number("0"); if (isNaN(rv)) rv=0; } catch (e) {} return rv; }  
function getSocietyJournals(index) { let rv=""; try { switch (index) { case 1:rv=""; break; case 2:rv="";  
break; case 3:rv=""; break; case 4:rv=""; break; case 5:rv=""; break; default:break; } } catch (e) {}  
return rv; }
```

```
$('#ru-society').attr('href', '/action/doLogout?redirectUri='+window.location.href); function  
restyleJournalAd(){ if ($('#society-login-form .literatumAd').length!==0) { $('#society-login-form  
#society-info-text, #society-login-form .topSeparator').hide(); } } function initSocietyInfo() { if ($('#.id-  
society-activated>img.user-logo').attr('title')===undefined) $('#.id-society-activated>img.user-  
logo').attr('alt', 'You are signed in via your society'); $('#.id-society-deactivated>img.user-  
logo').attr('title', 'You are not signed in via a society'); $('#society-info .portallnsitutionalButton').after('
```

## my society or association

```
'); if (hasSocietyIdentity()){ $('#society-info').show(); $('#society-login-form').hide(); } else {  
restyleJournalAd(); $('#society-info').hide(); $('#society-login-form').show(); } } function  
getYmSocietyIndex(){ let count = getYmCount() || 0; let currentJournal = "chp"; if  
(currentJournal.length!==0 && count>0) { console.log("Looking through "+count+" societies for journal  
code: "+currentJournal); for (i=0; i
```

—

—

```
if ('0.4822.7201.098CiteScoreSCImago Journal Rank (SJR)151563'.trim().length>0)
$('.impactFactorContainer').removeClass('not-show-important'); if ($("#impact-factor-container") &&
$("#impact-factor-container").size(>0) $("#showAllSocietiesBtn").addClass("ifBorder"); switch
($('#showNoFoldedSocietyLogos .societyImageLink').size()) { case 2:
$('#showNoFoldedSocietyLogos').addClass('two-logos'); break; case 1:
$('#showNoFoldedSocietyLogos').addClass('one-logo'); break; case 0: default: break; } function
resizeHeaderFont() { var headerTitleElement = document.getElementById('headerTitle'); if
(headerTitleElement) { var fontsize = 32; if (" && "FALSE"=="TRUE") fontsize=28;
$('#headerTitle').css('font-size', fontsize+"px"); /*Max font size, then reduce from there*/
$('#headerTitle h1').css('font-size', fontsize+"px"); /*Max font size, then reduce from there - journal
home only*/ var headerTitleSize = headerTitleElement.getBoundingClientRect(); var textHeight =
headerTitleSize.height; var textWidth = headerTitleSize.width; var containerElement =
document.getElementById('headerTitleContainer'); var containerSize =
containerElement.getBoundingClientRect(); var containerHeight = containerSize.height; var
containerWidth = containerSize.width; var fontstring = ""; while (textHeight > containerHeight) {
fontsize--; fontstring = fontsize.toString(); fontstring = fontstring + "px"; $('#headerTitle').css('font-size',
fontstring); $('#headerTitle h1').css('font-size', fontstring); headerTitleSize =
headerTitleElement.getBoundingClientRect(); textHeight = headerTitleSize.height; textWidth =
headerTitleSize.width; } } }; resizeHeaderFont(); $(window).resize(function() { resizeHeaderFont(); });
```

- 
- [Journal Home](#)
  - [Browse Journal](#)
    - [All Articles](#)
    - [Browse by Year](#)
  - [Submit Paper](#)
  - [About](#)
    - [More Information](#)
    - [Editorial Board](#)
    - [Email Alerts](#)
    - [Feedback](#)
    - [Recommend to Library](#)
    - [Advertise](#)
    - [Reprints](#)
    - [RSS](#)

Search in:

```
function offset(el) { let rect = el.getBoundingClientRect(), scrollLeft = window.pageXOffset ||
document.documentElement.scrollLeft, scrollTop = window.pageYOffset ||
document.documentElement.scrollTop; return { top: rect.top + scrollTop, left: rect.left + scrollLeft,
bottom: rect.bottom + scrollTop, right: rect.right + scrollLeft } } window.addEventListener("scroll",
function() { let y = window.pageYOffset; let $quickSearchId = $("#journalQuickSearch").parent(); if (y
>= offset(document.getElementById("portalQuickSearch")).bottom) {
$quickSearchId.removeClass("doNotShow"); } else { $quickSearchId.addClass("doNotShow"); } });
```

```
$(document).on("ready", sageQuickSearch.init('chpc'));
```

---

### Cookies Notification

This site uses cookies. By continuing to browse the site you are agreeing to our use of cookies. [Find out more.](#)

```
$("#accept-cookie-policy").click(function() { $.get('/action/cookiePolicy?response=accept',  
function(data) { $(".cookiePolicy").remove(); }); });
```

---

## Add Email Alerts

[close Add Email Alerts Dialog](#)

You are adding the following journals to your email alerts

Journal	New Content	Announcements
Journal of Evidence-Based Integrative Medicine		



---

[Contents](#)

```
_ $(document).ready(function() { if( $('#openAccessSideMenu .showFullText').size() == 0) ||  
(isDesktop() && $('#openAccessSideMenu').find('.noAccess').size() !=0) ) {  
$('#mobileContents').closest('.general-html-asset').addClass('hide');  
$('.mobileToolLink').addClass('double-button'); } });
```

Article Menu

[Download PDF](#)

- [Article Metrics](#)
- [Related Articles](#)

- 
- [Comments](#)

—

[Cite](#)

**Citation Tools**

---

## How to cite this article

If you have the appropriate software installed, you can download article citation data to the citation manager of your choice. Simply select your manager software from the list below and click on download.

How to cite this article  
Style

[Copy to clipboard](#)

[Tips on citation download](#)

Download Citation

Download article citation data for:

---

[Does Vitamin E and C Supplementation Improve the Recovery From Anterior Cruciate Ligament Surgery?](#)

Tyler Barker, PhD and Maret G. Traber, PhD

Journal of Evidence-Based Complementary & Alternative Medicine 2011 16:2, 114-128

---

## Download Citation

If you have the appropriate software installed, you can download article citation data to the citation manager of your choice. Simply select your manager software from the list below and click on

---

download.

Format

[Tips on citation download](#)

Download Citation

Download article citation data for:

---

[Does Vitamin E and C Supplementation Improve the Recovery From Anterior Cruciate Ligament Surgery?](#)

Tyler Barker, PhD and Maret G. Traber, PhD

Journal of Evidence-Based Complementary & Alternative Medicine 2011 16:2, 114-128

---

—

[Share](#)

---

## Share

### Via Social Media

```
var script = document.createElement('script'); script.type='text/javascript';  
script.src='//s7.addthis.com/js/250/addthis_widget.js#pubid=xa-4faab26f2cff13a7'; script.async = true;  
$('head').append(script)
```

### Via Email

All fields are required

Recipient's Email Address:

Your Email:

Your Name:

Subject:

---

---

Send me a copy

[Cancel](#)

—

[Request Permissions](#)

View permissions information for this article

```
$(document).ready(function () { if ($(".articleTools .rightsLink").length) {  
$(".permissionsToolContainer").css("display", "inherit"); } });
```

---

```
$( 'div.articleToolsLinks').insertBefore('li.RelatedArticles'); $( 'div.pdf-no-access a').removeAttr('href');  
$( '#copyToClipBoard').attr('data-item-name', 'copy-citation'); $( '#articleCitationDownloadContainer,  
#articleShareContainer, #articlePermissionsContainer').click(function () { articleToolsToggle(); });  
$( ".popup-dialog").on("click", function(event){ event.stopPropagation(); }); $( '  
' ).insertAfter('#copyToClipBoard'); trapKeys('.popup-dialog', '.articleToolPanelClose');
```

—

[Explore More](#)

—

---

```
function addFlashMovie(id, flv) { var flashvars = {file: flv ,type: 'flv'}; var params = {allowfullscreen :true}; var attributes = {}; swfobject.embedSWF('/flvplayer.swf', id, "352", "288", "7.0.0", false, flashvars, params, attributes); } function addFlashMovie(id, flv, image) { var flashvars = {file: flv ,type: 'flv', image: image}; var params = {allowfullscreen :true}; var attributes = {}; swfobject.embedSWF('/flvplayer.swf', id, "352", "288", "7.0.0", false, flashvars, params, attributes); }
```

## **Does Vitamin E and C Supplementation Improve the Recovery From Anterior Cruciate Ligament Surgery?**



---

Show all authors

[Tyler Barker](#), PhD

[Tyler Barker](#)

The Orthopedic Specialty Hospital, Intermountain Healthcare, Murray, UT, USA,  
tyler.barker@imail.org

[See all articles by this author](#)

[Search Google Scholar](#) for this author

, [Maret G. Traber](#), PhD

[Maret G. Traber](#)

Oregon State University, Corvallis, OR, USA

[See all articles by this author](#)

[Search Google Scholar](#) for this author

/\* \* Check the number of Author's \* if less than '3' we not display expandable-author \* \*/ var  
numItems = \$(''.contribDegrees').length; if(numItems

**Keywords** [antioxidants](#), [anterior cruciate ligament](#), [skeletal muscle](#), [cytokines](#), [oxidative stress](#),  
[vitamin C](#), [vitamin E](#), [knee](#)

Robson AW VI. Ruptured crucial ligaments and  
their repair by operation. Ann Surg. 1903;37:  
716-718.

[Google Scholar](#) | [Medline](#)

---

Lange F. Uber die Sehnenplastik. Verh Dtsch  
Orthop Ges. 1903;2: 10-12.

[Google Scholar](#)

---

Hey Groves EW Operation for the repair of the

---

crucial ligaments . Lancet. 1917;2:674-675.

[Google Scholar](#) | [Crossref](#)

---

Lyman S. , Koulouvaris P. , Sherman S. , et al. Epidemiology of anterior cruciate ligament reconstruction: trends, readmissions, and subsequent knee surgery. J Bone Joint Surg Am. 2009;91: 2321-2328.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Anderson JL , Lamb SE , Barker KL , et al. Changes in muscle torque following anterior cruciate ligament reconstruction. Acta Orthop Scand. 2002;73:546-552.

[Google Scholar](#) | [Crossref](#) | [Medline](#)

---

Arangio GA , Chen C. , Kalady M. , et al. Thigh muscle size and strength after anterior cruciate ligament reconstruction and rehabilitation. J Orthop Sports Phys Ther . 1997;26:238-243.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Arvidsson I. , Arvidsson H. , Eriksson E. , et al. Prevention of quadriceps wasting after immobilization: an evaluation of the effect of electrical stimulation. Orthopedics. 1986 ;9:1519-1528.

[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Barker T. , Leonard SW , Hansen J. , et al. Vitamin E and C supplementation does not ameliorate muscle dysfunction following anterior cruciate ligament surgery. Free Radic Biol Med. 2009; 47:1611-1618.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Elmqvist L-G. , Lorentzon R. , Johansson C. , et al. Knee extensor muscle function before and after reconstruction of anterior cruciate ligament tear. Scand J Rehabil Med Suppl. 1989;21:131-139.

[Google Scholar](#)

---

Eriksson K. , Hamberg P. , Jansson E. , et al. Semitendinosus muscle in anterior cruciate ligament surgery: morphology and function. Arthroscopy . 2001;17:808-817.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Gerber JP , Marcus RL , Dibble LE , et al. Effects of early progressive eccentric exercise on muscle

---

structure after anterior cruciate ligament reconstruction. J Bone Joint Surg Am. 2007; 89:559-570.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Gerber JP , Marcus RL , Dibble LE , et al. Effects of early progressive eccentric exercise on muscle size and function after anterior cruciate ligament reconstruction: a 1-year follow-up study of a randomized clinical trial. Phys Ther. 2009;89:51-59.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Hamada M. , Shino K. , Horibe S. , et al. Single-versus bi-socket anterior cruciate ligament reconstruction using autogenous multiple-stranded hamstring tendons with EndoButton femoral fixation: a prospective study. Arthroscopy. 2001;17:801-807.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Jarvela T. , Kannus P. , Latvala K. , et al. Simple measurements in assessing muscle performance after an ACL reconstruction. Int J Sports Med. 2002 ;23:196-201.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Konishi Y. , Aihara Y. , Sakai M. , et al. Gamma loop dysfunction in the quadriceps femoris of patients who underwent anterior cruciate ligament reconstruction remains bilaterally . Scand J Med Sci Sports. 2007;17:393-399.

[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Konishi Y. , Ikeda K. , Nishino A. , et al. Relationship between quadriceps femoris muscle volume and muscle torque after anterior cruciate ligament repair. Scand J Med Sci Sports. 2007;17:656-661.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Mattacola CG , Perrin DH , Gansneder BM , et al. Strength, functional outcome, and postural stability after anterior cruciate ligament reconstruction . J Athl Train. 2002;37:262-268.

[Google Scholar](#) | [Medline](#) | [ISI](#)

---

McHugh MP , Tyler TF , Gleim GW , et al. Preoperative indicators of motion loss and weakness following anterior cruciate ligament

---

reconstruction. J Orthop Sports Phys Ther. 1998;27:407-411.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

McHugh MP , Tyler TF , Nicholas SJ , et al. Electromyographic analysis of quadriceps fatigue after anterior cruciate ligament reconstruction . J Orthop Sports Phys Ther. 2001;31:25-32.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Rosenberg TD , Franklin JL , Baldwin GN , et al. Extensor mechanism function after petallar tendon graft harvest for anterior cruciate ligament reconstruction . Am J Sports Med. 1992;20: 519-526.

[Google Scholar](#) | [SAGE Journals](#) | [ISI](#)

---

Snyder-Mackler L. , Binder-MaCleod SA , Williams PR Fatigability of human quadriceps femoris muscle following anterior cruciate ligament reconstruction . Med Sci Sports Exerc. 1993; 25:783-789.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Snyder-Mackler L. , Delitto A. , Stralka SW , et al. Use of electrical stimulation to enhance recovery of quadriceps femoris muscle force production in patients following anterior cruciate ligament reconstruction. Phys Ther. 1994;74:901-907.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Urbach D. , Nebelung W. , Weiler H-T. , et al. Bilateral deficit of voluntary quadriceps muscle activation after unilateral ACL tear. Med Sci Sports Exerc. 1999;31:1691-1696.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Mikesky AE , Mazzuca SA , Brandt KD , et al. Effects of strength training on the incidence and progression of knee osteoarthritis. Arthritis Rheum. 2006 ;55:690-699.

[Google Scholar](#) | [Crossref](#) | [Medline](#)

---

Holm L. , Esmarck B. , Mizuno M. , et al. The effect of protein and carbohydrate supplementation on strength training outcome of rehabilitation in ACL patients. J Orthop Res. 2006;24: 2114-2123.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

---

Fang Y. -Z, Yang S. , Wu G. Free radicals, antioxidants, and nutrition. Nutrition . 2002;18: 872-879.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Meucci E. , Mele MC Amino acids and plasma antioxidant capacity. Amino Acids. 1997;12: 373-377.

[Google Scholar](#) | [Crossref](#) | [ISI](#)

---

Newham DJ , Jones DA , Clarkson PM Repeated high-force eccentric exercise: effects on muscle pain and damage . J Appl Physiol. 1987;63: 1381-1386.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Friden J. , Sjostrom M. , Ekblom B. A morphological study of delayed muscle soreness. Experientia . 1981;37:506-507.

[Google Scholar](#) | [Crossref](#) | [Medline](#)

---

Newham DJ , McPhail G. , Mills KR , et al. Ultrastructural changes after concentric and eccentric contractions of human muscle. J Neurol Sci. 1983;61:109-122.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Friden J. , Sjostrom M. , Ekblom B. Myofibrillar damage following intense eccentric exercise in man. Int J Sports Med. 1983;4: 170-176.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Cannon JG , Fielding RA , Fiatarone MA , et al. Increased interleukin 1 $\beta$  in human skeletal muscle after exercise. Am J Physiol Regul Integr Comp Physiol. 1989;257:R451-R455.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Fielding RA , Manfredi TJ , Ding W. , et al. Acute phase response in exercise: III. Neutrophil and IL-1 beta accumulation in skeletal muscle. Am J Physiol Regul Integr Comp Physiol. 1993 ;265:R166-R172.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Petersen EW , Ostrowski K. , Ibfelt T. , et al. Effect of vitamin supplementation on cytokine response and on muscle damage after strenuous exercise. Am J Physiol Cell Physiol. 2001 ;280: C1570-C1575.

Toft AD , Jensen LB , Bruunsgaard H. , et al. Cytokine response to eccentric exercise in young and elderly humans. Am J Physiol Cell Physiol. 2002;283:C289-C295.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Close GL , Ashton T. , Cable T. , et al. Eccentric exercise, isokinetic muscle torque and delayed onset muscle soreness: the role of reactive oxygen species. Eur J Appl Physiol. 2004;91: 615-621.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Hellsten Y. , Frandsen U. , Orthenblad N. , et al. Xanthine oxidase in human skeletal muscle following eccentric exercise: a role in inflammation . J Physiol. 1997;498:239-248.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Radak Z. , Pucsok J. , Mecseki S. , et al. Muscle soreness-induced reduction in force generation is accompanied by increased nitric oxide content and DNA damage in human skeletal muscle . Free Radic Biol Med. 1999;26:1059-1063.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Traber MG , Atkinson J. Vitamin E, antioxidant and nothing more. Free Radic Biol Med . 2007;43:4-15.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Traber MG Vitamin E regulatory mechanisms. Annu Rev Nutr. 2007;27:347-362.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Azzi A. , Gysin R. , Kempna P. , et al. Vitamin E mediates cell signaling and regulation of gene expression . Ann N Y Acad Sci. 2004; 1031:86-95.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Carr A. , Frei B. Does vitamin C act as a pro-oxidant under physiological conditions ? FASEB J. 1999;13:1007-1024.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Bonetto A. , Penna F. , Muscaritoli M. , et al. Are antioxidants useful for treating skeletal muscle atrophy ? Free Radic Biol Med. 2009; 47:906-916.

Sies H. , Jones DP Oxidative stress. In: Fink G , ed. Encyclopedia of Stress. 2nd ed. New York, NY: Elsevier; 2007;45-48.

[Google Scholar](#) | [Crossref](#)

---

Powers SK , Jackson MJ Exercise-induced oxidative stress: cellular mechanisms and impact on muscle force production. *Physiol Rev.* 2008 ;88:1243-1276.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Tidball JG , Villalta SA Regulatory interactions between muscle and the immune system during muscle regeneration. *Am J Physiol Regul Integr Comp Physiol* . 2010.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Hawke TJ , Garry DJ Myogenic satellite cells: physiology to molecular biology. *J Appl Physiol.* 2001;91:534-551.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Charge SB , Rudnicki MA Cellular and molecular regulation of muscle regeneration. *Physiol Rev.* 2004;84:209-238.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Glass DJ Skeletal muscle hypertrophy and atrophy signaling pathways. *Int J Biochem Cell Biol.* 2005;37:1974-1984.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Jackman RW , Kandarian SC The molecular basis of skeletal muscle atrophy. *Am J Physiol Cell Physiol.* 2004;287:C834-C843.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Powers SK , Kavazis AN , McClung JM Oxidative stress and disuse muscle atrophy. *J Appl Physiol* . 2007;102:2389-2397.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Fitts RH The cross-bridge cycle and skeletal muscle fatigue. *J Appl Physiol.* 2008;104:551-558.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Spindler KP , Wright RW Clinical practice: anterior cruciate ligament tear. *N Engl J Med.*

---

2008;359:2135-2142.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Palmieri-Smith RM , Thomas AC A  
Neuromuscular mechanism of posttraumatic  
osteoarthritis associated with ACL injury. Exerc  
Sport Sci Rev. 2009;37:147-153.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Frei B. , England L. , Ames BN Ascorbate is an  
outstanding antioxidant in human blood plasma.  
Proc Natl Acad Sci U S A. 1989;86: 6377-6381.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Bergman M. , Salman H. , Djaldetti M. , et al. In  
vitro immune response of human peripheral blood  
cells to vitamins C and E. J Nutr Biochem.  
2004;15:45-50.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Bruno RS , Leonard SW , Atkinson J. , et al.  
Faster plasma vitamin E disappearance in  
smokers is normalized by vitamin C  
supplementation. Free Radic Biol Med. 2006  
;40:689-697.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Englard S. , Seifter S. The biochemical functions  
of ascorbic acid. Annu Rev Nutr . 1986;6:365-406.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Reiter E. , Jiang Q. , Christen S. Anti-  
inflammatory properties of alpha- and gamma-  
tocopherol. Mol Aspects Med. 2007;28: 668-691.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

McLaughlin PJ , Weihrauch JL Vitamin E content  
of foods. J Am Diet Assoc. 1979;75:647-665.

[Google Scholar](#) | [Medline](#)

---

Lehmann J. , Martin HL , Lashley EL , et al.  
Vitamin E in foods from high and low linoleic acid  
diets. J Am Diet Assoc. 1986; 86:1208-1216.

[Google Scholar](#) | [Medline](#)

---

Burton GW , Doba T. , Gabe EJ , et al.  
Autoxidation of biological molecules: 4.  
Maximizing the antioxidant activity of phenols. J  
Am Chem Soc. 1985;107:7053-7065.

[Google Scholar](#) | [Crossref](#) | [ISI](#)

---



---

Devaraj S. , Li D. , Jialal I. The effects of alpha tocopherol supplementation on monocyte function: decreased lipid oxidation, interleukin 1beta secretion, and monocyte adhesion to endothelium . J Clin Invest. 1996;98:756-763.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Devaraj S. , Leonard S. , Traber MG , et al. Gamma-tocopherol supplementation alone and in combination with alpha-tocopherol alters biomarkers of oxidative stress and inflammation in subjects with metabolic syndrome. Free Radic Biol Med. 2008;44: 1203-1208.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Devaraj S. , Jialal I. Alpha tocopherol supplementation decreases serum C-reactive protein and monocyte interleukin-6 levels in normal volunteers and type 2 diabetic patients. Free Radic Biol Med. 2000;29:790-792.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Jiang Q. , Ames BN Gamma-tocopherol, but not alpha-tocopherol, decreases proinflammatory eicosanoids and inflammation damage in rats. FASEB J. 2003;17:816-822.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Wiser J. , Alexis NE , Jiang Q. , et al. In vivo gamma-tocopherol supplementation decreases systemic oxidative stress and cytokine responses of human monocytes in normal and asthmatic subjects. Free Radic Biol Med. 2008;45:40-49.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Cooney RV , Franke AA , Harwood PJ , et al. Gamma-tocopherol detoxification of nitrogen dioxide: superiority to alpha-tocopherol. Proc Natl Acad Sci U S A. 1993;90:1771-1775.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Traber MG , Kayden HJ Preferential incorporation of alpha-tocopherol vs gamma-tocopherol in human lipoproteins. Am J Clin Nutr. 1989 ;49:517-526.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Traber MG , Rudel LL , Burton GW , et al. Nascent VLDL from liver perfusions of cynomolgus monkeys are preferentially enriched

---

in RRR- compared with SRR-alpha-tocopherol: studies using deuterated tocopherols. J Lipid Res. 1990;31:687-694.

[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Traber MG , Sokol RJ , Burton GW , et al. Impaired ability of patients with familial isolated vitamin E deficiency to incorporate alpha-tocopherol into lipoproteins secreted by the liver. J Clin Invest. 1990;85:397-407.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Traber MG , Burton GW , Hughes L. , et al. Discrimination between forms of vitamin E by humans with and without genetic abnormalities of lipoprotein metabolism. J Lipid Res. 1992;33: 1171-1182.

[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Bartali B. , Frongillo EA , Guralnik JM , et al. Serum micronutrient concentrations and decline in physical function among older persons. JAMA. 2008;299:308-315.

[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Ble A. , Cherubini A. , Volpato S. , et al. Lower plasma vitamin E levels are associated with the frailty syndrome: the InCHIANTI study. J Gerontol A Biol Sci Med Sci . 2006;61:278-283.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Cesari M. , Pahor M. , Bartali B. , et al. Antioxidants and physical performance in elderly persons: the Invecchiare in Chianti (InCHIANTI) study. Am J Clin Nutr. 2004;79:289-294.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Thompson D. , Bailey DM , Hill J. , et al. Prolonged vitamin C supplementation and recovery from eccentric exercise. Eur J Appl Physiol. 2004;92:133-138.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Shafat A. , Butler P. , Jensen RL , et al. Effects of dietary supplementation with vitamins C and E on muscle function during and after eccentric contractions in humans. Eur J Appl Physiol. 2004;93: 196-202.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

---

Jakeman P. , Maxwell S. Effect of antioxidant vitamin supplementation on muscle function after eccentric exercise. Eur J Appl Physiol Occup Physiol. 1993;67:426-430.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Thompson D. , Williams C. , Garcia-Roves P. , et al. Post-exercise vitamin C supplementation and recovery from demanding exercise. Eur J Appl Physiol. 2003;89:393-400.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Close GL , Ashton T. , Cable T. , et al. Ascorbic acid supplementation does not attenuate post-exercise muscle soreness following muscle-damaging exercise but may delay the recovery process. Br J Nutr. 2006;95:976-981.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Beaton LJ , Allan DA , Tarnopolsky MA , et al. Contraction-induced muscle damage is unaffected by vitamin E supplementation. Med Sci Sports Exerc. 2002 ;34:798-805.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Demiryurek S. , Babul A. Effects of vitamin E and electrical stimulation on the denervated rat gastrocnemius muscle malondialdehyde and glutathione levels. Int J Neurosci. 2004;114: 45-54.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Servais S. , Letexier D. , Favier R. , et al. Prevention of unloading-induced atrophy by vitamin E supplementation: links between oxidative stress and soleus muscle proteolysis? Free Radic Biol Med. 2007;42:627-635.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Kondo H. , Miura M. , Itokawa Y. Oxidative stress in skeletal muscle atrophied by immobilization. Acta Physiol Scand. 1991;142: 527-528.

[Google Scholar](#) | [Crossref](#) | [Medline](#)

---

Kondo H. , Miura M. , Nakagaki I. , et al. Trace element movement and oxidative stress in skeletal muscle atrophied by immobilization. Am J Physiol Endocrinol Metab . 1992;262:E583-E590.

[Google Scholar](#) | [Crossref](#)

---

---

Kondo H. , Kodama J. , Kishibe T. , et al.  
Oxidative stress during recovery from muscle atrophy. FEBS J. 1993;326:189-191.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Appell HJ , Duarte JAR , Soares JMC.  
Supplementation of vitamin E may attenuate skeletal muscle immobilization atrophy. Int J Sports Med. 1997;18:157-160.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Koesterer TJ , Dodd SL , Powers S. Increased antioxidant capacity does not attenuate muscle atrophy caused by unweighting. J Appl Physiol. 2002;93:1959-1965.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Ikemoto M. , Okamura Y. , Kano M. , et al. A relative high dose of vitamin E does not attenuate unweighting-induced oxidative stress and ubiquitination in rat skeletal muscle. J Physiol Anthropol Appl Human Sci. 2002;21:257-263.

[Google Scholar](#) | [Crossref](#) | [Medline](#)

---

Whidden MA , Smuder AJ , Wu M. , et al. Oxidative stress is required for mechanical ventilation-induced protease activation in the diaphragm. J Appl Physiol. 2010;108:1376-1382.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

McClung JM , Kavazis AN , Whidden MA , et al. Antioxidant administration attenuates mechanical ventilation-induced rat diaphragm muscle atrophy independent of protein kinase B (PKB/Akt) signaling . J Physiol. 2007;585:203-215.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Mastaloudis A. , Morrow JD , Hopkins DW , et al. Antioxidant supplementation prevents exercise-induced lipid peroxidation, but not inflammation, in ultramarathon runners. Free Radic Biol Med. 2004;36:1329-1341.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Mastaloudis A. , Yu T-W. , O'Neil RM , et al. Endurance exercise results in DNA damage as detected by the comet assay. Free Radic Biol Med. 2004;36:966-975.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

---

Howard C. , Ferrucci L. , Sun K. , et al. Oxidative protein damage is associated with poor grip strength among older women living in the community. J Appl Physiol . 2007;103:17-20.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Semba RD , Ferrucci L. , Sun K. , et al. Oxidative stress and severe walking disability among older women . Am J Med. 2007;120: 1084-1089.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Bernard S. , LeBlanc P. , Whittom F. , et al. Peripheral muscle weakness in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 1998;158:629-634.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Hambrecht R. , Adams V. , Gielen S. , et al. Exercise intolerance in patients with chronic heart failure and increased expression of inducible nitric oxide synthase in the skeletal muscle. J Am Coll Cardiol . 1999;33:174-179.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Szentesi P. , Bekedam MA , Beek-Harmsen BJ , et al. Depression of force production and ATPase activity in different types of human skeletal muscle fibers from patients with chronic heart failure. J Appl Physiol. 2005;99:2189-2195.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Minotti JR , Pillay P. , Oka R. , et al. Skeletal muscle size: relationship to muscle function in heart failure. J Appl Physiol. 1993;75: 373-381.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Lanone S. , Mebazaa A. , Heymes C. , et al. Muscular contractile failure in septic patients: role of the inducible nitric oxide synthase pathway. Am J Respir Crit Care Med. 2000;162: 2308-2315.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Sayer AA , Dennison EM , Syddall HE , et al. Type 2 diabetes, muscle strength, and impaired physical function: the tip of the iceberg? Diabetes Care. 2005 ;28:2541-2542.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Slemenda C. , Heilman DK , Brandt KD , et al. Reduced quadriceps strength relative to body

---

weight: a risk factor for knee osteoarthritis in women? *Arthritis Rheum.* 1998;41: 1951-1959.  
[Google Scholar](#) | [Crossref](#) | [Medline](#)

---

Petterson SC , Barrance P. , Buchanan T. , et al. Mechanisms underlying quadriceps weakness in knee osteoarthritis. *Med Sci Sports Exerc.* 2008;40:422-427.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Ogilvie AC , Groeneveld AB , Straub JP , et al. Plasma lipid peroxides and antioxidants in human septic shock. *Intensive Care Med.* 1991;17:40-44.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Tkacova R. , Kluchova Z. , Joppa P. , et al. Systemic inflammation and systemic oxidative stress in patients with acute exacerbations of COPD . *Respir Med.* 2007;101:1670-1676.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Barreiro E. , de la PB , Minguella J. , et al. Oxidative stress and respiratory muscle dysfunction in severe chronic obstructive pulmonary disease. *Am J Respir Crit Care Med.* 2005 ;171:1116-1124.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Riede UN , Forstermann U. , Drexler H. Inducible nitric oxide synthase in skeletal muscle of patients with chronic heart failure. *J Am Coll Cardiol.* 1998;32:964-969.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Ayilavarapu S. , Kantarci A. , Fredman G. , et al. Diabetes-induced oxidative stress is mediated by Ca<sup>2+</sup>-independent phospholipase A2 in neutrophils . *J Immunol.* 2010;184:1507-1515.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Altindag O. , Erel O. , Aksoy N. , et al. Increased oxidative stress and its relation with collagen metabolism in knee osteoarthritis. *Rheumatol Int.* 2007;27:339-344.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Surapaneni KM , Venkataramana G. Status of lipid peroxidation, glutathione, ascorbic acid, vitamin E and antioxidant enzymes in patients with osteoarthritis . *Indian J Med Sci.* 2007;61:9-14.

Pinto S. , Rao AV , Rao A. Lipid peroxidation, erythrocyte antioxidants and plasma antioxidants in osteoarthritis before and after homeopathic treatment. Homeopathy. 2008;97:185-189.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Andrade FH , Reid MR , Allen DG , et al. Effect of hydrogen peroxide and dithiothreitol on contractile function of single skeletal muscle fibres from the mouse. J Physiol. 1998;509:565-575.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Moopanar TR , Allen DG Reactive oxygen species reduce myofibrillar Ca<sup>2+</sup> sensitivity in fatiguing mouse skeletal muscle at 37 degrees C. J Physiol. 2005;564:189-199.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Reid MB , Stokic DS , Koch SM , et al. N-acetylcysteine inhibits muscle fatigue in humans. J Clin Invest. 1994;94:2468-2474.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Barker T. , Leonard SW , Trawick RH , et al. Modulation of inflammation by vitamin E and C supplementation prior to anterior cruciate ligament surgery. Free Radic Biol Med. 2009; 46:599-606.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Barker T. , Leonard SW , Trawick RH , et al. Antioxidant supplementation lowers circulating IGF-1 but not F2-isoprostanes immediately following ACL surgery. Redox Rep . 2009;14: 221-226.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Kondo H. , Miura M. , Kodama J. , et al. Role of iron in oxidative stress in skeletal muscle atrophied by immobilization. Pflugers Arch. 1992;421:295-297.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Kondo H. , Nakagaki I. , Sasaki S. , et al. Mechanism of oxidative stress in skeletal muscle atrophied by immobilization. Am J Physiol Endocrinol Metab. 1993;28:E839-E844.

[Google Scholar](#) | [Crossref](#)

---

---

Kondo H. , Nishino K. , Itokawa Y. Hydroxyl radical generation in skeletal muscle atrophied by immobilization . FEBS Lett. 1994; 349:169-182.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Lawler JM , Song W. , Demaree SR Hindlimb unloading increases oxidative stress and disrupts antioxidant capacity in skeletal muscle. Free Radic Biol Med. 2003 ;35:9-16.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Zergeroglu MA , McKenzie MJ , Shanely RA , et al. Mechanical ventilation-induced oxidative stress in the diaphragm. J Appl Physiol. 2003 ;95:1116-1124.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Liu MJ , Li JX , Lee KM , et al. Oxidative stress after muscle damage from immobilization and remobilization occurs locally and systemically. Clin Orthop Relat Res. 2005;434:246-250.  
[Google Scholar](#)

---

Selsby JT , Dodd SL Heat treatment reduces oxidative stress and protects muscle mass during immobilization . Am J Physiol Regul Integr Comp Physiol. 2005;289:R134-R139.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Arbogast S. , Smith J. , Matuszczak Y. , et al. Bowman-Birk inhibitor concentrate prevents atrophy, weakness, and oxidative stress in soleus muscle of hindlimb-unloaded mice. J Appl Physiol. 2006;102:956-964.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Falk DJ , DeRuisseau KC , Van Gammeren DL , et al. Mechanical ventilation promotes redox status alterations in the diaphragm. J Appl Physiol. 2006;101:1017-1024.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Suzuki N. , Motohashi N. , Uezumi A. , et al. NO production results in suspension-induced muscle atrophy through dislocation of neuronal NOS. J Clin Invest. 2007;117:2468-2476.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Dodd SL , Gagnon BJ , Senf SM , et al. Ros-mediated activation of NF-kappaB and Foxo



---

during muscle disuse. Muscle Nerve. 2009;41: 110-113.

[Google Scholar](#) | [Crossref](#) | [ISI](#)

---

Brocca L. , Pellegrino MA , Desaphy JF , et al. Is oxidative stress a cause or consequence of disuse muscle atrophy in mice? A proteomic approach in hindlimb unloaded mice. Exp Physiol. 2009; 95:331-350.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Kavazis AN , Talbert EE , Smuder AJ , et al. Mechanical ventilation induces diaphragmatic mitochondrial dysfunction and increased oxidant production. Free Radic Biol Med. 2009;46: 842-850.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Whidden MA , McClung JM , Falk DJ , et al. Xanthine oxidase contributes to mechanical ventilation-induced diaphragmatic oxidative stress and contractile dysfunction. J Appl Physiol. 2009;106:385-394.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Abruzzo PM , di Tullio S. , Marchionni C. , et al. Oxidative stress in the denervated muscle. Free Radic Res. 2010;44:563-576.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Hudson NJ , Lehnert SA , Ingham AB , et al. Lessons from an estivating frog: sparing muscle protein despite starvation and disuse. Am J Physiol Regul Integr Comp Physiol . 2006;290: R836-R843.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Barker T. , Traber MG From animals to humans: evidence linking oxidative stress as a causative factor in muscle atrophy. J Physiol. 2007;583: 421-422.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Barker T. , Traber MG Response to the letter to the editor by Rennie et al. J Physiol. 2008 ;586:309-310.

[Google Scholar](#) | [ISI](#)

---

Rennie MJ , Atherton P. , Selby A. , et al. Letter to the editor on the journal club article by Barker

---

and Traber. J Physiol. 2008;586: 307-308.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Levine S. , Nguyen T. , Taylor N. , et al. Rapid disuse atrophy of diaphragm fibers in mechanically ventilated humans. N Engl J Med. 2008;358:1327-1335.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Dalla LL , Ravara B. , Gobbo V. , et al. A transient antioxidant stress response accompanies the onset of disuse atrophy in human skeletal muscle. J Appl Physiol . 2009 ;107:549-557.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Brocca L. , Borina E. , Pellegrino MA , et al. Qualitative and quantitative adaptations of muscle fibers and muscle protein pattern to 35-days bed rest. Basic Appl Myol . 2009;19:117-126.

[Google Scholar](#)

---

Glover EI , Yasuda N. , Tarnopolsky MA , et al. Little change in markers of protein breakdown and oxidative stress in humans in immobilization-induced skeletal muscle atrophy. Appl Physiol Nutr Metab. 2010;35:125-133.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Frost RA , Nystrom GJ , Lang CH Tumor necrosis factor- $\alpha$  decreases insulin-like growth factor-I messenger ribonucleic acid expression in C2C12 myoblasts via a Jun N-terminal kinase pathway. Endocrinology. 2003;144:1770-1779.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Mallat Z. , Heymes C. , Ohan J. , et al. Expression of interleukin-10 in advanced human atherosclerotic plaques: relation to inducible nitric oxide synthase expression and cell death . Arterioscler Thromb Vasc Biol. 1999;19:611-616.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Adams V. , Jiang H. , Yu J. , et al. Apoptosis in skeletal myocytes of patients with chronic heart failure is associated with exercise intolerance. J Am Coll Cardiol. 1999;33:959-965.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Qi WN , Chen LE , Zhang L. , et al. Reperfusion

---

injury in skeletal muscle is reduced in inducible nitric oxide synthase knockout mice. J Appl Physiol. 2004;97:1323-1328.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Zhang L. , Looney CG , Qi W-N. , et al. Reperfusion injury is reduced in skeletal muscle by inhibition of inducible nitric oxide synthase. J Appl Physiol. 2003;94:1473-1478.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Pacher P. , Beckman JS , Liaudet L. Nitric oxide and peroxynitrite in health and disease. Physiol Rev. 2007;87:315-424.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Beckman JS , Ischiropoulos H. , Zhu L. , et al. Kinetics of superoxide dismutase- and iron-catalyzed nitration of phenolics by peroxynitrite . Arch Biochem Biophys. 1992;298:438-445.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Beckmann JS , Ye YZ , Anderson PG , et al. Extensive nitration of protein tyrosines in human atherosclerosis detected by immunohistochemistry . Biol Chem Hoppe Seyler. 1994; 375:81-88.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Ischiropoulos H. , Zhu L. , Beckman JS Peroxynitrite formation from macrophage-derived nitric oxide. Arch Biochem Biophys . 1992 ;298:446-451.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Ischiropoulos H. , Zhu L. , Chen J. , et al. Peroxynitrite-mediated tyrosine nitration catalyzed by superoxide dismutase. Arch Biochem Biophys. 1992;298:431-437.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Phillips L. , Toledo AH , Lopez-Neblina F. , et al. Nitric oxide mechanism of protection in ischemia and reperfusion injury. J Invest Surg. 2009;22: 46-55.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Takano H. , Manchikalapudi S. , Tang XL , et al. Nitric oxide synthase is the mediator of late preconditioning against myocardial infarction in conscious rabbits. Circulation . 1998;98: 441-449.

Guo Y. , Jones WK , Xuan YT , et al. The late phase of ischemic preconditioning is abrogated by targeted disruption of the inducible NO synthase gene. Proc Natl Acad Sci U S A. 1999;96: 11507-11512.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Xi L. , Jarrett NC , Hess ML , et al. Essential role of inducible nitric oxide synthase in monophosphoryl lipid A-induced late cardio-protection: evidence from pharmacological inhibition and gene knockout mice. Circulation. 1999;99:2157-2163.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Li G. , Labruto F. , Sirsjo A. , et al. Myocardial protection by remote preconditioning: the role of nuclear factor kappa-B p105 and inducible nitric oxide synthase. Eur J Cardiothorac Surg. 2004;26:968-973.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Chen CH , Chuang JH , Liu K. , et al. Nitric oxide triggers delayed anesthetic preconditioning-induced cardiac protection via activation of nuclear factor-kappaB and upregulation of inducible nitric oxide synthase. Shock. 2008;30:241-249.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Huang J. , Forsberg NE Role of calpain in skeletal-muscle protein degradation. Proc Natl Acad Sci U S A. 1998;95: 12100-12105.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Smith IJ , Dodd SL Calpain activation causes a proteasome dependent increase in protein degradation and inhibits the Akt signaling pathway in rat diaphragm muscle . Exp Physiol. 2007 ;92:561-573.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

McClung JM , Judge AR , Talbert EE , et al. Calpain-1 is required for hydrogen peroxide-induced myotube atrophy. Am J Physiol Cell Physiol. 2009;296:C363-C371.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Smuder AJ , Kavazis AN , Hudson MB , et al.

---

Oxidation enhances myofibrillar protein degradation via calpain and caspase-3. Free Radic Biol Med. 2010;49:1152-1160.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Bettters JL , Criswell DS , Shanely RA , et al. Trolox attenuates mechanical ventilation-induced diaphragmatic dysfunction and proteolysis. Am J Respir Crit Care Med. 2004;170: 1179-1184.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Ikegami K. , Lalonde C. , Young YK , et al. Comparison of plasma reduced glutathione and oxidized glutathione with lung and liver tissue oxidant and antioxidant activity during acute inflammation . Shock. 1994;1:307-312.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Jiang Q. , Lykkesfeldt J. , Shigenaga MK , et al. Gamma-tocopherol supplementation inhibits protein nitration and ascorbate oxidation in rats with inflammation. Free Radic Biol Med. 2002;33: 1534-1542.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Lang CH , Frost RA , Nairn AC , et al. TNF-alpha impairs heart and skeletal muscle protein synthesis by altering translation initiation. Am J Physiol Endocrinol Metab. 2002;282: E336-E347.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Li W. , Moylan JS , Chambers MA , et al. Interleukin-1 stimulates catabolism in C2C12 myotubes. Am J Physiol Cell Physiol. 2009 ;297:C706-C714.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Strle K. , Broussard SR , McCusker RH , et al. Proinflammatory cytokine impairment of insulin-like growth factor I-induced protein synthesis in skeletal muscle myoblasts requires ceramide . Endocrinology. 2004;145:4592-4602.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Broussard SR , McCusker RH , Novakofski JE , et al. Cytokine-hormone interactions: tumor necrosis factor alpha impairs biologic activity and downstream activation signals of the insulin-like growth factor I receptor in myoblasts . Endocrinology. 2003;144: 2988-2996.

Wilcox PG , Wakai Y. , Walley KR , et al. Tumor necrosis factor  $\alpha$  decreases in vivo diaphragm contractility in dogs. Am J Respir Crit Care Med. 1994;150:1368-1373.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Li X. , Moody MR , Engel D. , et al. Cardiac-specific overexpression of tumor necrosis factor- $\alpha$  causes oxidative stress and contractile dysfunction in mouse diaphragm. Circulation. 2000;102:1690-1696.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Hardin BJ , Campbell KS , Smith JD , et al. TNF- $\alpha$  acts via TNFR1 and muscle-derived oxidants to depress myofibrillar force in murine skeletal muscle. J Appl Physiol . 2008;104:694-699.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Divangahi M. , Demoule A. , Danialou G. , et al. Impact of IL-10 on diaphragmatic cytokine expression and contractility during Pseudomonas infection. Am J Respir Cell Mol Biol. 2007 ;36: 504-512.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Meador BM , Krzyszton CP , Johnson RW , et al. Effects of IL-10 and age on IL-6, IL-1 $\beta$ , and TNF- $\alpha$  responses in mouse skeletal and cardiac muscle to an acute inflammatory insult. J Appl Physiol. 2008;104:991-997.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Krzyszton CP , Sparkman NL , Grant RW , et al. Exacerbated fatigue and motor deficits in interleukin-10-deficient mice after peripheral immune stimulation. Am J Physiol Regul Integr Comp Physiol . 2008;295:R1109-R1114.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Yende S. , Waterer GW , Tolley EA , et al. Inflammatory markers are associated with ventilatory limitation and muscle dysfunction in obstructive lung disease in well functioning elderly subjects. Thorax. 2006;61:10-16.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

---

Adams V. , Nehrhoff B. , Spate U. , et al.  
Induction of iNOS expression in skeletal muscle  
by IL-1beta and NFkappaB activation: an in vitro  
and in vivo study. Cardiovasc Res. 2002;54: 95-  
104.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Niebauer J. , Pflaum CD , Clark AL , et al.  
Deficient insulin-like growth factor I in chronic  
heart failure predicts altered body composition,  
anabolic deficiency, cytokine and neurohormonal  
activation. J Am Coll Cardiol. 1998;32:393-397.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Levine B. , Kalman J. , Mayer L. , et al. Elevated  
circulating levels of tumor necrosis factor in severe  
chronic heart failure. N Engl J Med. 1990  
;323:236-241.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Larsen AI , Lindal S. , Aukrust P. , et al. Effect of  
exercise training on skeletal muscle fibre  
characteristics in men with chronic heart failure:  
correlation between skeletal muscle alterations,  
cytokines and exercise capacity. Int J Cardiol.  
2002;83:25-32.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Meduri GU , Headley S. , Kohler G. , et al.  
Persistent elevation of inflammatory cytokines  
predicts a poor outcome in ARDS. Plasma IL-1  
beta and IL-6 levels are consistent and efficient  
predictors of outcome over time. Chest. 1995  
;107:1062-1073.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Cavallo MG , Pozzilli P. , Bird C. , et al.  
Cytokines in sera from insulin-dependent diabetic  
patients at diagnosis. Clin Exp Immunol.  
1991;86:256-259.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Smith MD , Triantafillou S. , Parker A. , et al.  
Synovial membrane inflammation and cytokine  
production in patients with early osteoarthritis. J  
Rheumatol. 1997 ;24:365-371.

[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Cannon JG , Meydani SN , Fielding RA , et al.  
Acute phase response in exercise. II. Associations

---

between vitamin E, cytokines, and muscle proteolysis. Am J Physiol Regul Integr Comp Physiol. 1991;260:R1235-R1240.

[Google Scholar](#) | [Crossref](#)

---

Devaraj S. , Tang R. , Adams-Huet B. , et al. Effect of high-dose alpha-tocopherol supplementation on biomarkers of oxidative stress and inflammation and carotid atherosclerosis in patients with coronary artery disease. Am J Clin Nutr. 2007;86: 1392-1398.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Fischer CP , Hiscock NJ , Penkowa M. , et al. Supplementation with vitamins C and E inhibits the release of interleukin-6 from contracting human skeletal muscle . J Physiol. 2004;558: 633-645.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Li YP , Schwartz RJ , Waddell ID , et al. Skeletal muscle myocytes undergo protein loss and reactive oxygen-mediated NF- $\kappa$ B activation in response to tumor necrosis factor  $\alpha$ . FASEB J. 1998;12:871-880.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Buck M. , Chojkier M. Muscle wasting and dedifferentiation induced by oxidative stress in a murine model of cachexia is prevented by inhibitors of nitric oxide synthesis and antioxidants. EMBO J. 1996;15:1753-1765.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Goodman MN Tumor necrosis factor induces skeletal muscle protein breakdown in rats. Am J Physiol Endocrinol Metab. 1991;260:E727-E730.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Li YP , Reid MB NF- $\kappa$ B mediates the protein loss induced by TNF- $\alpha$  in differentiated skeletal muscle myotubes. Am J Physiol Regul Integr Comp Physiol . 2000;279:R1165-R1170. 188. Haddad F. , Zaldivar F. , Cooper DM , et al. IL-6-induced muscle atrophy. J Appl Physiol . 2005;98:911-917.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Cameron M. , Buchgraber A. , Passler H. , et al. The natural history of the anterior cruciate



---

ligament-deficient knee: changes in synovial fluid cytokine and keratan sulfate concentrations. Am J Sports Med. 1997 ;25:751-754.

[Google Scholar](#) | [SAGE Journals](#) | [ISI](#)

---

Irie K. , Uchiyama E. , Iwaso H. Intraarticular inflammatory cytokines in acute anterior cruciate ligament injured knee. Knee. 2003;10:93-96.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Higuchi H. , Shirakura K. , Kimura M. , et al. Changes in biochemical parameters after anterior cruciate ligament injury. Int Orthop. 2006;30:43-47.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Elsaid KA , Fleming BC , Oksendahl HL , et al. Decreased lubricin concentrations and markers of joint inflammation in the synovial fluid of patients with anterior cruciate ligament injury. Arthritis Rheum. 2008;58:1707-1715.

[Google Scholar](#) | [Crossref](#) | [Medline](#)

---

Willy C. , Dahouk S. , Starck C. , et al. DNA damage in human leukocytes after ischemia/reperfusion injury . Free Radic Biol Med. 2000;28:1-12.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Saricaoglu F. , Dal D. , Salman AE , et al. Effect of low-dose n-acetyl-cysteine infusion on tourniquet-induced ischaemia-reperfusion injury in arthroscopic knee surgery. Acta Anaesthesiol Scand. 2005 ;49:847-851.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Le Moine O. , Louis H. , Stordeur P. , et al. Role of reactive oxygen intermediates in interleukin 10 release after cold liver ischemia and reperfusion in mice . Gastroenterology. 1997 ;113: 1701-1706.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Haddad JJ , Fahlman CS Redox- and oxidant-mediated regulation of interleukin-10: an anti-inflammatory, antioxidant cytokine? Biochem Biophys Res Commun. 2002;297:163-176.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Wanidworanun C. , Strober W. Predominant role of tumor necrosis factor-alpha in human monocyte

---

IL-10 synthesis. J Immunol . 1993;151:6853-6861.  
[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Tilg H. , Atkins MB , Dinarello CA , et al.  
Induction of circulating interleukin 10 by interleukin  
1 and interleukin 2, but not interleukin 6  
immunotherapy. Cytokine . 1995;7:734-739.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Daftarian PM , Kumar A. , Kryworuchko M. , et al.  
IL-10 production is enhanced in human T cells by  
IL-12 and IL-6 and in monocytes by tumor  
necrosis factor-alpha . J Immunol. 1996;157:12-  
20.  
[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Garcia CA , Wang H. , Benakanakere MR , et al.  
c-Jun controls the ability of IL-12 to induce IL-10  
production from human memory CD4+ T cells. J  
Immunol. 2009;183:4475-4482.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Jeschke MG , Barrow RE , Suzuki F. , et al. IGF-  
I/IGFBP-3 equilibrates ratios of pro- to anti-  
inflammatory cytokines, which are predictors for  
organ function in severely burned pediatric  
patients. Mol Med. 2002;8:238-246.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Warzecha Z. , Dembinski A. , Ceranowicz P. , et  
al. IGF-1 stimulates production of interleukin-10  
and inhibits development of caeruleininduced  
pancreatitis. J Physiol Pharmacol. 2003;54:  
575-590.  
[Google Scholar](#) | [Medline](#) | [ISI](#)

---

Kooijman R. , Coppens A. Insulin-like growth  
factor-I stimulates IL-10 production in human T  
cells. J Leukoc Biol. 2004;76: 862-867.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Zysk SP , Fraunberger P. , Veihelmann A. , et al.  
Tunnel enlargement and changes in synovial fluid  
cytokine profile following anterior cruciate  
ligament reconstruction with petallar tendon and  
hamstring tendon autografts. Knee Surg Sports  
Traumatol Arthrosc. 2004;12:98-103.  
[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Ling PR , Schwartz JH , Bistrian BR Mechanisms

---

of host wasting induced by administration of cytokines in rats . Am J Physiol Endocrinol Metab. 1997;272:E333-E339.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Langen RCJ , Schols Amwj , Kelders Mcjm , et al. Inflammatory cytokines inhibit myogenic differentiation through activation of nuclear factor- $\kappa$ B . FASEB J. 2001;15:1169-1180.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Bodine SC , Latres E. , Baumhueter S. , et al. Identification of ubiquitin ligases required for skeletal muscle atrophy. Science. 2001;294:1704-1708.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Broussard SR , McCusker RH , Novakofski JE , et al. IL-1 $\beta$  impairs insulin-like growth factor i-induced differentiation and downstream activation signals of the insulin-like growth factor i receptor in myoblasts. J Immunol . 2004;172:7713-7720.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Elliott S. , Hays E. , Mayor M. , et al. The triterpenoid CDDO inhibits expression of matrix metalloproteinase-1, matrix metalloproteinase-13 and Bcl-3 in primary human chondrocytes. Arthritis Res Ther . 2003 ;5:R285-R291.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Pfander D. , Heinz N. , Rothe P. , et al. Tenascin and aggrecan expression by articular chondrocytes is influenced by interleukin 1 $\beta$ : a possible explanation for the changes in matrix synthesis during osteoarthritis . Ann Rheum Dis. 2004;63:240-244.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Fan Z. , Bau B. , Yang H. , et al. Freshly isolated osteoarthritic chondrocytes are catabolically more active than normal chondrocytes, but less responsive to catabolic stimulation with interleukin-1 $\beta$ . Arthritis Rheum. 2005;52:136-143.

[Google Scholar](#) | [Crossref](#) | [Medline](#)

---

Darabos N. , Hundric-Haspl Z. , Haspl M. , et al. Correlation between synovial fluid and serum IL-1 $\beta$  levels after ACL surgery-preliminary

---

report. Int Orthop. 2009;33:413-418.

[Google Scholar](#) | [Crossref](#) | [Medline](#) | [ISI](#)

---

Daniel DM , Stone ML , Dobson BE , et al. Fate of the ACL-injured patient. Am J Sports Med. 1994;22:632-644. 214. Ferretti A. , Conteduca F. , De Carli A. , et al. Osteoarthritis of the knee after ACL reconstruction. Int Orthop. 1991;15:367-371. [Google Scholar](#) | [SAGE Journals](#) | [ISI](#)

[View access options](#)

## My Account

Welcome

You do not have access to this content.

[Sign Out](#)

```
var href = window.location; if (window.location.href.indexOf('verifyEmail')!=-1)
href=window.location.origin;
//document.getElementById('returnLink').href="/action/doLogout?redirectUri="+href;
$('.logOut').attr("href", "/action/doLogout?redirectUri="+href);
```

---

```
let $user=$('#portalLoginBar .my-profile-col.id-person-activated'); if ($user && $user.attr('name') && $user.attr('name').length>0) $('<u>+$user.attr('name')</u>').appendTo('#denial-welcome span.individualUser');
```

Email (required)  
Password (required)  
Remember me

[Forgotten your password?](#)

[Need to activate?](#)

[Need Help?](#)

**Chinese Institutions / 中 国 机 构**

Click the button below for the full-text content

[illegible]

[Click here to view / ã§Ä.Â¹Ã¥Ä±Ä»Ã¨ÄŽÄ.Ã¥Ä•Ä–Ã¥Ä Ä¨Ä!Ä–Ä±](#)

Need Help?

```
document.getElementById("denial-2-cn").style.display = "block";
document.getElementById("denial-2").style.display = "none";
```

## Institutional Access

---

does not have access to this content.

```
if ($('#span.institutionBannerText').length===0) { if ($('#img#accessLogo').length===0) { $('#denial-  
institution').hide(); } else { var altText = $('.welcome span.institutionBannerLogo img').attr("alt"); var  
hrefText = $('.welcome span.institutionBannerLogo a').attr("href"); console.log(altText+'-'+hrefText); if  
(!altText || altText.length===0) $('.welcome span.institutionBannerLogo').clone().prependTo('#denial-  
institution div.error:first'); else { if (!hrefText || hrefText.length===0) $('#denial-institution  
div.error:first').prepend("+altText+"); else $('#denial-institution div.error:first').prepend("+altText+"); } }  
}
```

[Shibboleth](#)

[Open Athens](#)

[Need Help?](#)

Members of \_ can log in with their society credentials below

Username (required)

Password (required)

Society (required)

---

## Purchase Content

24 hours online access to download content

```
$('.addOffer input[name="backUri"]').val(window.location.pathname); $(document).ready(function() {
var ppvOffers=0; var articleTitle="Does Vitamin E and C Supplementation Improve the Recovery
From Anterior Cruciate Ligament Surgery?"; $('.ecommDenial
#ecommerceForm>div').each(function(){ try{ let
offerText=$(this).find('b')[0].text().trim().toLowerCase(); let
offerId=$(this).find('input[name="offerId"]')[0].val(); let offerValue=" for "; if (offerText.length // Here
we keep the JS functions that use context sensitive parameters, since these are not working outside
of HTML assets (e.g. in js files) function removeTlaFromTaxonomyFacet() { //SAGE-2005
$("li.ConceptID.parentFacets").each(function(){ let $link = $(this).find(".facet-link-container a"); if
($link.length) { if ($link[0].innerHTML.toLowerCase().trim() === "chp".toLowerCase()) {
$(this).css("display", "none"); // hide this //console.log("Removed TLA code from taxonomy filter"); if
$(this).parents(".hiddenChildrenFacets").length) { // If TLA code found in hidden facets, change the
More(n) text to More(n-1) $(this).parents("div.facetContainer").find("div.toggleMoreFacets a.facet-
link").each(function(){ if (this.innerHTML.toLowerCase().indexOf("more (") !== -1) { let moreNumber =
this.innerHTML.match(/<math>d+</math>)[0]; if (moreNumber > 1) $(this).text($(this).text().replace(moreNumber,
moreNumber - 1)); else // if only one was hidden, no need to expand $(this).parent().css("display",
"none"); } }); } }); } function cpTitlesDates() { if ('cpv'==='cp' || 'cpv'==='cpv') { $('<div>.pubDate-
left').addClass('not-show-important'); } } function deniedPdfAccess() { if
($('div#accessOptionsTop').length > 0) { // clicked on page with access denial bar toggleDenialBar();
$('div#accessOptionsTop input#login').focus(); } else { // no access denial bar window.location =
'/doi/pdf/10.1177/1533210110392954'; } } function accesibilityImageAltText() {
$('.moreFromThisJournalModules img').each(function(){ if ($(this).attr('alt')===undefined)
$(this).attr('alt', ""); }); $('div.portalResourcesContainer img, .tellUsImage img').attr('alt', "");
$('.relatedJournalsTextContainer').each(function(){ let $journalText = $(this);
```



```

$journalText.closest('.relatedJournalsColumn>a').append($journalText.text()); $journalText.remove();
}); $('<span>.relatedJournalsImageContainer img</span>').each(function(){ let $coverImage = $(this); let $parent =
$(this).parent(); $coverImage.addClass('relatedJournalsImageContainer');
$coverImage.prependTo($coverImage.closest('.relatedJournalsColumn>a')); $parent.remove(); });
$('td.savedSearch.savedResult:nth-child(4) img').attr('alt', function() { return
$(this).attr('alt').replace('alert type', 'saved date'); }) $('td.savedSearch.savedResult:nth-child(5)
img').attr('alt', function() { return $(this).attr('alt').replace('alert type', 'last run date'); }) } //run these
before document finished loading //SAGE-1878 //if ($('<span>.more-than</span>').offset().left 0) $('<div>.pb-ui
.accessOptionsBar</div>').css('display', 'block'); else $('<div>.pb-ui .accessOptionsBar</div>').hide(); if ($('<span>.related-
Article-wrapper span</span>').length===0) $('<span>.related-Article-wrapper</span>').hide(); cpTitlesDates(); // Add
data module attributes in related journals HTML widget $("<div>.otherSociety</div>").attr("data-module-name",
"related-journals"); $("<div>.otherSocietyButton #viewMoreText</div>").attr("data-item-name", "view-more");
$("<div>.otherSocietyButton #viewLessText</div>").attr("data-item-name", "view-fewer"); $("<div>.otherSocietyButton
#viewFewerText</div>").attr("data-item-name", "view-fewer"); // Add a separator before issue
// $('<div>.mostReadCited .contentItemIssue</div>').text(function () { // if ($(this).text().trim().length > 0 &&
$(this).text().trim().indexOf('-')!=0) // return '- '+$(this).text(); //}); //Move related articles indication into
proper place: $('<span>.related-Article-wrapper</span>').insertAfter('div.articleInformation'); $('<div>.related-article-
title</div>').text(function() { return $(this).text().replace(/s*/, ' '); }); $('<div>.online-pub-date</div>').text(function() {
return $(this).text().replace(/-g, ' '); }); $('<div>.contentItemVol</div>').text(function() { return
$(this).text().replace('Vol 0,', '').replace('Vol.', 'Vol ').replace(/s*/, ' '); });
$('<div>.issueFormat</div>').text(function() { return $(this).text().replace('issue', 'Issue').replace('vol.',
'Vol').replace(/s*/, ' '); }); //Remove trailing dot from a.deleteAccountLink
$('<div>.a.deleteAccountLink</div>').text('Delete your account'); //Remove trailing dot from a.deleteAccountLink
$('<div>.a#copyToClipboard</div>').text('Copy to Clipboard'); // Rename "Views" to "Views and downloads"
$('<div>.view-count</div>').text(function() { if (inJournalScope()) return $(this).text().replace('Views:', 'Views &
downloads:'); else return $(this).text(); }); // Keep only anchor element if already in citedBy page if
($('<div>.view-all-citedBy a</div>').attr('href') === window.location.pathname) $('<div>.view-all-citedBy a</div>').attr('href', '');
// Add #top-content-scroll on 'View All' citedBy link $('<div>.view-all-citedBy a</div>').attr('href', $('<div>.view-all-
citedBy a</div>').attr('href') + '#top-content-scroll'); // Change MR/MC panel text $('<div>#mostReadCitedPage
.online-pub-date</div>').text(function() { return $(this).text().replace("Online publication date", "First
published"); }); //Wait for images to load, before deciding whether to move the related journals
$('<div>.journalHomeFourRight</div>').imagesLoaded().always(function(){ moveRelatedJournals();
//console.log('Ad(right) image is loaded'); }); // Fix for 'more...' label falling into 2nd line if ($('<div>.authors
.more-than</div>').length && $('<div>.authors .more-than</div>').offset().left 1)
$('<input[name=AllField]</input>').autocomplete('close'); } catch(e) {} }); //console.log('Journal: Journal of
Evidence-Based Integrative Medicine, Issue: , Article: Does Vitamin E and C Supplementation
Improve the Recovery From Anterior Cruciate Ligament Surgery?');

```

---

[Streaming video collections](#)

- [SAGE Knowledge](#)

[The ultimate social sciences library](#)

- [SAGE Research Methods](#)

[The ultimate methods library](#)

- [SAGE Stats](#)

[Data on Demand](#)

- [CQ Library](#)

[American political resources](#)

## **SAGE Journals**

[About](#)

[Privacy Policy](#)

[Terms of Use](#)

[Contact Us](#)

[Help](#)

## **Browse**

[Health Sciences](#)

[Life Sciences](#)

[Materials Science & Engineering](#)

[Social Sciences & Humanities](#)

[Journals A-Z](#)

## **Resources**

---

[Authors](#)  
[Editors](#)  
[Reviewers](#)  
[Librarians](#)  
[Researchers](#)  
[Societies](#)

## Opportunities

[Advertising](#)  
[Reprints](#)  
[Content Sponsorships](#)  
[Permissions](#)

## Journal of Evidence-Based Integrative Medicine

ISSN: 2515-690X  
Online ISSN: 2515-690X

Copyright © 2018 by SAGE Publications

showDfpAd(4)

---

[Top](#) var dataLayer = dataLayer || []; dataLayer.push({"site":{"environment":"live","platform":"responsive-web"},"page":{"title":"Does Vitamin E and C Supplementation Improve the Recovery From Anterior Cruciate Ligament Surgery?: Journal of Evidence-Based Complementary & Alternative Medicine: Vol 16, No 2","type":"article/chapter-view"},"user":{"action":"showAbstract","id":596907869,"type":[],"loginStatus":false,"authentication":false,"subscriptions":[],"institution":["National Science Library"]},"product":{"type":"article","format":"electronic","journal":{"name":"Journal of Evidence-Based Integrative Medicine","tla":"CHP","category":[],"subCategory":[],"open\_access":false,"e\_issn":"2515-690X","p\_issn":"2515-690X","issue":{"volume":"16","number":"2","article":{"doi":"10.1177/1533210110392954"},"title":"Does Vitamin E and C Supplementation Improve the Recovery From Anterior Cruciate Ligament Surgery?"}}}}}); (function(w,d,s,l,i){w[l]=w[l]||[];w[l].push({'gtm.start':new Date().getTime(),event:'gtm.js'});var f=d.getElementsByTagName(s)[0],j=d.createElement(s),dl=!!'dataLayer'?'&l='+l:'';j.async=true;j.src='https://www.googletagmanager.com/gtm.js?id='+i+dl;f.parentNode.insertBefore(j,f)})(window,document,'script','dataLayer','GTM-5M58KS');