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WEVERTON RUFO TAVARES DA SILVA

EFEITO DE 10 SEMANAS DE TREINAMENTO COM *KETTLEBELL* E DESTREINAMENTO DE CURTO PRAZO, SOBRE A FORÇA, POTÊNCIA, DISTÚRBIO DE HUMOR, SONO E QUALIDADE DE VIDA EM MULHERES JOVENS SAUDÁVEIS

VITÓRIA
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Dissertação apresentada como requisito para obtenção de título de Mestre em Educação Física junto ao Programa de Pós-graduação em Educação Física do Centro de Educação Física e Desportos da Universidade Federal do Espírito Santo.

Área de concentração: Educação física, movimento corporal humano e saúde.

Orientador: Prof. Dr. Rodrigo Luiz Vancini

VITÓRIA

2017

WEVERTON RUFO TAVARES DA SILVA

Laboratório de Força e Condicionamento (LAFEC), Centro de Educação Física e Desportos, Universidade Federal do Espírito Santo – UFES, Vitória/ES.

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Dissertação apresentada ao Programa de Pós-graduação em Educação Física do Centro de Educação Física e Desportos da Universidade Federal do Espírito Santo.

Avaliado em: ____ de _______ de _____.

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Galileu Galilei

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1. INTRODUÇÃO

Ao longo da última década o exercício com *kettlebell* tem desfrutado de uma reintrodução bem-sucedida na indústria do *fitness*. O mesmo consiste de exercícios balísticos e com técnica relativamente simples, além de ter capacidade de envolver o corpo inteiro (LAKE & LAUDER, 2012). O "kettlebell" ou *Gyria* é uma bola de ferro tradicional usado na antiga União Soviética (URSS), que se parece com uma bola de canhão com uma alça. Foi tão popular nesse país que qualquer homem forte ou levantador de peso era chamado de "girevik", ou "homem kettlebell". Em 1945 aconteceu o primeiro campeonato nacional de levantamento de *kettlebells* na Rússia, e nas olímpiadas de 1980 o *kettlebell* passou a fazer parte da preparação dos atletas de atletismo da equipe russa. Assim com o passar do tempo, o *kettlebell* se tornou muito pular na Rússia como uma possível ferramenta para aprimorar o condicionamento físico, manter a população saudável, diminuir gastos com o sistema de saúde e aumentar a produtividade do trabalhador braçal (TSATSOULINE, 2006).

Atualmente, o exercício com *kettlebell* tornou-se popular pelo baixo custo e pela possibilidade de aprimorar simultaneamente a capacidade e potência aeróbia e anaeróbia. Alguns estudos apontam que o treinamento com *kettlebell* é capaz de provocar importantes respostas cardiorrespiratórias agudas (FARRAR et al., 2010; HULSEY et al., 2012; THOMAS et al., 2014; FORTNER et al., 2014; WILLIAMS & KRAEMER, 2015) e crônicas (JAY et al., 2011; BELTZ el al., 2013; FALATIC et al., 2015).

Jay et al. (2011), não constataram diferença significativa na potência cardiorrespiratória, após oito semanas de treinamento em adultos sem experiência com *kettlebell e* com alta prevalência de dor musculo esquelética nos ombros e pescoço. Por outro lado, Beltz et al. (2013) relataram que após oito semanas de treinamento com *kettlebell,* o consumo máximo de oxigênio ($\dot{V}O_2$máx) de estudantes universitários recreacionalmente ativos, aumentou 13,8%, enquanto não foram encontradas alterações significativas no grupo controle. Falatic et al. (2015) avaliaram o efeito de um programa de treinamento com *kettlebell* sobre a capacidade aeróbica de atletas de futebol do sexo feminino com experiência no método, e concluíram que quatro semanas de treinamento foi eficaz para melhorar significativamente (≈6%) o $\dot{V}O_2$máx das atletas.

Tradicionalmente o levantamento de peso com *kettlebell* era utilizado para ganhos de força muscular e um dos principais benefícios apontados pelos entusiastas do método, é o argumento de que uma típica rotina com esta ferramenta desenvolve, simultaneamente, além do sistema cardiorrespiratório, a resistência, a força e potência muscular (TSATSOULINE, 2006).

Os estudos que avaliam o impacto dessa ferramenta sobre o desenvolvimento da capacidade e potência anaeróbia de forma crônica são relativamente recentes. Nesse sentido os trabalhos encontrados demonstram que os ganhos podem variar entre 12 a 25% para força máxima e 2 a 15% para força explosiva, dependendo da duração do plano de treinamento, população estudada e intensidade das sessões (COBURN et al., 2012; LAKE & LAUDER, 2012; MANOCCHIA, SPIERER, et al., 2013; BELTZ, ERBES, et al., 2013; JAY et al., 2013; KRAMER et al., 2015; MEIER et al, 2015; HOLMSTRUP et al., 2016).

Por exemplo, Lake e Lauder (2012), avaliaram o efeito de seis semanas de treinamento com *kettlebell* na força máxima (1RM para o exercício de meio agachamento) e explosiva (salto vertical na plataforma de força) de homens saudáveis e fisicamente ativos, com idade entre 18 e 27 e concluíram que seis semanas de treino com *kettlebell* foram suficientes para o aumento da força máxima e explosiva. Otto et al. (2012), compararam o efeito do treinamento de levantamento de peso e *kettlebell*; duas vezes por semana durante 6 semanas; em homens saudáveis, sobre a força, a potência, e as medidas antropométricas. Os resultados mostraram que tanto o treinamento de levantamento de peso como o de *kettlebell* foram eficazes no aumento da força máxima (levantamento de peso - 11,3% e *kettlebell* - 4,3%) e explosiva (levantamento de peso - 3,9% e *kettlebell* - 2,1%). No entanto, os mesmos não conduziram a alterações significativas nas medidas antropométricas.

Por outro lado, Manocchia, et al. (2013) não encontraram diferença significativa na resposta de força explosiva após 10 semanas de treinamento (20 sessões) com *kettlebell* em homens e mulheres saudáveis. Beltz et al. (2013), avaliaram o efeito de oito semanas (duas vezes/semana) de treinamento com *kettlebell* (*swing* com uma e duas mãos, *clean*, *snatches*, *lunges*, *presses* e levantamento turco*),* em sujeitos saudáveis, sobre a força de membros superiores, inferiores e complexo *core*; capacidade aeróbia, composição corporal e equilíbrio dinâmico (*Y balance test*). Os participantes foram orientados a usar uma carga (em kg) confortável no início do estudo e ao longo do tempo progredindo para cargas mais intensas. Os resultados apontaram aumento na força de membros inferiores (14,8% para 1RM no *leg press*), na força de pressão manual (9%), na força do complexo *core* (70%) e melhora do equilíbrio dinâmico.

Nota-se que apenas um estudo avaliou o treinamento com *kettlebell* exclusivamente em mulheres jovens saudáveis (HOLMSTRUP et al., 2016). Holmstrup et al. (2016) examinaram o efeito de oito semanas de treinamento com *kettlebell* (duas vezes por semana), em mulheres fisicamente ativas, sobre o desempenho de *sprint* (30 metros) e salto vertical. Os autores não reportaram diferenças significativas no desempenho de *sprint* entre o período pré e pós-treinamento. Contudo, observou-se aprimoramento no desempenho de salto vertical. Eles atribuíram a falta de melhora no teste de *sprint* o baixo volume de exercício.

Adicionalmente, é importante destacar que não foram encontrados trabalhos que avaliaram o impacto do destreinamento (MUJIKA & PADILLA, 2000a) após o treinamento com *kettlebell*. Mujika e Padilla, (2000a) definem o destreinamento como a perda parcial ou completa das adaptações causadas pelo treinamento em resposta a um estímulo de treinamento insuficiente e basicamente são divididos em dois tipos: destreinamento de curto (menos de 4 semanas) e longo (mais de 4 semanas) prazo (MELCHIORRI et al, 2014; MUJIKA e PADILLA, 2000).

Nesse sentido, Delshad et al (2013) demonstraram que quatro semanas de destreinamento (após um programa de treinamento resistido de 12 semanas) foram suficientes para diminuir a potência muscular em mulheres pós-menopáusicas. Kannas et al (2015) examinaram os efeitos de um período de destreinamento (quatro semanas) após o treinamento pliométrico específico (inclinado e plano) sobre o desempenho em salto vertical e observaram que a altura de salto (cm) foi reduzida em aproximadamente 7 a 12%. Osawa e Oguma (2013) investigaram se a vibração de corpo inteiro (WBV) associada ao exercício de baixa velocidade durante 13 semanas mantinha o desempenho muscular dos membros inferiores (*avaliado pelo salto de contra movimento; extensão isométrica, máxima, concêntrica e excêntrica do joelho; resistência muscular localizada; e torque na extensão lombar*) após 5 semanas de destreinamento em comparação com um programa de exercícios de baixa velocidade sem WBV. Os mesmos concluíram que a força muscular de membros inferiores pode ser mais suscetível ao destreinamento de curto prazo quando o exercício é combinado com WBV.

Embora o método *kettlebell* seja antigo, os efeitos fisiológicos do treinamento com *kettlebell* vem sendo reportados na literatura a partir de 2010 (FARRAR et al., 2010). Baseado nas importantes investigações acerca da eficácia dessa ferramenta no desenvolvimento da aptidão física relacionada a saúde e desempenho (GARBER et al., 2011), cabe ressaltar que a avaliação ou conhecimento sobre a eficácia desta modalidade de treinamento sobre parâmetros de saúde e qualidade de vida também é relevante, pois podem apontar fatores externos e internos que afetam a percepção, função e a sensação de bem-estar individual (ARAÚJO & ARAÚJO, 2000). A exemplo disso, alguns autores demonstraram que a prática de exercício físico também pode influenciar positivamente a ansiedade (JAYAKODY et al., 2014), os níveis de depressão (STANTON, HAPPELL, 2013; STANTON et al., 2013), o estado de humor (JAGGERS et al., 2015), a qualidade do sono (ALLEY et al., 2015, SILVA-BATISTA et al., 2016) e a saúde em populações clínicas e saudáveis. No entanto, não foram encontrados estudos que investigassem o efeito do treinamento com *kettlebell* sobre esses aspectos gerais de saúde, tão pouco o efeito do destreinamento de curto prazo.

Dessa forma o primeiro objetivo do trabalho, foi avaliar a influência de um programa de treinamento sistematizado com *kettlebell* sobre a força máxima e os níveis de potência em mulheres jovens saudáveis e fisicamente ativas e sem experiência com *kettlebell*. Nosso segundo objetivo, foi avaliar a influência do treinamento com kettlebell sobre os níveis de ansiedade e depressão, perfil do estado de humor e qualidade de vida e sono na mesma população. Além disso, foi analisado o efeito do destreinamento de curto prazo sobre todas variáveis mencionadas previamente.

2. PERGUNTAS

1. O treinamento com *kettlebell* é eficaz para melhorar a força e potência musculares de mulheres jovens saudáveis e fisicamente ativas e sem experiência com *kettlebell*?
2. O treinamento com *kettlebell* pode impactar positivamente os níveis de ansiedade e depressão, o perfil do estado de humor e a qualidade de vida e sono de mulheres jovens saudáveis e fisicamente ativas e sem experiência com *kettlebell*?
3. O destreinamento de curto prazo (4 semanas) pode atenuar possíveis melhoras advindas do treinamento com *kettlebell* em todos os parâmetros mencionados na mesma amostra?

3. METODOLOGIA

3.1. Estudo piloto e cálculo do tamanho da amostra

A priori foi realizado um estudo piloto no qual os objetivos eram obter informações importantes sobre a logística das avaliações a serem realizadas durante o estudo (tempo estimado, ordem das coletas, recurso pessoal e materiais necessários), organização das sessões de treinamento e cálculo do tamanho amostral de forma que os testes utilizados posteriormente pudessem alcançar significância estatística. O estudo piloto foi realizado com cinco voluntárias saudáveis com idade média de 27.0±8.0 anos seguindo os mesmos procedimentos destacados a partir do item 3.4. O cálculo amostral foi realizado através da ANOVA para medidas repetidas e os parâmetros utilizados para o cálculo foram: poder do teste de 80%, onde este é o valor mínimo para que o erro do tipo II (β - consiste em não rejeitar a hipótese nula quando a mesma na realidade é falsa), não aumente nível de significância (α - consiste em rejeitar a hipótese nula quando a mesma na realidade é verdadeira) de 0,05. O desvio padrão de 64,6 foi utilizado (maior variabilidade entre as medidas. O tamanho da amostra calculado com estes parâmetros foi de 17 pessoas avaliadas em três momentos. O pacote estatístico utilizado foi o G*Power versão 3.1.9.2 onde este é de livre acesso.

3.2. Casuística

A amostra foi selecionada por conveniência e envolveu mulheres jovens e saudáveis (idade: 26,0±5,0 anos; Peso: 60,9±12,5kg; Altura: 164,6±5.5 cm). Todas as voluntárias recrutadas eram estudantes, participavam das atividades oferecidas pelo Núcleo de Pesquisa e Extensão em Ciências do Movimento Corporal (NUPEM) do Centro de Educação Física e Desportos (CEFD) da Universidade Federal do Espírito Santo (UFES) e possuíam experiência prévia com treinamento resistido no mínimo por três meses. As participantes do estudo receberam informações necessárias sobre os métodos a serem utilizados no trabalho e assinaram o termo de consentimento livre e esclarecido (Anexo A). A pesquisa foi aprovada pelo Comitê de Ética em Pesquisa da Universidade Federal do Espírito santo (UFES) sob o número de protocolo 1.038.512 (Anexo B).

3.3. Critérios de inclusão

As participantes do estudo deveriam ser maiores de idade (mais de 18 anos), saudáveis e sem qualquer histórico de doença neurológica e limitações cognitivas e presença de doenças cardiovasculares, metabólicas, ortopédicas, endócrinas e/ou respiratórias. Não poderiam ser fumantes, ter experiência com a prática de *kettlebell* e utilizar fármacos que afetassem o controle da frequência cardíaca e suplementos nutricionais e recursos ergogênicos que afetassem o desempenho de potência e força musculares. Além disso, durante todo o período de pesquisa não poderiam executar quaisquer atividades físicas que intervisse no processo de coleta de dados.

3.4. Delineamento experimental do estudo

Inicialmente 24 voluntárias foram selecionadas para participar do presente estudo. Durante o andamento da pesquisa duas voluntárias não puderam finalizar os treinamentos por incompatibilidade de horário, três por faltas frequentes e duas por motivos pessoais, totalizando 17 voluntárias para as avaliações no período pós-treinamento. No período de destreinamento (n=16) uma voluntária não retornou na data marcada para realizar as avaliações. O plano de treino compreendeu um total de 36 sessões. Todas as voluntárias incluídas na análise mantiveram uma adesão aos treinamentos acima dos 85%.

Com relação aos testes, foram aplicados em três momentos distintos: antes do treinamento com *kettlebell*, após as 12 semanas de intervenção e após o destreinamento de quatro semanas. Os procedimentos e avaliações realizadas foram as mesmas nos três momentos, com exceção da *anamnese* inicial que foi aplicada apenas no primeiro momento. Os testes foram realizados no período vespertino e distribuídos em três dias não consecutivos (tabela 1 - abaixo).

Quadro 1: Organização das avaliações.

1º dia (120 minutos)	**2º dia (90 minutos)**	**3º dia (15 minutos)**
Anamnese detalhada	Resistência abdominal	Capacidade e potência anaeróbia
Questionários	Força de pressão manual	
Antropometria e Composição corporal	Salto horizontal	
	Teste de uma repetição máxima (1 RM)	

3.4.1 Primeiro dia de testes

Anamnese detalhada

No primeiro dia, no laboratório de força e condicionamento (LAFEC) da UFES, as participantes foram submetidas a uma entrevista e *anamnese* detalhada, para coleta de informações básicas (cadastro e dados demográficos), fatores que se relacionavam com doenças e possíveis limitações em relação a prática de atividade física.

Questionários

Em seguida, no tempo estimado de 40 minutos, foram aplicados os seguintes questionários: *Medical Outcomes Study 36 item Short-Form Health Survey* (SF-36), Inventário de *Beck* (*Beck Depression Inventory* - BDI), Inventário do nível de ansiedade (Estado), Perfil de estado de humor (*Profile of Mood States* - POMS), A escala de sono de *Pittsburgh* (*Pittsburgh Sleep Quality Index-PSQI).*

Qualidade de vida

A qualidade de vida foi avaliada através da versão curta do questionário SF-36 de 36 itens adaptada à população brasileira (CICONELLI et al., 1999). Este questionário consiste em 36 questões, agrupadas em oito domínios: capacidade funcional - 1 questão com 10 itens (1), limitações por aspectos físicos - 1 questão com 4 itens (2), dor (3) - 2 questões com 2 itens, 2 questões com 5 itens (4), vitalidade - 1 questão com 4 itens (5), funcionamento social - 2 perguntas com 2 itens (6), limitações por problemas emocionais - 5 perguntas com 3 itens (7) e saúde mental - 1 pergunta com 5 itens (8). O item sobre saúde (questão 2) não faz parte do cálculo para nenhum domínio e é usado apenas para avaliar quanto melhor ou pior o assunto é comparado um ano atrás. Os escores variam de 0 a 100, sendo 100 a melhor qualidade de vida mais positiva nessa área e 0 a pior (CICONELLI et al., 1999).

Sinais e sintomas de depressão e ansiedade

A versão brasileira (GORENSTEIN, ANDRADE, 1996) do Inventario de *Beck* (BECK et al, 1961) foi aplicada. Este instrumento tem 21 perguntas sobre sintomas clínicos de depressão e avalia aspectos afetivos, comportamentais, somáticos e interpessoais. Cada item consiste em uma série de quatro afirmações escalonadas para indicar sintomatologia depressiva crescente. Pontuações inferiores a 9 são consideradas normais e entre 10-18 indicam depressão ligeira a moderada; 19-29 indicam depressão moderada a grave; e 30-63 indicam depressão grave (GORENSTEIN, ANDRADE, 1996).

Além disso, os níveis de ansiedade foram avaliados pelo inventário do nível de ansiedade (apenas a escala ESTADO). Este instrumento é um dispositivo de autoavaliação (com escala de pontuação de 20 itens) que avalia os sentimentos do indivíduo em um determinado momento e sob condições específicas (características agudas). As pontuações podem variar de um mínimo de 20 a um máximo de 80. Uma pontuação maior que 30 indica presença de ansiedade, uma pontuação de 31 a 49 indica um nível intermediário de ansiedade e uma pontuação maior ou igual a 50 indica elevado grau de ansiedade (GORENSTEIN, ANDRADE, 1996).

Perfil do estado de humor

O perfil do humor foi avaliado pelo questionário do Perfil do Estado de Humor (POMS), que é uma medida global de auto avaliação do estado de humor, que consiste de 65 itens que se enquadram em 6 categorias: tensão-ansiedade, depressão, raiva-hostilidade, vigor, fadiga e confusão mental. O questionário POMS foi utilizado devido à sua validade e uso em trabalhos científicos (MORGAN, 1979; MORGAN et al., 1987; MORGAN et al., 1988).

Qualidade do sono

A qualidade do sono foi avaliada pela escala de *Pittsburgh* (PSQI). Esta escala tem sete componentes, cada um versando sobre um aspecto importante do sono: 1) qualidade subjetiva do sono; 2) latência do início do sono; 3) duração do sono; 4) eficiência do sono; 5) presença de distúrbios do sono; 6) uso de medicação hipnótico-sedativas e 7) presença de distúrbios diurnos, como indicação de alerta diurno. Indivíduos com um escore total de PSQI de 6 ou mais são considerados com distúrbio de sono (BUYSSE et al., 1989).

Antropometria

Foram coletados os dados antropométricos de massa corporal (kg), estatura (cm), circunferência (cm) e dobras cutâneas (mm) do tríceps, subescapular, peitoral, abdômen, suprailíaca, axilar média, coxa medial e panturrilha. A avaliação antropométrica foi conduzida por um único avaliador experiente. Para os registros de peso e estatura foram utilizados a balança e estadiômetro de precisão (Marte, modelo LC200). As medidas de dobras cutâneas foram realizadas com um adipômetro científico de precisão de 0,1 mm (Cerscorf). A composição corporal (% de gordura, massa magra e Σ de dobras) foi avaliada através dos protocolos de Jackson e Pollock de 7 dobras (POLLOCK; WILMORE, 1993). Para os cálculos de composição corporal foi utilizado o software *Physical Test*, versão 8.0.

3.4.2. Segundo dia de testes

Resistência Abdominal Força e Preensão Manual

Também realizamos a avaliação da resistência abdominal através da flexão parcial do tronco (RIBEIRO et al., 2002). Neste teste as avaliadas deveriam se posicionar em decúbito dorsal com os joelhos flexionados em 90º e pés no solo, as mãos entrelaçadas atrás da cabeça e os cotovelos fechados. Para a realização do teste, as voluntárias elevaram o tronco até o ponto onde a escápula é erguida do colchonete e foi contado o número máximo de repetições durante um minuto (SARTI et al., 1996).

Força de Preensão Manual

Em seguida, foi realizada a avaliação da força de preensão manual com um dinamômetro com precisão de 2 kgf (Jamar®, Asimow Engineering Co., Los Angeles, EUA). O teste de força de preensão manual é bastante útil para avaliação da função muscular por ser de fácil aplicação e de baixo custo (BUDZIARECK et al., 2008; GÜNTHER et al., 2008). No presente estudo, as voluntárias foram instruídas a fazer o máximo de força durante três segundos. Os testes foram realizados em pé com o braço estendido ao longo do corpo. Foram coletadas três medidas reprodutíveis (diferença menor que 10%) em cada mão e considerada a maior delas para a análise. Entre as medidas, foram respeitados 60 segundos de pausa e durante o teste a voluntária foi estimulada verbalmente para que desse seu máximo. Os resultados foram expressos em kgf.

Salto horizontal

As voluntárias realizaram o salto horizontal onde as participantes ficaram com os pés separados e paralelos, distantes alguns centímetros (10 - 20 cm), posicionados atrás de uma linha de saída demarcada no chão com um giz. Na preparação para o salto, as participantes balançam os braços para trás e flexionavam os joelhos. O salto deveria ser efetivado com as participantes estendendo os membros inferiores durante o movimento. Três tentativas foram permitidas, sendo que a mensuração é realizada da linha de saída até a primeira parte da participante que tocou o solo. Coletou-se a melhor medida por uma trena (Starfer P2005, 20m).

Teste de uma repetição máxima

Ao final do segundo dia de avaliação foi realizado o teste de uma repetição máxima (1RM) no *leg press* (45º) e supino reto (com pesos livres). Objetivando reduzir a margem de erro no teste de 1 RM adotaram-se as seguintes estratégias: instruções padronizadas antes do teste, de modo que as voluntárias estivessem cientes de toda a rotina que envolve a coleta de dados. As voluntárias foram instruídas sobre a técnica de execução do exercício, inclusive, quando necessário, realizaram algumas repetições sem carga para que pudessem se sentir seguras na execução do exercício. O avaliador esteve atento quanto à posição adotada pelo praticante no momento da medida. As anilhas de ferro utilizadas no estudo foram checadas em balança previamente calibrada. Após um breve aquecimento, a força máxima foi determinada em cinco tentativas, com cinco minutos de intervalo para cada tentativa. O 1RM para membros inferiores e superiores foi definido como a quantidade máxima de peso levantado durante uma repetição com técnica correta, de acordo com as diretrizes da *National Strength and Conditioning Association* (CARMER & COBURN, 2004).

3.4.3 Terceiro dia de testes

Capacidade e potência anaeróbia

No terceiro dia de avaliações, as voluntárias foram submetidas ao teste de *Wingate*, com o intuito de avaliar a potência e capacidade anaeróbias. As participantes realizaram um aquecimento preconizado de 3 a 5 minutos com 2 a 3 tiros de aproximadamente 6 segundos a cada minuto, seguido por 2 minutos de pausa antes do início do teste (INBAR et al., 1996). O teste anaeróbio de *Wingate* tem duração de 30 segundos, durante o qual o indivíduo que está sendo avaliado tenta pedalar o maior número possível de vezes contra uma resistência fixa equivalente a 5% da massa corporal (carga para mulheres fisicamente inativas) objetivando gerar a maior potência possível nesse período de tempo. A potência gerada durante os 30 segundos é denominada potência média, e provavelmente reflete a resistência localizada do grupo muscular em exercício, utilizando energia predominantemente das vias anaeróbias. Foram obtidos os seguintes dados (média de 5 s): potência de pico absoluta (watts) e potência de pico relativa (watts/kg), a potência mais elevada obtida durante o ensaio; potência média absoluta (watts) e potência média relativa (watts/kg), potência média obtida durante o ensaio; e índice de fadiga (IF). O IF (expresso em %) foi calculado como a diferença entre a potência máxima e a potência mais baixa obtidas no teste durante os 30 segundos.

3.5. Protocolo de treinamento

O período de intervenção do programa de treinamento com *kettlebell* foi de 12 semanas. Os treinos foram executados três vezes por semana em dias não consecutivos totalizando 36 sessões de treinamento. O protocolo de treinamento foi organizado em quatro fases: fase adaptativa (2 semanas), fase específica I (2 semanas), fase específica II (4 semanas) e fase III específica (4 semanas).

Como as voluntárias não possuíam experiência com exercícios utilizando o *kettlebell*, antes do início do protocolo de treinamento, as participantes do estudo foram submetidas a uma FASE ADAPTATIVA (2 semanas) para aprender a técnica adequada. Durante esta fase foi realizada três sessões por semana que duraram 15 a 20 minutos (parte principal). Os seguintes exercícios foram realizados e nesta ordem: flexão e extensão livres do tronco, levantamento terra com *kettlebell* (16 kg), primeira parte do movimento *swing* (12 kg), *swing* com toalha (8 kg), movimento completo do *swing* (8 kg), agachamento livre em frente à parede com as mãos sobre a cabeça e agachamento frontal com *kettlebell* em frente à parede (8 kg). Os sujeitos foram instruídos a realizar um conjunto de 10 a 15 repetições de cada exercício. Cada conjunto foi intercalado por um intervalo de recuperação de 90 s.

Durante a FASE ESPECÍFICA I (2 semanas), os sujeitos realizaram cinco séries do exercício *swing* com *kettlebell* (30 segundos de exercício/30 segundos de pausa). Após dois minutos de período de recuperação, os indivíduos realizaram três conjuntos de movimentos de agachamento (30 segundos de exercício/30 segundos de pausa). As participantes foram instruídas a completar tantas repetições quanto possível durante cada intervalo de trabalho de 30 segundos, e colocar o *kettlebell* no chão durante o repouso. A parte principal das sessões nesta fase durou 10 minutos.

Nas quatro semanas seguintes (FASE ESPECÍFICA II) as voluntárias realizaram três séries de cinco (30 segundos de exercício/30 segundos de pausa) alternando movimentos *swing* e agachamento com dois minutos de intervalo entre os conjuntos. Finalmente, durante as últimas quatro semanas de treinamento (FASE ESPECÍFICA III) foram mantidos os mesmos números de séries, sequência de exercícios e estímulo/recuperação. No entanto, o intervalo entre os conjuntos foi alterado de dois para um minuto. A parte principal das fases específicas I, II e III durou, 10, 19 e 17 minutos, respectivamente.

A carga inicial de *kettlebell* foi de 8 kg (TSATSOULINE, 2006) e os seguintes critérios foram utilizados para aumentar a carga (em kg) ao longo do protocolo de treinamento: 1-cadência maior ou igual a 22 repetições no movimento *swing*, 2-percepção subjetiva do esforço após 5 minutos do termino da sessão de treinamento inferior ou igual a 5 e 3-execução da técnica de movimentos adequada (BORG, 1982; TSIGAMEANN et al., 2010). A escala de esforço percebido subjetivo de Borg (0 a 10 pontos) foi usada para controlar a intensidade de treinamento das sessões (BORG, 1982).

Antes de todas as sessões de treinamento, as voluntarias realizaram exercícios dinâmicos de aquecimento (cerca de 5 minutos), envolvendo movimentos balísticos de flexão, extensão e rotação de membros superiores, membros inferiores e tronco. Após as sessões de treinamento, as voluntárias realizaram um período de volta calma (5 minutos) que envolveram alongamentos estático para todo o corpo. Todas as sessões de treinamento foram supervisionadas por instrutores de exercício experientes e registros cuidadosos das respostas fisiológicas foram mantidos durante a execução para cada participante.

3.6. Análise estatística

A análise estatística foi iniciada pela caracterização dos dados clínicos avaliados através da mediana, média, desvio padrão, frequência observada e porcentagem. Para verificação da distribuição de normalidade dos dados, foi requerido o teste de *Shapiro-Wilk*. Quando o teste de *Shapiro-Wilk* rejeitou a hipótese nula de normalidade (variáveis contínuas), se utilizou o teste de *Friedman* que é um teste não paramétrico para comparação entre as medianas dos três momentos (repouso, após o treinamento e após 4 semanas de destreinamento) e também o teste de comparações múltiplas de *Duncan*. No entanto, quando o teste não rejeitou a hipótese de normalidade, foi utilizada a ANOVA para medidas repetidas e o de comparações múltiplas de *Bonferroni* para verificar qual par (ou pares) se diferenciaram entre os três momentos. O teste do qui-quadrado para uma amostra (variáveis categóricas) verificou as diferenças entre as proporções dos três momentos. O nível de significância adotado em todas as análises foi de 5% com o intervalo de confiança de 95%. O *software* IBM SPSS *Statistics version* 21 foi utilizado nas análises acima descritas.

3.7. Exequibilidade para a realização do estudo

Todos os procedimentos e recursos para a realização do estudo foram disponibilizados pelo Laboratório de Fisiologia do Exercício (LAFEX), pela academia de musculação, Laboratório de Fisiologia e Bioquímica Experimental (LAFIBE) e pelo Laboratório de Força e

Condicionamento (LAFEC), pertencentes ao Núcleo de Pesquisa e Extensão em Ciências do Movimento Corporal (NUPEM), do CEFD/UFES.

4. RESULTADOS E DISCUSSÃO

No que se refere aos resultados e discussão de nossos achados optamos por apresentar e organizar na forma de dois artigos (*ambos já escritos e em processo final de alterações para submissão*) que serão submetidos à revista *Journal of Strength Conditioning Research*:

Artigo 1 - Efeitos de dez semanas de treinamento com *kettlebell* e destreinamento de curto prazo sobre o desempenho de força e potência muscular em mulheres jovens e saudáveis;

Artigo 2 - Efeitos de dez semanas de treinamento com *kettlebell* e destreinamento sobre os transtornos de humor e qualidade de vida e sono em mulheres jovens e saudáveis.

4.1. Artigo 1: **Effects of ten weeks of *kettlebell* training and short-term detraining on power and strength performance in young health women**

INTRODUCTION

K*ettlebell* exercise it is as an alternative to perform functional power exercises and has been disseminated during the last decade. This type of exercise has been used to improve physiological (cardiorespiratory endurance and health) and neuromuscular responses, rehabilitation process, physical fitness and sport performance (Greenwald et al., 2016; Edinborough et al, 2016; Williams, Kraemer, 2015; Falatic et al, 2015; Thomas et al, 2014; Lake, Lauder, 2012a; Brumitt et al, 2010). For example, Jay et al (2011) showed that *kettlebell* training (3 times per week for 8 weeks) could reduce low back pain and improves muscle strength among people from labour activities with a high prevalence of musculoskeletal pain and disorders and Brumitt et al (2010) proposed the prescription of functional strengthening and power exercises (*kettlebell*) during the rehabilitation later stages of athletes with a lower extremity injuries.

Furthermore, many strength and conditioning professionals have encouraged the use *kettlebell* training as a useful way because they provide simultaneously improvements in muscular strength (e.g. back squat and one-repetition maximum – 1RM), endurance, and power (e.g. vertical jump) (Greenwald et al., 2016; Lake, Lauder, 2012a; Otto et al., 2012; Jay et al., 2011).

Lake and Lauder (2012a) evaluated the effect of *kettlebell* training (6 weeks and twice/week) on measures of maximum and explosive strength and observed that maximum strength improved by approximately 10% and explosive by 20%. Otto et al. (2012) compared the effects of 6 weeks of traditional weightlifting and *kettlebell* training on strength (back squat 1RM) and power (vertical jump and power clean 1RM) and showed that both types of strength training were effective in increasing strength and power.

Despite that there are some studies that have tested the effectiveness of *kettlebell* training programs on strength and power variables (Holmstrup et al., 2016; Williams, Kraemer, 2015; Falatic et al., 2015; Fortner et al., 2014; Lake, Lauder, 2012a) , by our literature review, there is only one study of *kettlebell* training conducted exclusively in health women (Holmstrup et al., 2016). Holmstrup et al. (2016) examined the effect of eight-week of *kettlebell* training (twice weekly), in recreationally active females, on sprint and countermovement vertical jump performances and not observed significant differences in sprint performance (30 meter) from pre- to post-training period. However, an improvement in vertical jump performance was noted. They attributed the lack of sprint improvement to low exercise volume.

In addition, there are still no studies that evaluated the impact short-term detraining (four weeks - Mujika and Padilla, 2000a) after *kettlebell* training. Mujika and Padilla (2000a) defined detraining as the partial or complete loss of training-induced adaptations, in response to an insufficient training stimulus and short term detraining as less than 4 weeks of insufficient training stimulus.

Delshad et al (2013) demonstrated that four weeks of detraining (after a resistance training program of 12 weeks) had adverse effects on muscle power in post-menopausal women. Kannas et al (2015) examined the effects of a detraining period (four weeks) after specific plyometric training (incline and plane ground) on vertical jump performance and observed that jumping height (cm) was decreased by approximately 7 to 12%. Osawa and Oguma (2013) investigated whether whole-body vibration (WBV) associated with low-velocity exercise for 13 weeks retains lower extremity muscle performance (evaluated by countermovement jump; maximal isometric, concentric, and eccentric knee extension; local muscular endurance; and lumbar extension torque) improvements after 5 weeks of detraining compared with an identical low-velocity exercise program without WBV and concluded that lower extremity muscle strength might be more susceptible to short-term detraining when exercise is combined with WBV.

Thus, our aims were to evaluate the influence of systematized *kettlebell* training program (10 weeks) on maximum strength and power levels and short-term (four weeks) detraining of healthy physical activity women, but with no experience with *kettlebell* practice.

METHODS

Subjects

A convenience sample of health women (n=17, body mass: 60.9±12.5 kg; height: 164.6±5.5 m; age: 26.0±5.0 years), recruited among students of the *Federal University of Espírito Santo* (Vitória, Brazil), participated in the study. The inclusion criteria were not having experience with *kettlebell* training; able to perform physical exercise; no chronic diseases; and not currently smoking or using drugs/ergogenic aids.

After a clear explanation of the procedures, including the risks and benefits of participation, written consent was obtained. All experimental procedures were approved by the University Human Research Ethics Committee (protocol number: 1.038.512) and they conformed to the principles outlined in the Declaration of Helsinki. The characteristics (body mass, height and body mass index) of the participants during all study phases (before *kettlebell* training - B; after *kettlebell* training - A; and after *kettlebell* detraining - D) are given in table 1.

Table 1- Participant characteristics in the three moments of the study (B, A and D).

Variables	B (n=17) Mean±SD/Median	A (n=17) Mean±SD/Median	D (n=16) Mean±SD/Median	p value
Body mass (kg)	**60.9±12.5**/59.0	**61.4±12.0**/60.0	**60.7±11.0**/60.1	0.290
Height (cm)	**164.6±5.5**/165.0	**164.6±5.2**/165.0	**164.4±4.9**/165.0	0.239
BMI	**22.3±3.8**/21.3	**22.5±3.8**/21.7	**22.3±3.6**/22.1	0.333

BMI: Body mass index

Experimental Approach to the Problem

The study was organized in five successive phases: before (B) *kettlebell* training evaluations, *kettlebell* training period, after (A) *kettlebell* training evaluations, detraining period of four weeks, and post *kettlebell* detraining (D) evaluations. The procedures and evaluations were performed in the same period of the day (afternoon) in three moments.

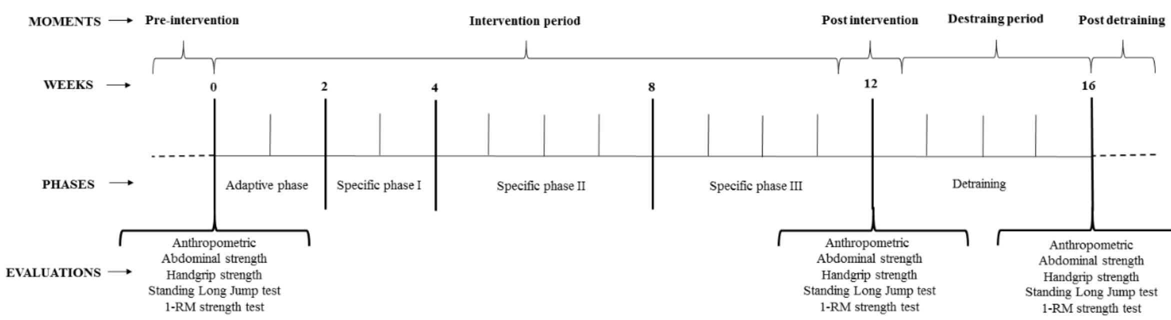

Figure 1 - Study desing

Training protocol

Kettlebell training was a whole body program for 10 weeks, three times per week on non-consecutive days totalizing 36 training sessions. The training protocol was organized in four phases: adaptative phase (2 weeks), specific phase I (2 weeks), specific phase II (4 weeks) and specific phase III (4 weeks).

Since subjects have no experience with *kettlebell* exercise, before beginning of training protocol, participants were submitted to an ADAPTATIVE PHASE (two weeks) in order to provide the adequate technique to subject. During this phase was performed three sessions per week that lasted 15 to 20 minutes (main part). The following exercise was performed in this order: free trunk flexion and extension, deadlift with *kettlebell*, first part of the swing *kettlebell* movement, *kettlebell* swing with towel, complete *kettlebell* swing, free squat in front of the wall with hands over head and front squat *kettlebell* in front wall. The subjects were instructed to perform one set of 10-15 repetitions of each exercise. Each set was interspersed by a 90-s recovery interval.

In SPECIFIC PHASE I (two weeks), the subjects performed five sets of *kettlebell* swing (30 seconds of exercise/30 seconds of rest interval). After two minutes of recovery period, subjects performed three sets of squat movements (30 seconds of exercise/30 seconds of rest interval). Participants were instructed to complete as many repetitions as possible during each thirty-second work interval, and place the *kettlebell* on the floor during rest. The main part of the sessions in this phase lasted 10 minutes.

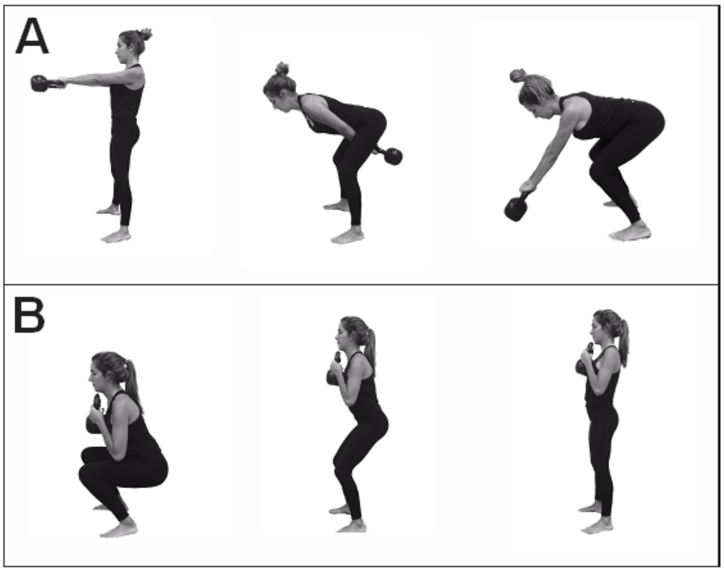

Figure 2 - Exercises used in the training sessions. A: swing; B: squat. The image is from one of the study participants.

In the following four weeks (SPECIFIC PHASE II) volunteers performed three sets of five 30-second of exercise separated by 30 seconds of rest interval alternating swing and squat movements with two-minute of interval between sets. Finally, during the last four weeks of training (SPECIFIC PHASE III) were maintained the same number of sets, exercise sequence and stimulus/recovery time. However, the interval between sets was changed from two to one minute. The main part of the specific phases I, II and III lasted, 10, 19 and 17 minutes respectively.

Before all training sessions (warm-up), subjects performed dynamic exercises (about 5 minutes), which involved ballistic movements of flexion, extension and rotation of upper limbs, lower limbs and trunk. After training sessions (cool-down), subjects performed a period of 5 minutes that involved static stretching to whole body. All training sessions were supervised by experienced exercise instructors, and careful records were kept of each subject's workout performance and physiologic responses.

The participants were instructed to arrive at the laboratory in a rested and fully hydrated state and having not consumed caffeine in the previous 4 hours. To minimize the effects of diurnal biological variation, all training sessions were performed at the same time of day.

All volunteers maintained a training adherence above 85%. There were no adverse effects reported by subjects during training session.

Overload and control of kettlebell training sessions intensity

The initial *kettlebell* load was 8 kg (Tsatsouline, 2006) and following criteria was used to increase the load (in kg) along the training protocol: cadence greater than or equal to 22 repetitions in the swing movement, subjective perceived exertion after 5 minutes of the training session end lower or equal to 5 and movements' technical execution (Tsatsouline, 2006; Tiggemann et al., 2010). In addition, Borg subjective perceived exertion scale (0 to 10 points) was used to control the sessions training intensity, where 0, was considered a very very weak effort and 10, very very strong effort (Borg, 1982). Moreover, exercise intensity was controlled by measuring heart rate (HR) through HR monitor (Polar RS300X, Finland). HR was monitored during all training session.

Battery of tests

Abdominal strength

In this test the volunteers should position them in dorsal decubitus with their knees flexed at 90º and feet on the ground, their hands clasped behind their heads and their elbows closed. To perform the test, the volunteers raised the trunk (partial flexion) to the point where the scapula was lifted from the mat and the maximum number of repetitions was counted for one minute (Sarti et al., 1996).

Handgrip strength

We performed the handgrip strength evaluation (values in kgf with an accuracy measure of 2 kgf) with dynamometer (Jamar®, Asimow Engineering Co., Los Angeles, USA). Handgrip strength test is very useful for assessing muscle function because it is easy to apply and has low cost (Budziareck et al., 2008; Günther et al., 2008). In the present study, volunteers were instructed to make maximum strength for three seconds. The tests were performed standing up with arms extended along the body. Three reproducible measures (difference less than 10%) were collected in each hand (right and left) and considered the bigger one for the analysis. Between the measurements, 60 seconds of recovery were respected and during the test volunteer was verbally stimulated to realize maximum performance.

Standing Long Jump Test

Volunteers of the present study performed the Standing Long Jump Test. For this, they were positioned with their feet separated, parallel, and distant of 10 - 20 centimeters. In addition, they were positioned behind an exit line demarcated on the ground with a chalk. In preparation for the jump, the participants swung their arms back and flexed their knees. Horizontal jump was performed with the participants extending the lower limbs during the movement. Three attempts were realized, and the measurement was performed from the exit line to the first part that touched on the ground. The best measure was considered for the analysis (Bosco, 1991). A measuring tape (Starfer P2005, 20m) was used to measure the distance reached during the jump.

One-repetition maximum strength test

Muscle strength is often determined to evaluate the adaptive response to exercise training. For this reason, we performed one-repetition maximum strength on the leg press (45º) and bench press (free weight). For the test application, we adopted the following strategies: provide standardized instruction regarding to exercise technique and encourage low-load movements to minimize the learning effect. After a brief warm-up, one-repetition maximum strength was determined by five maximal attempts of one repetition, with five-minutes of interval for each attempt. One-repetition maximum strength (for lower and upper limbs) was defined as the maximum amount of weight lifted during a complete repetition with correct and safe technique (Carmer, Coburn, 2004).

Anaerobic power and capacity evaluation

For the evaluation of the anaerobic power and capacity, the participants performed the *Wingate* anaerobic test on a lower limb cycle-ergometer (Cefise, Cicloergômetro Biotec 2100 - Brazil). Before the test, participants performed a warm-up (3 to 5 minutes) with 2 to 3 all-out 6-s sprints (at low intensity) on the command of the investigator. Following this warm-up period, participants rested quietly for two minutes (Bar-Or, 1987; Inbar et al., 1996). Wingate anaerobic test has a total duration of 30 seconds, during which the individual must pedal as many times as possible against a fixed and proportional to the body mass resistance. For the evaluation of participants we chose to use a load equivalent to 5% of body mass with the objective of generating the highest possible muscle mechanical power. Verbal encouragement was provided throughout the 30 seconds period. The following data (average of 5 s) were obtained: absolute peak power (watts) and relative peak power (watts/kg), the highest power obtained during the test; absolute mean power (watts) and relative mean power (watts/kg), the average power obtained during the test; and fatigue index (FI). The FI (expressed as %) was calculated as the e difference between the highest and the lowest power output obtained in the 30 seconds test

Statistical analysis

Statistical analyses were performed using the SPSS (*Statistics version* 21). Data were expressed as median, mean ± standard deviation (SD) and absolute (n) and relative frequency (%). All variables (data) were tested for normal distribution according to the *Shapiro-Wilk* test. When the data did not pass by the normality test, were used the *Friedman* test for the comparison of medians; at before (B) and after (A) *kettlebell* training and after detraining (D); and *Duncan's* multiple comparison test. For data with normal distribution ANOVA for repeated measures and *Bonferroni* multiple comparisons test were used to verify which pair (or pairs) differentiated between B, A and D moments. Statistical significance was set at an alpha value of 0.05.

RESULTS

Kettlebell training intensity

Regarding the training intensity, monitored by HR and Borg scale (RPE 0 to 10), there were significant differences to the four phases of protocol training. The values reached for the adaptive phase and specific phases I, II, and III, were 65%, 78%, 82% and 84% of estimated maximal HR, respectively. The mean HR (bpm) in the specific phase I (150±10 bpm) was significantly higher (20%) when compared to the adaptive phase (125±7 bpm); HR mean, in the specific phase II (157 ± 7 bpm), was significantly higher when compared to the adaptive phase (25.6%) and the specific phase I (4.6%); and mean HR in the specific phase III (161±8) was significantly higher when compared to the adaptive phase (28.8%) and specific I (7.3%). Finally, there were no significant differences relative to HR response in the comparison between the specific phases II and III. Regarding the subjective perception effort (scale from 0 to 10) we obtained the following mean values: adaptive (4±1); Specific I (4±1); Specific II (6±1); and specific III (6±1). In this sense, we observed significant differences (+33.3%) between the specific phases II and III when compared to the adaptive phase and specific phase I. There was no significant difference between the specific phases II and III.

Strength and power tests

Regarding the Wingate anaerobic test (table 2), it was observed that the absolute mean power in the A-training was significantly higher when compared to B-training (+2.7%) and D (+2.6%). However, there were no differences between B and D. In addition, the relative mean power was significantly higher in the A-training (+1.9%) when compared to D. There was no significant difference when comparing B-training vs. A-training and B vs. D. Regarding the other variables related to the Wingate test (absolute maximum power, absolute final power, relative maximum power, relative final power, and fatigue index) there were no significant differences between the three moments evaluated.

Table 2 - Results for Wingate anaerobic test before-training (B), after-training (A) and after detraining (D) period.

Variables	B (n=17) Mean±SD/Median	A (n=17) Mean±SD/Median	D (n=16) Mean±SD/Median	p value
Absolute peak power (watts)	**368.9±78.0**/366.3	**371.5±71.0**/359.1	**371.9±74.3**/360.9	0.191**
Absolute mean power (watts)	**314.7±72.5**[a]/305.5	**323.3±68.5**[b]/313.6	**315.1±66.0**[a]/304.3	0.004*
Absolute final power (watts)	**236.7±82.3**/216.4	**245.9±64.5**/227.3	**238.6±59.1**/227.5	0.516*
Relative peak power (watts/kg)	**6.0±0.2**/6.01	**6.03±0.06**/6.02	**6.0±0.1**/6.01	0.725**
Relative mean power (watts/kg)	**5.1±0.4**[ab]/5.1	**5.2±0.3**[b]/5.2	**5.1±0.2**[a]/5.1	0.023*
Relative final power (watts/kg)	**3.7±0.9**/3.8	**4.0±0.7**/4.0	**4.0±0.7**/3.8	0.572*
Fatigue index (%)	**37.8±13.2**/38.3	**33.5±12.2**/31.8	**35.7±9.8**/36.8	0.592*

*ANOVA for repeated measurements; ***Friedman* test; [ab]differences between means (*Bonferroni* test) and medians (*Duncan* test).

Regarding the behavior of the variable relative mean power (watts/kg) during the 30s of test (Figure 2), we observe that in the comparisons performed through the mean value reached between 0-5s, the B-training (5.5 ± 0.4) was significantly ($p < 0.05$) higher (5.8%) when compared to D-training moment of (5.2 ± 0.5), between the A-training moments (5.3 ± 0.4) vs B and D vs A, there was no significant difference. In the comparisons performed between 5-10s, we did not observe statistical difference between the moments B (5.8 ± 0.3), A (5.7 ± 0.2) and D (5.7 ± 0.2). In the comparisons performed between 10-15s, there were no statistically significant differences between the B (5.6 ± 0.4), A (5.8 ± 0.2) and D (5.6 ± 0.3). Between 15-20s, we observed that the A (5.5 ± 0.4) was significantly ($p < 0.05$) higher (5.8%) when compared to the D moment (5.2 ± 0.4), between the moments A vs. B (5.2 ± 0.5) and B vs D, there was no significant difference. In the comparisons between 20-25s, there were no significant statistical differences between the B (4.7 ± 0.6), B (4.9 ± 0.6) and D (4.7 ± 0.5) times. Finally in 25-30s, there were also no statistically significant differences between the B (4.1 ± 0.7), A (4.3 ± 0.7) and D (4.1 ± 0.6) times.

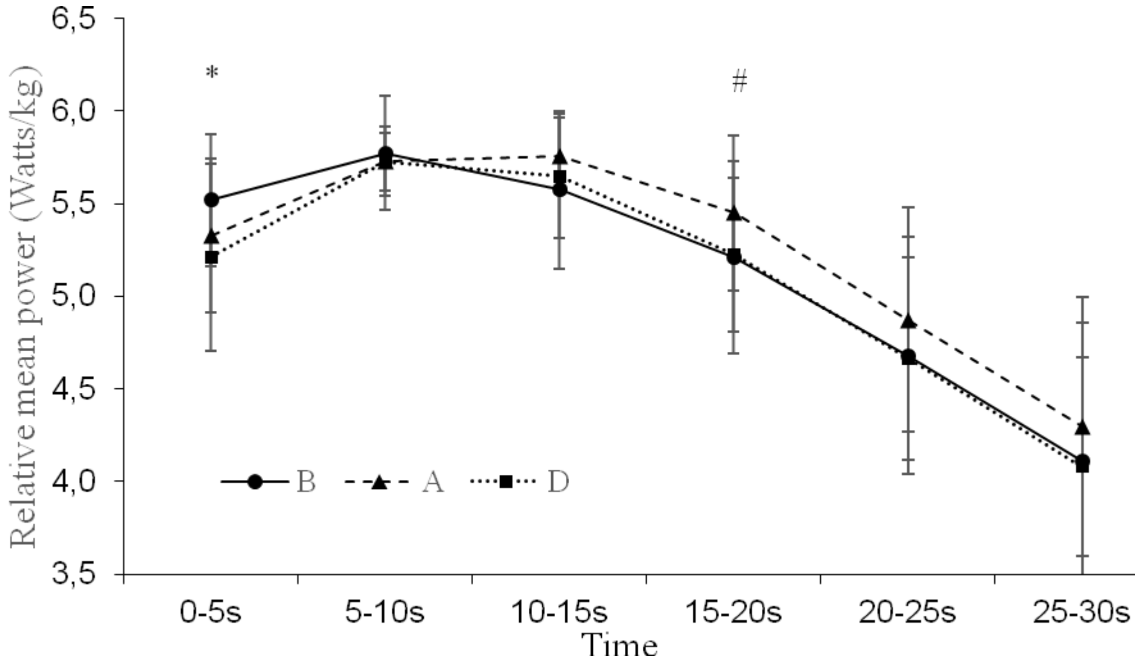

Figure 3 - Relative mean power behavior for the Wingate anaerobic test before-training (B), after-training (A), and after detraining period (D). *Significant difference ($p<0.05$) between B and D periods; #Significant difference ($p<0.05$) between A and D periods.

Relative to standing long jump test we observed that the median (190.0) of A-training it was significantly higher (+4.4%) when compared to B (182.0) and higher (+3.3%) when compared D (188.0) *vs.* B-training. There was no significant difference when comparing A-training vs. D. For the 1RM test, regarding to supine, there was no significant difference when comparing the three study moments. However, for the leg press 45º we observed that the median of A-training (156.0) it was significantly higher (+15.3%) when compared to B-training (135.2) and higher (+12.6%) when compared D (152.2) *vs.* B-training. There was no significant difference when comparing A-training *vs.* D. Regarding handgrip strength the mean of A-training (58.9±12.8) it was significantly higher (+9.0%) when compared to B-training (54.0±2.3) and higher (+9.8%) when compared D (59.3±11.1) *vs.* B-training. There was no significant difference when comparing A-training *vs.* D. Finally, there was no significant difference for abdominal strength when comparing the three study moments (table 3).

Table 3 - Results for standing long jump test, one-repetition maximum strength test (supine and leg press 45º), handgrip strength and abdominal strength before-training (B), after-training (A) and after detraining (D) period.

Variables test	B (n=17) Mean±SD/Median	A (n=17) Mean±SD/Median	D (n=16) Mean±SD/Median	p value
Standing long jump (cm)	**177.3±17.8**/182.0[a]	**192.0±14.6**/190.0[b]	**189.0±14.3**/188.0[b]	< 0.001**
Supine (kg)	**19.6±8.6**/16.0	**21.0±7.7**/18.0	**20.5±8.0**/18.0	0.158**
Leg press 45º (kg)	**135.8±55.8**/135.2[a]	**171.4±56.7**/156.0[b]	**157.5±48.5**/152.2[b]	< 0.001**
Handgrip strength (kg/f)	**54.0±12.3[a]**/52.0	**58.9±12.7[b]**/56.0	**59.3±11.1[b]**/56.5	0.022*
Abdominal strength (numbers of repetitions)	**30.0±8.9**/30.0	**33.0±8.4**/31.0	**32.2±8.3**/29.5	0.207*

*ANOVA for repeated measurements; ***Friedman* test; [ab]differences between means (*Bonferroni* test) and medians (*Duncan* test).

DISCUSSION

The objectives of present study were to evaluate the impact of 10 weeks of *kettlebell* training and short term detraining in variables related to muscle strength and power of healthy and physically activity women. Our main results were: *Wingate anaerobic test*: absolute mean power A-training was significantly higher when compared to B-training and D and relative mean power was significantly higher when compared B-training *vs.* D; *Standing long jump test*: median of A-training it was significantly higher when compared to B-training and higher when compared D *vs.* B-training; *Leg press 45°*: median of A-training it was significantly higher when compared to B-training and higher when compared D *vs.* B-training; *Handgrip strength*: mean of A-training it was significantly higher when compared to B-training and higher when compared D *vs.* B-training.

Recently, Wade et al (2016) investigate the effects of 10 weeks (3 times/week) of continuous one-arm *kettlebell* swing training on US Air Force (USAF) physical fitness testing components (*1.5-mile run, 1-minute maximal push-ups and sit-ups, maximal grip strength, pro-agility, vertical jump and 40-yard dash*). For this, trained male and female US Air Force was assigned to three groups: *kettlebell* one-arm swing training (KB), *kettlebell* one-arm swing training plus high intensity running (KBrun) and traditional USAF physical training (TPT). They observed that 40-yard dash significantly improved within the KB and KBrun groups. In addition, maximal push-ups significantly improved in the KBrun group and trends toward significant improvements in maximal push-ups were found in both the KB and TPT groups. This study suggests that *kettlebell* swing training may be used as an alternative by US Air Force members to improve speed and maximal push-ups. However, Lake et al (2014) suggested, as we proceed in the present study, that two-handed *kettlebell* swing exercise could be used as useful strategy for the improvement of maximum and explosive strength.

Moreover, just as Wade et al. we studied the effects of 10 weeks, 3 times/week, of *kettlebell* training (swing and squat exercises) and observed that this type of exercise training was efficient in improving strength and power variables. In the other hand, Holmstrup et al (2016) demonstrated that eight-week of *kettlebell* swing training, in recreationally-active females, it is not sufficient to improve sprint performance but efficient in improving vertical jump performance. Jay et al (2013) investigated the effect of *kettlebell* training (3 times/week for 8 weeks), in adults (men and women) from occupations with a high prevalence of musculoskeletal pain and discomfort, on maximal countermovement jump height performance and demonstrated that jump height increased significantly after training. It is important to point even as Holmstrup et al (2016) we observed that *kettlebell* training could increase jump performance, of physical activity women, but in our case horizontal jump performance.

Lake and Lauder (2012a) evaluated the effect of *kettlebell* swing training (6 weeks and 2 times/week) on 1RM (half squat) and vertical jump performances and observed that this type of exercise could be an alternative to increase maximum (1RM) and explosive strength (jump height). In our study, we observed an improvement in median values for horizontal jump and leg press 45º evaluations after *kettlebell* training.

One of the possible explanations for the improvement of strength and power would be the ability of the *kettlebell* exercise to elucidate increases in hormones involved in muscle adaptations such as testosterone, growth hormone and cortisol, as demonstrated by Budnar et al (2014) after acute *kettlebell* exercise (12 series of 30 seconds of 16 kg swings alternated with 30 seconds of recovery).

In addition, Manocchia et al (2013) demonstrate a possible positive transfer; for strength, power, and muscular endurance as well as performance enhancement; of training with *kettlebells* for weightlifting and powerlifting practitioners. This may be related to the manner (ballistic, cyclic and repetitive movements and rapid and rhythmic contractions) that activities are carried out and architecture of *kettlebells* (handle distal to the center of mass). Moreover, being the *kettlebell* exercise with a load predominantly eccentric provides a longer lever arm where the center of mass is not fixed (Manocchia et al, 2013). Finally, Lake and Lauder (2012b) reinforce the benefits of *kettlebell* swing exercise due to a large mechanical demand that could make this exercise type a useful way to strength and conditioning programs for the development of ability to rapidly apply force.

In addition, despite we observed that 10 weeks of *kettlebell* training improved maximal (leg press 45º 1RM) and isometric (handgrip) strengths and muscle power (absolute relative mean powers for the Wingate and horizontal jump distance), 4 weeks of detraining negatively impacted these variables. In is important to point that at the muscle level, short term detraining, reduced capillary density and enzymatic activity, reversed changes in fiber cross-sectional, and provoke slight decline on strength performance (Mujika, Padilla, 2000a). It is interesting to note that cross-training (which has similar characteristics to *kettlebell* routines) may be effective in maintaining training-induced adaptations and physical activity individuals could benefit from this type of exercise (Mujika, Padilla, 2000b).

As we are, Kraemer et al (2002) investigated the changes in muscular strength (1RM performance for shoulder, bench press and squat), power (Wingate and vertical jump), and resting hormonal concentrations (growth hormone, follicle-stimulating hormone, luteinizing hormone, sex hormone-binding globulin, testosterone, cortisol and adrenocorticotropin) during 6 weeks of detraining in recreationally strength-trained men (*in our study strength-trained women*). Subjects (n=16) were randomly assigned to detraining (n = 9) or resistance training (n = 7) group and matched for strength, body size and training experience. They authors showed that 6 weeks of resistance detraining, in recreationally trained men, affects power more than it does strength without any accompanying changes in resting hormonal concentrations. For the recreational weight trainer, losses in strength over 6 weeks are less of a concern compared with anaerobic power and upper arm isometric force production. A minimal maintenance training program is recommended for the recreational lifter to offset any reductions in performance.

We could conclude that 10 weeks of *kettlebell* training improved maximal and isometric strengths and muscle power. However, four weeks of detraining negatively impacted these variables in recreationally physically activity women.

PRACTICAL APPLICATIONS

Our research was the first to evaluate the impact of 10 weeks of training with *kettlebell* and short-term detraining (4-weeks) on variables associated with strength and muscle power of healthy physically active women. In our view, this fact is a strong point since it was possible to establish reference values for healthy women, for important variables of physical and muscular fitness.

In addition, we evaluated the effect of 4 weeks of detraining, which allowed us to verify that despite the interruption of *kettlebell* training there were no significant losses for most of the studied variables. This allows us to state that the use and practice of the *kettlebell* training in isolation may be of interest for the improvement of muscle strength and power as well as maintaining them at desirable levels even after detraining period.

Moreover, Traditional strength training equipments (for example, barbells) and places (Gym) could be expensive and keep away beginners and *kettlebell* exercise may be a more affordable strength training alternative with a low cost because it requires less equipment and restricted physical space. However, it needs to be guided by trained and certified strength conditioning professionals.

LIMITATIONS

Because our volunteers are physically active, they may have already had higher values of strength and power than the general population. However, they were beginners in the *kettlebell* practice which may have caused some impairment in maintaining high training intensity. In addition, the fact of not having a control group also causes some disadvantage in the data interpretation. Another weak point of the present study is the fact that it was not a randomized study. Finally, it is important to point that randomized and controlled studies should be conduct to examine clearly and accurately the effectiveness of *kettlebell* exercise and training.

REFERENCES

Bar-Or O. The Wingate anaerobic test. An update on methodology, reliability and validity. Sports Med. 1987 Nov-Dec;4(6):381-94.

Brumitt J, En Gilpin H, Brunette M, Meira EP. Incorporating kettlebells into a lower extremity sports rehabilitation program. N Am J Sports Phys Ther. 2010 Dec;5(4):257-65.

Budnar RG Jr, Duplanty AA, Hill DW, McFarlin BK, Vingren JL. The acute hormonal response to the kettlebell swing exercise. J Strength Cond Res. 2014 Oct;28(10):2793-800.

Budziareck MB, Pureza Duarte RR, Barbosa-Silva MC. Reference values and determinants for handgrip in healthy subjetcts. Clin. Nutro. 2008 Jun; 27(3:357-62).

Delshad M, Ghanbarian A, Mehrabi Y, Sarvghadi F, Ebrahim K. Effect of Strength Training and Short-term Detraining on Muscle Mass in Women Aged Over 50 Years Old. Int J Prev Med. 2013 Dec;4(12):1386-94.

Edinborough L, Fisher JP, Steele J. A Comparison of the Effect of Kettlebell Swings and Isolated Lumbar Extension Training on Acute Torque Production of the Lumbar Extensors. J Strength Cond Res. 2016 May;30(5):1189-95.

Falatic JA, Plato PA, Holder C, Finch D, Han K, Cisar CJ. Effects of Kettlebell Training on Aerobic Capacity. J Strength Cond Res. 2015 Jul;29(7):1943-7.

Fortner HA, Salgado JM, Holmstrup AM, Holmstrup ME. Cardiovascular and Metabolic Demads of the Kettlebell Swing using Tabata Interval versus a Traditional Resistance Protocol. Int J Exerc Sci. 2014 Jul 1;7(3):179-185.

Greenwald S, Seger E, Nichols D, Ray AD, Rideout TC, Gosselin LE. Effect of an Acute Bout of Kettlebell Exercise on Glucose Tolerance in Sedentary Men: A Preliminary Study. Int J Exerc Sci. 2016 Oct 1;9(3):524-535.

Günther CM, Bürger A, Rickert M, Crispin A, Schulz CU. Grip Strength in healthy caucasian adults: reference values. J Hand surg Am. 2008 April; 33(4:558-65).

Holmstrup ME, Jensen BT, Evans WS, Marshall EC. Eight Weeks of Kettlebell Swing Training Does not Improve Sprint Performance in Recreationally Active Females. Int J Exerc Sci. 2016 Oct 1;9(3):437-444.

Inbar O, Bar-Or O, Skinner JS. The Wingate anaerobic test. Human Kinetics. 1996.

Jay K, Frisch D, Hansen K, Zebis MK, Andersen CH, Mortensen OS, Andersen LL. Kettlebell training for musculoskeletal and cardiovascular health: a randomized controlled trial. Scand J Work Environ Health. 2011 May;37(3):196-203.

Jay K, Jakobsen MD, Sundstrup E, Skotte JH, Jørgensen MB, Andersen CH, Pedersen MT, Andersen LL. Effects of kettlebell training on postural coordination and jump performance: a randomized controlled trial. J Strength Cond Res. 2013 May;27(5):1202-9.

Kannas TM, Amiridis IG, Arabatzi F, Katis A, Kellis E. Changes in specific jumping performance after detraining period. J Sports Med Phys Fitness. 2015 Oct;55(10):1150-6.

Lake JP, Hetzler BS, Lauder MA. Magnitude and relative distribution of kettlebell snatch force-time characteristics. J Strength Cond Res. 2014 Nov;28(11):3063-72.

Lake JP, Lauder MA. Kettlebell swing training improves maximal and explosive strength. J Strength Cond Res. 2012a Aug;26(8):2228-33.

Lake JP, Lauder MA. Mechanical demands of kettlebell swing exercise. J Strength Cond Res. 2012b Dec;26(12):3209-16.

Liebenson C. Functional training with the kettlebell. J Bodyw Mov Ther. 2011 Oct;15(4):542-4.

Manocchia P, Spierer DK, Lufkin AK, Minichiello J, Castro J. Transference of kettlebell training to strength, power, and endurance. J Strength Cond Res. 2013 Feb;27(2):477-84.

Mujika I, Padilla S. Detraining: loss of training-induced physiological and performance adaptations. Part I: short term insufficient training stimulus. Sports Med. 2000a Aug;30(2):79-87.

Mujika I, Padilla S. Detraining: loss of training-induced physiological and performance adaptations. Part II: Long term insufficient training stimulus. Sports Med. 2000b Sep;30(3):145-54.

Osawa Y, Oguma Y. Effects of combining whole-body vibration with exercise on the consequences of detraining on muscle performance in untrained adults. J Strength Cond Res. 2013 Apr;27(4):1074-82.

Otto WH 3rd, Coburn JW, Brown LE, Spiering BA. Effects of weightlifting vs. kettlebell training on vertical jump, strength, and body composition. J Strength Cond Res. 2012 May;26(5):1199-202.

Sarti NA, Monfort M, Fuster MA, Vilaplana LA. Muscle activity and lower rectus abdominus during abdominal exercises. Arch Phys Med Rehabil. 1996; 77(12):1293.

Silva-Batista C, Campos de Brito L, Corcos DM, Roschel H, Túlio de Mello M, Pimentel Piemonte ME, Tricoli V, Ugrinowitsch C. Resistance Training Improves Sleep Quality In Subjects With Moderate Parkinson's Disease. J Strength Cond Res. 2016 Oct 13.

Thomas JF, Larson KL, Hollander DB, Kraemer RR. Comparison of two-hand kettlebell exercise and graded treadmill walking: effectiveness as a stimulus for cardiorespiratory fitness. J Strength Cond Res. 2014 Apr;28(4):998-1006.

Wade M, O'Hara R, Caldwell L, Ordway J, Bryant D. Continuous One-Arm Kettlebell Swing Training on Physiological Parameters in US Air Force Personnel: A Pilot Study. J Spec Oper Med. Winter 2016;16(4):41-47.

Williams BM, Kraemer RR. Comparison of Cardiorespiratory and Metabolic Responses in Kettlebell High-Intensity Interval Training Versus Sprint Interval Cycling. J Strength Cond Res. 2015 Dec;29(12):3317-25.

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4.2. Artigo 2: **Effects of ten weeks of *kettlebell* training and detraining on mood disorders, sleep and quality of life in young women**

INTRODUCTION

Kettlebell exercise has become popular in the fitness community. The use of this equipment present several specific characteristics: it is based on movements that are predominantly ballistic (for example, swing exercise); relatively simple, and in general involve the whole body; can be performed at home, which is advantageous in contemporary society since people has little time to practice physical exercise; and is a low cost equipment (Lake, Lauder, 2012).

In addition, *kettlebell* exercises have been used as an alternative way to improve simultaneously aerobic and anaerobic fitness (Jay et al, 2011). Physiological effects of *kettlebell* training has been previously described (Holmstrup et al., 2016; Falatic et al, 2015; Lake, Lauder, 2012; Otto et al, 2012).

Besides the physiological effects, it is noteworthy that exercise training could also positively impact the anxiety (Jayakody et al., 2014) and depression levels (Stanton, Happell, 2013; Stanton et al., 2013), mood state (Jaggers et al., 2015) and sleep quality (Alley et al., 2015; Silva-Batista et al., 2016) on health and clinical populations. However, to our knowledge, there is a lack of studies that investigated the effect of *kettlebell* training on these health general aspects. Therefore, it is reasonable to suppose that *kettlebell* training evokes the same effects mentioned above. In addition, there is only one study of *kettlebell* training conducted in health women (Holmstrup et al., 2016).

Another point of our interest is the investigation of detraining effects on general health and quality of life. Detraining can be defined as a partial or complete loss of training-induced adaptations in response to an insufficient training stimulus (Mujika and Padilla, 2000).

Basically, two types of detraining were described, short-term (less than 4 weeks) and long-term detraining (longer than 4 weeks) (Melchiorri et al, 2014; Mujika and Padilla, 2000). Several previous authors who investigated the effects of detraining demonstrated that it has negative impact on physical fitness (Tokmakidis et al, 2014; Delshad et al, 2013; Bocalini et al, 2010). However, one more time we have no knowledge about detraining effects on aspects of general health and quality of life.

Thus, our primary aim was to evaluate the influence of systematized training program with *kettlebell* on anxiety and depression levels, profile of mood state and quality of life and sleep in healthy and physically active women but with no experience with *kettlebell* training. Secondarily, we also evaluated the effect of short-term detraining on these variables. According to our literature research, our study is the first to evaluate the effect of *kettlebell* training and detraining, on previously mentioned parameters.

METHODS

Subjects

Initially, 24 young women volunteered (convenience sample) to participate in this study. Participants had, in mean ± standard deviation, the following characteristics: age=26.0±5.0years; body mass=60.9±12.5kg; height=164.6±5.5m.

Participants were health and physically active women who were recruited among students of the *Federal University of Espírito Santo* (Vitória, Brazil). All participants had a minimum of 3 months strength training experience in the basal evaluation. The inclusion criteria were never having participated in *kettlebell* training; able to perform physical exercise; no chronic disease; and not currently smoking or using drugs/ergogenic aids.

Seven participants were withdrawal from study protocol due to following reasons: time incompatibility (n=2), frequent absences (n=3), personal reasons (n=2) and did not perform post-training period evaluations. Thus, the final samples consisted of 17 subjects.

After a clear explanation of the procedures, including the risks and benefits of participation, written consent was obtained. All experimental procedures were approved by the University Human Research Ethics Committee (protocol number: 1.038.512) and they conformed to the principles outlined in the Declaration of Helsinki. All participants were highly motivated to participate in the study.

Experimental design

The study was organized in five successive phases: the pre-intervention evaluations (PRE), the intervention period, the post-intervention evaluations (POST), the detraining period, and post detraining (D) evaluations as figure 1.

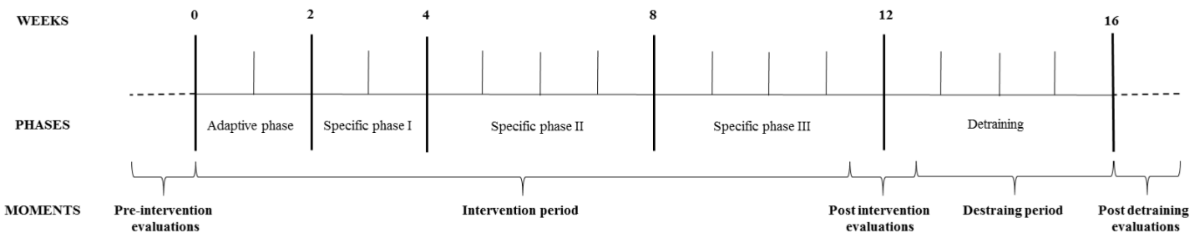

Figure 4 - Study design

In the PRE, POST, and D evaluations, subjects answered the following questionnaires: 36-Item Short Form Health Survey (SF-36), Beck Depression Inventory, State anxiety level, Profile of Mood States (POMS) and the Pittsburgh Sleep Quality Index (PSQI). These questionnaires were applied randomly in the same day in the two days before and after the training period.

Finally, the subjects were submitted to 10 weeks of training intervention with *kettlebell*, three times per week, on non-consecutive days. After that, subjects were submitted to 4 weeks of detraining.

Kettlebell training protocol

Kettlebell training was a whole body program for 10 weeks, three times per week on non-consecutive days totalizing 36 training sessions. The training protocol was organized in four phases: adaptative phase (2 weeks), specific phase I (2 weeks), specific phase II (4 weeks) and specific phase III (4 weeks).

Since subjects have no experience with *kettlebell* exercise, before beginning of training protocol, study participants were submitted to an ADAPTATIVE PHASE (2 weeks) in order to provide the adequate technique. During this phase was performed three sessions per week that lasted 15 to 20 minutes (main part). The following exercise was performed in this order (figure 2): free trunk flexion and extension (A), deadlift with *kettlebell* (B), first part of the swing *kettlebell* movement (C), *kettlebell* swing with towel (D), complete *kettlebell* swing (E), free squat in front of the wall with hands over head (F) and front squat *kettlebell* in front wall (G). The subjects were instructed to perform one set of 10-15 repetitions of each exercise. Each set was interspersed by a 90-s recovery interval.

Figure 2 below showed the exercise sequence of the adaptative phase.

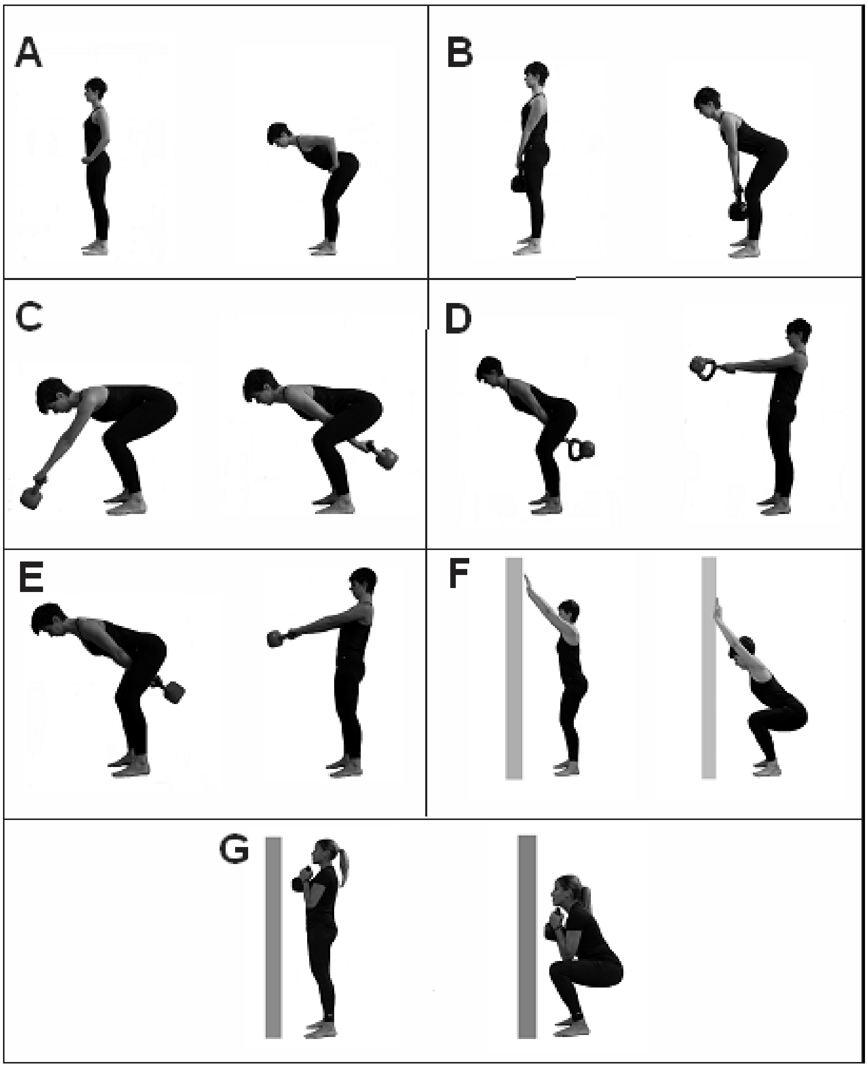

Figure 5 - Exercises used in the adaptative phase. A: Free trunk flexion and extension; B: Deadlift (16kg); C: First part of the swing kettlebell (12kg); D: Kettlebell swing with towel (8kg); E: Kettlebell swing (8kg); F: Free squat in front of the wall with hand

In SPECIFIC PHASE I (2 weeks), the subjects performed five sets of kettlebell swing (30 seconds of exercise/30 seconds of rest interval). After two minutes of recovery period, subjects performed three sets of squat movements (30 seconds of exercise/30 seconds of rest interval). Participants were instructed to complete as many repetitions as possible during each thirty-second work interval, and place the *kettlebell* on the floor during rest. The main part of the sessions in this phase lasted 10 minutes (figure 3).

Figure 6 - Exercises used in the specific phases of training. A: swing; B: squat. The image is from one of the study participants.

In the following four weeks (SPECIFIC PHASE II) volunteers performed three sets of five 30-second of exercise separated by 30 seconds of rest interval alternating swing and squat movements with two-minute of interval between sets. Finally, during the last four weeks of training (SPECIFIC PHASE III) were maintained the same number of sets, exercise sequence, and stimulus/recovery time. However, the interval between sets was changed from two to one minute. The main part of the specific phases I, II and III lasted, 10, 19 and 17 minutes respectively. Figure 3 illustrates the training plan.

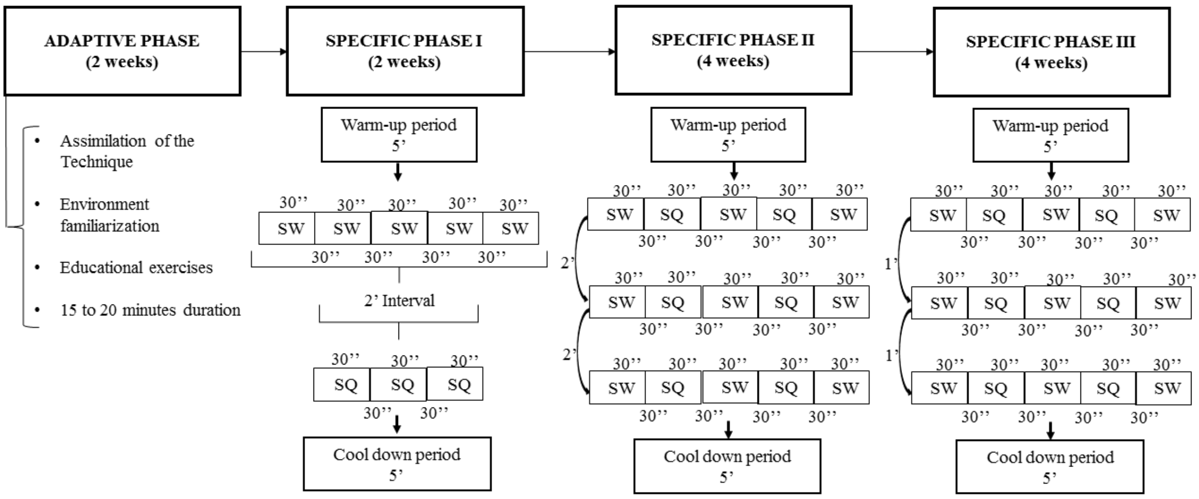

Figure 7 - Kettlebell training plan. SW: Swing; SQ: Squat

The initial *kettlebell* load was 8 kg (Tsatsouline, 2006) and following criteria were used to increase the load (in kg) along the training protocol: 1-cadence greater than or equal to 22 repetitions in the swing movement, 2-subjective perceived exertion after 5 minutes of the training session end lower or equal to 5, and 3-movements technical execution (Borg, 1982; Tsatsouline, 2006; Tiggemann et al., 2010). The Borg subjective perceived exertion scale (0 to 10 points) was used to control the sessions training intensity (Borg, 1982).

Before all training sessions, subjects performed dynamic warm-up exercises (about 5 minutes), which involved ballistic movements of flexion, extension and rotation of upper limbs, lower limbs and trunk. After training sessions, subjects performed a cool down period (5 minutes) that involved static stretching to whole body. All training sessions were supervised by experienced exercise instructors, and careful records were kept of each subject's workout performance and physiologic responses.

The participants were instructed to arrive at the laboratory in a rested and fully hydrated state and having not consumed caffeine in the previous 4 hours. To minimize the effects of diurnal biological variation, all the tests were performed at the same time of day.

All volunteers maintained a training adherence above 85%. There were no adverse effects reported by subjects during training session.

Assessments

The subjects were assessed in the PRE, POST and D intervention periods by an investigator who was experienced with application of questionnaires. The following assessments were performed: *36-Item Short Form Health Survey* (SF-36), *Beck Depression Inventory*, *State anxiety inventory*, *Profile of Mood States* (POMS) and *Pittsburgh Sleep Quality Index* (PSQI).

Quality of life

The quality of life was evaluated through 36-Item Short Form Health Survey (SF-36) adapted to Brazilian population (Ciconelli et al, 1999). This questionnaire consists of 36 questions, grouped into eight domains: functioning capacity - *1 question with 10 items* (1), limitations because of physical aspects - *1 question with 4 items* (2), pain (3) - *2 questions with 2 items*, general health - *2 questions with 5 items* (4), vitality - *1 question with 4 items* (5), social functioning - *2 questions with 2 items* (6), limitations because emotional problems - *5 questions with 3 items* (7), and mental health - *1 question with 5 items* (8). The item about health (question 2) is not part of the calculation of any domain and used only to evaluate how much better or worse the subject is compared a year ago. Subscale scores range from 0 to 100, with 100 as the best, most positive life quality in that area and 0 is the worst (Ciconelli et al, 1999).

Depression and Anxiety evaluation

The Brazilian version (Gorenstein, Andrade, 1996) of Beck Depression Inventory (Beck et al, 1961) was applied. This instrument has 21 questions about clinical symptoms of depression that covers affective, behavioral, somatic and interpersonal aspects. Each item consists of a series of four statements scaled to indicate increasing depressive symptomatology. Scores below 9 are considered normal and between: 10–18 indicate mild to moderate depression; 19–29 indicate moderate to severe depression; and 30–63 indicate severe depression (Gorenstein, Andrade, 1996).

In addition, anxiety levels were evaluated by the *State Anxiety Inventory*. This Anxiety Inventory it is a self-reported assessment device (with 20-item score scale) which evaluated how the individual's feelings at a particular time and under specific conditions (acute characteristics). Scores can vary from a minimum of 20 to a maximum of 80. A score higher than 30 indicates the presence of anxiety, a score of 31 to 49 indicates an intermediate level of anxiety and a score greater than or equal to 50 indicates a higher degree of anxiety (Gorenstein, Andrade, 1996).

Profile of Mood States evaluation

The mood profile was assessed by the POMS questionnaire, which is a self-reporting and mood global measure, that consisting of 65 items that fit into 6 categories: tension-anxiety, depression, anger-hostility, vigor, fatigue and confusion, and scored from 1-4 according to severity. The POMS questionnaire was utilized because of its validity and common use (Morgan, 1979; Morgan et al, 1987; Morgan et al, 1988).

Sleep quality

Sleep quality was evaluated by the *Pittsburgh Sleep Quality Index* (PSQI). This scale has seven components, each one dealing with a major aspect of sleep: 1) subjective quality of sleep, 2) sleep onset latency, 3) sleep duration, 4) sleep efficiency, 5) presence of sleep disturbances, 6) use of hypnotic-sedative medication, and 7) presence of daytime disturbances, as an indication of daytime alertness. Individuals with a total PSQI score of 6 or more were considered to be poor sleepers (Buysse et al, 1989).

Statistical analysis

Data were expressed as median, mean±standard deviation (SD) and absolute (n) and relative frequency (%). All variables (data) were tested for normal distribution according to the *Shapiro-Wilk* test. When the data did not pass by the normality test, were used the *Friedman* test for the comparison of medians; at PRE, POST and D moments; and *Duncan's* multiple comparison test. For data with normal distribution, ANOVA for repeated measures and *Bonferroni* multiple comparisons test were used to verify which pair (or pairs) differentiated between PRE, POST and D moments. Finally, the *Chi-Square* test (for one sample) was used to verify differences between proportions of PRE, POST and D moments. All statistical analyses were performed using SPSS version 21.0 (SPSS Inc., Chicago, IL, USA) and the level of statistical significance was set at $p < 0.05$.

RESULTS

The characteristics of the participants are given in table 1. No differences were observed between the different moments of the protocol study (table 1).

Table 4 - Participant characteristics in the three moments of the study (PRE, POST and D).

Variables	**PRE (N = 17)** **Mean±SD/**Median	**POST (N = 17)** **Mean±SD/**Median	**D (N = 16)** **Mean±SD/**Median	p value
Body mass (kg)	**60.9±12.5**/59.0	**61.4±12.0**/60.0	**60.7±11.0**/60.1	0.29
Height (cm)	**164.6±5.5**/165.0	**164.6±5.2**/165.0	**164.4±4.9**/165.0	0.23
BMI	**22.3±3.8**/21.3	**22.5±3.8**/21.7	**22.3±3.6**/22.1	0.33

Data are presented as mean ± standard deviation (SD)/Median. BMI: Body mass index. D: detraining.

Questionnaires battery

In relation to quality of life assessment (by SF-36) there were no significant differences between data for any of the evaluated domains in the three moments (PRE, POST and D) as observed in table 2.

Table 5 - Quality of life evaluation in the three moments of the study (PRE, POST and D).

Domain	**PRE (n=17)** **Mean±SD/**Median	**POST (n=17)** **Mean±SD/**Median	**D (n=16)** **Mean±SD/**Median	**p value**
Functioning capacity	**90.0±10.7**/95	**95.3±4.8**/95	**90.3±12.3**/95	0.91
Limitations because of physical aspects	**90.6±19.5**/100	**85.3±28.0**/100	**81.2±19.4**/75	0.86
Pain	**71.8±19.9**/72	**72.9±17.6**/72	**79.9±21.4**/84	0.49
General health	**79.0±16.5**/80	**82.2±12.8**/87	**84.4±15.1**/87	0.62
Vitality	**67.8±15.1**/68	**65.9±20.6**/65	**71.6±20.1**/72.5	0.54
Social functioning	**87.5±18.2**/87.5	**87.5±17.1**/100	**82.8±23.7**/100	0.57
Limitations because emotional problems	**79.2±28.5**/100	**74.5±34.4**/100	**72.9±38.9**/100	0.95
Mental health	**75.8±11.9**/76	**77.4±13.6**/76	**73.0±19.1**/78	0.58
Total mean	**80.2±9.9**/83.5	**80.7±12.6**/83	**79.5±14.6**/83.6	0.94

Data are presented as mean ± standard deviation (SD)/Median. D: detraining.

Regard to POMS domains there were no significant differences between the medians in PRE, POST, and D moments (figure 5 and table 3 - below). The same happened for state anxiety levels. Concerning the level of anxiety, 17.6% (n = 3), 70.6% (n = 12) and 11.8 (n = 2) of the participants, in the PRE period, presented low, medium, and high levels, respectively. In the POST period, 17.6% (n = 2), 70.6% (n = 13) and 11.8 (n = 1) of the participants presented low, medium and high levels, respectively. Finally, in the period D, 12.5% (n = 2), 81.3% (n = 13) and 6.2 (n = 1) of the participants presented low, medium and high levels, respectively. There was no significant difference between the moments – Table 4. Finally, we observed statistical significant differences between the medians for the depression in PRE (9.0), POST (7.0), and D (7.0) moments. The median was (+22.0%) higher in PRE period when compared to the POST and D. Regard to depression, in the PRE period, 64.7% (n = 11), 29.4% (n = 5) and 5.9 (n = 1) of the participants presented normal, mild, and severe levels, respectively. In the POST period, 76.5% (n = 13) and 23.5% (n = 4) of the participants presented normal and mild levels, respectively, with absence of the severe level. Finally, in the D period, 81.3% (n = 13) and 18.7% (n = 3) of the participants presented normal and mild levels, respectively, also with absence of severe level. There was no significant difference between the periods (table 3).

Table 6 - Profile of mood state, anxiety and depression evaluation in the three moments of the study (PRE, POST and D).

	PRE (n=17) **Mean±SD**/Median	**POST (n=17)** **Mean±SD**/Median	**D (n=16)** **Mean±SD**/Median	**p value**
Profile of mood state				
Tension-anxiety	**2.9±3.5**/2.0	**3.4±4.0**/2.0	**3.1±4.5**/3.0	0.516
Depression	**4.2±5.0**/2.0	**3.2±3.7**/1.0	**3.4±4.1**/2.5	0.726
Anger-hostility	**3.1±3.8**/2.0	**3.8±5.0**/1.0	**4.2±4.4**/3.0	0.576
Vigor	**16.9±4.4**/18.0	**18.3±4.4**/19.0	**18.1±6.2**/21.0	0.105

Fatigue	**6.1±4.9**/6.0	**5.5±4.2**/4.0	**4.9±4.2**/3.5	0.346
Confusion	**2.2±4.1**/0.0	**1.2±4.2**/0.0	**2.0±4.6**/1.0	0.225
Disturbance mood total score	**1.6±19.5**/-4.0	**-1.18±20.4**/-7.0	**-0.38±22.5**/-7.5	0.159
Anxiety				
	40.3±9.3/40.0	**40.9±9.9**/39.0	**37.8±8.8**/39.0	0.539
Depression				
	10.0±7/9.0	**6.9±3.4**/7.0[a]	**6.5±4**/7.0[a]	0.003*

Data are presented as mean ± standard deviation (SD)/Median. D: detraining.

**Friedman* test; [a]differences in relation to PRE moment (*Duncan* test).

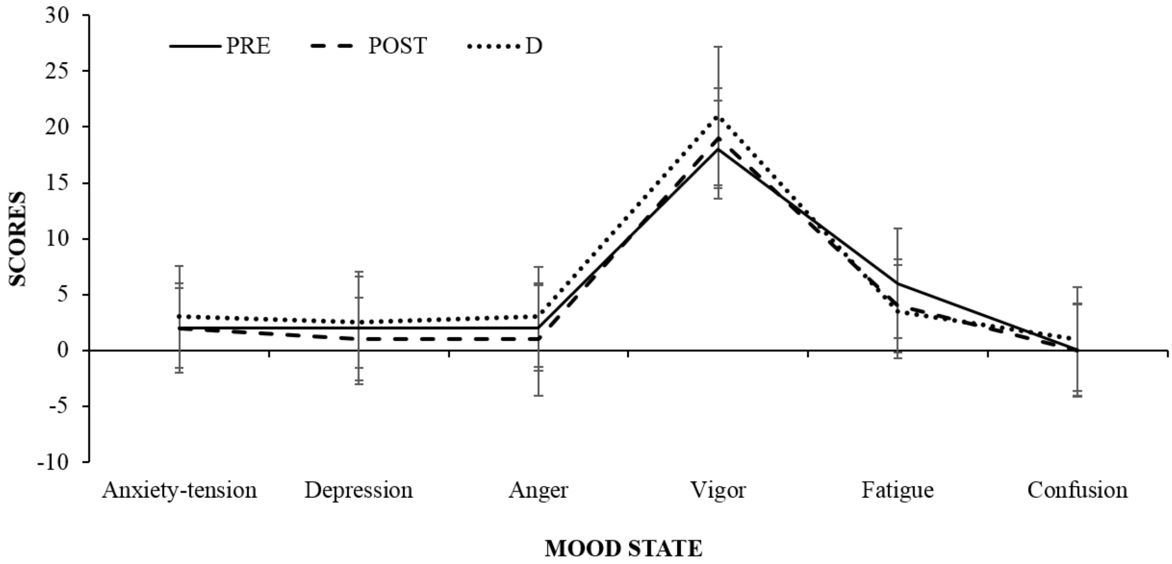

Figure 8 - Profile of mood state (POMS) evaluation in the PRE, POST and D periods

Regard to sleep quality, in the PRE period, 52.9% (n = 9), 47.1% (n = 8) and 0% (n = 0) of the participants presented good, bad, and sleep disorders, respectively. In the POST period, 35.3% (n = 6), 58.8% (n = 10) and 5.9% (n = 1) of the participants presented good, bad, and sleep disorder, respectively. Finally, in the D period, 43.8% (n = 7), 50.0% (n = 8) and 6.2% (n = 1) of the participants presented good, bad, and sleep disorders, respectively.

There was no significant difference between the periods regarding sleep disorders. Concerning the means, of sleep quality, of PRE (4.8±2.7), POST (5.2±2.4) and D (5.3±2.4) periods there was no significant differences.

Finally, table 4 shows all results variations (delta - Δ %) of the differences (significant or not) observed when we compare PRE vs. D; POST vs. PRE, and D vs. POST moments.

Table 7 - Data variation (% - delta) of the comparisons between PRE, POST and D moments.

	Δ % (PRE vs. D)		**Δ % (POST vs. PRE)**		**Δ % (D vs. POST)**	
	Median	Mean	Median	Mean	Median	Mean
SF-36						
Functioning capacity	NA	-0.3	NA	+5.8	NA	-5.2
Limitations because of physical aspects	+33.0	+11.6	NA	-5.8	-33.0	-4.8
Pain	-14.3	-10.1	NA	+1.5	-36.1	+9.6
General health	-8.0	-6.3	8.7	+4.0	NA	+2.7
Vitality	-6.2	-5.3	-4.4	-2.8	11.5	+8.6
Social functioning	-12.5	+5.7	+12.5	NA	NA	-5.4
Limitations because emotional problems	NA	NA	NA	-5.9	NA	-2.1
Mental health	-2.6	+3.8	NA	+2.1	2.6	-5.7
Total mean	-0.1	+0.9	+0.6	+0.6	+0.7	-1.5
POMS						
Tension-anxiety	-33.0	-6.4	NA	+17.2	+50.0	-8.8
Depression	-20.0	+23.5	-50.0	-23.8	+150.0	+6.2
Anger-hostility	-33.0	-26.1	-50.0	+22.6	+200.0	+10.5
Vigor	-14.3	-6.6	+5.5	+8.3	+10.5	-1.0
Fatigue	+71.4	+24.4	-33.3	-9.8	-12.5	-10.9
Confusion	-100.0	+10.0	NA	-45.4	+100.0	+6.7
Disturbance mood total score	+46.0	+521.0	-75.0	-173.7	-7.1	-67.8
IDATE – State scale						
	+2.6	+6.6	-2.5	+1.48	NA	-7.6

BECK						
	+28.6	+53.8	-22.2	-31.0	NA	-5.8
PITTSBURGH						
	-27.3	-9.4	+25.0	+8.3	+10.0	+1.9

NA: not applied

DISCUSSION

Our main objectives were to study the effects of *kettlebell* training (10 weeks) and detraining (short-term, 4-weeks) in variables relate to health status and quality of life in healthy and recreationally physically active women. We observed that the levels of quality of life, anxiety (state), profile of mood state and sleep quality did not present significant differences between the three moments evaluated (PRE, POST and D). However, our main result was that the depression level decreased after *kettlebell* training and remained constant after detraining. Our research was the first to evaluate the impact of *kettlebell* training and detraining on health and quality of life parameters. This fact is interesting but at the same time generates some difficulty in possible comparisons with the current literature. However, we will counterpoint with activities types that bear some resemblance (*Pilates* and Concurrent and Circuit training) to those used in the present study.

Cruz-Ferreira et al. (2015) demonstrated that Mat Pilates training (twice per week, 60-minutes/session by 24 weeks) could improve the perception of health status of healthy women. García-Soidán et al. (2014) assessed the effects of 12 weeks of Pilates training on quality of life (by SF-36) and sleep latency and quantity (by *Pittsburgh Sleep Quality Index*) in middle-aged people. Physical and emotional components of the SF-36 questionnaire and latency and sleep quantity showed significant improvement. Pilates training is an accessible and alternative strategy (as *kettlebell*) that could impact in a positive manner the health status of middle age people and other populations (Hale et al, 2002; Vieira et al, 2013; Ekici et al, 2017). Vieira et al. (2013) evaluated the effects of Pilates training on SF-36 quality of life components, in female and male individuals (beginners, experienced and ex-practitioners), and observed that physical function, general health and mental health were improved. Finally, Leopoldino et al. (2013) investigate the effects of a Mat Pilates training program (12 weeks and 2 sessions per week), in sleep quality and quality of life, on sedentary women and observed that Pilates training could improve sleep quality and quality of life. These findings do not compare with those of our study, since we did not observe alterations in the quality of sleep and quality of life between the different moments (PRE, POST and D) of the experimental protocol.

In clinical populations, Ekici et al. (2017) demonstrated that four weeks of *Pilates* training, in women with fibromyalgia, improved the level of anxiety (state and trait). Gomes Neto et al. (2013), in patients with stable HIV/AIDS, demonstrated that concurrent strength training improved health-related quality of life and that this training model appears to be safe and beneficial for these people. Kofotolis et al (2016) studied the impact of eight weeks (3 times/week) of *Pilates* training and trunk strengthening exercises on quality of life (evaluated by SF-36) in women with chronic low back pain. They demonstrated that *Pilates* group had greater improvements on self-reported quality of life compared to trunk strengthening exercise group. In addition, the effects were remained after a period of three months of detraining only for the Pilates group.

Regarding to cross training we found only one study that evaluated variables analyzed by the present work. Hale et al (2002) evaluated the state anxiety responses (acute effect - one of the aspects monitoring in the present study) to 60 minutes of cross training (*aerobic exercise and resistance training in the same exercise session*) in collegiate athletes and concluded that this activity type are associated with reductions in state anxiety. In addition, the exercise order (*aerobic/strength or strength/aerobic*) does not influence this response.

However, in our study, we did not find significant differences in anxiety levels during the experimental protocol.

Kamahara et al. (2004) evaluated the impact of circuit training (five times a week for to 2 weeks) in elderly patients with chronic obstructive pulmonary disease and demonstrated that this type of training (*with strength and aerobic components*) improves the quality of life in this clinical population. It should be pointed that not only the predominant aerobic training, but also predominantly strength work as well as concurrent and circuit training (which bear some resemblance to the dynamics of *kettlebell* exercise) could positively impact variables associated with health status and quality of life, in clinical and health populations (Silva-Batista et al., 2016; Shobeiri et al, 2016; Cruz-Ferreira et al, 2015; Alley et al., 2015; Gomes Neto et al, 2015; Jaggers et al., 2015; Jayakody et al., 2014; Stanton, Happell, 2013; Stanton et al., 2013; Arcos-Carmona et al, 2011), as those evaluated and monitored in the present study.

Although the training protocol used in the present study was not enough to improve the majority of studied variables, there was an improvement in the depression levels of the participants. Because the volunteers are already physically active it is likely that they have departed from higher values when compared to other populations. For example, Vieira et al. (2013) evaluated the effects of *Pilates* training on SF-36 quality of life components in practitioners of different levels (beginners and experienced) and observed that functional capacity (median) of beginners and experienced were 72.31 and 86.38, respectively. In our study the PRE-values (median) of healthy and recreationally physically active women (i.e., experienced with physical activity) was 95.0. This clearly denotes that the level of practice and conditioning is a factor that could influence the initial levels of quality of life.

Regarding to detraining period we did not observe significant differences when we compared with before and after training. However, our main finding was that depression levels remained low after detraining when compared to baseline values. Our main difficulty with this important phase of our study is the fact that there are no studies with the same type of training to compare our findings. However, we will make some considerations with this respect.

Delshad et al (2013) demonstrated that four weeks of detraining (after a resistance training program of 12 weeks) had adverse effects on muscle power in post-menopausal women. Sañudo et al (2012) evaluate the effects of 6 months of combined exercise program on quality-of-life and physical function (evaluated by SF-36 and Fibromyalgia Impact Questionnaire), depression (by Beck Depression Inventory) and physical fitness in women with fibromyalgia. Outcomes were assessed at baseline and after each 6 months intervention, which was delivered over 30 months (six months of training/six of detraining). They observed that improvements (in quality of life, physical function, depression and physical fitness) achieved for the training period were maintained during the detraining. Bocalini et al (2010) showed that 12 weeks of water-based exercise program improves the functional fitness and quality of life of older women. However, after a short detraining period of 4-6 weeks studied parameters returns to untrained levels.

Finally, Teixeira-Salmela et al (2005) demonstrated that four weeks of detraining in elderly people; after a muscle strengthening and aerobic conditioning program twice a week; was enough to show functional decline. However, the gains in quality of life remained unchanged during detraining period.

Our main conclusion is that 10 weeks of *kettlebell* training is effective to decrease the depression level that remains constant after 4 weeks detraining period.

PRACTICAL APPLICATIONS

Our research was the first to evaluate the impact of systematized *kettlebell* training and detraining on quality of life, depression and anxiety levels, profile of mood state and sleep quality of healthy and physically active women. In our view, this fact is a strong point since it was possible to establish reference values, in healthy people, for important variables related to health and quality of life. In addition, we tested a *kettlebell* training protocol that was effective in improving the emotional health of healthy and physical activity women. This is interesting, since *kettlebell* could be a cheaper and affordable alternative method for people who do not have access to Strength and Conditioning places. However, caution should be exercised regarding the exercises technical orientation as well as the health status of the practitioners for a safe practice. Finally, we demonstrated that 10 weeks of *kettlebell* training is sufficient to maintain the health state and quality of life even after 4 weeks of detraining.

LIMITATIONS

As every questionnaire study always has the subjectivity question and the need for a high number of participants (which was not possible in this study). Another factor to note is that the participants, because they were physically active, started from high base values for most of the analyzed variables. This may be one of the reasons why we did not observe significant differences and improvements during the experimental protocol. Finally, a weak point of the present study is the lack of control group and the fact that it was not a randomized study.

REFERENCES

Alley JR, Mazzochi JW, Smith CJ, Morris DM, Collier SR. Effects of resistance exercise timing on sleep architecture and nocturnal blood pressure. J Strength Cond Res. 2015 May;29(5):1378-85.

Arcos-Carmona IM, Castro-Sánchez AM, Matarán-Peñarrocha GA, Gutiérrez-Rubio AB, Ramos-González E, Moreno-Lorenzo C. Effects of aerobic exercise program and relaxation techniques on anxiety, quality of sleep, depression, and quality of life in patients with fibromyalgia: a randomized controlled trial. Med Clin (Barc). 2011 Oct 8;137(9):398-401.

Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. Arch Gen Psychiatry. 1961 Jun;4:561-71.

Bocalini DS, Serra AJ, Rica RL, Dos Santos L. Repercussions of training and detraining by water-based exercise on functional fitness and quality of life: a short-term follow-up in healthy older women. Clinics (Sao Paulo). 2010;65(12):1305-9.

Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989; 28: 193-213.

Ciconelli RM, Ferraz MB, Santos W, Meinão I, Quaresma MR. Brazilian-Portuguese version of the SF-36. A reliable and valid quality of life outcome measure. Rev Bras Reumatol. 1999;39:143-50.

Cruz-Ferreira A, Fernandes J, Gomes D, Bernardo LM, Kirkcaldy BD, Barbosa TM, Silva A. Effects of Pilates-based exercise on life satisfaction, physical self-concept and health status in adult women. Women Health. 2011 May;51(3):240-55.

Falatic JA, Plato PA, Holder C, Finch D, Han K, Cisar CJ. Effects of Kettlebell Training on Aerobic Capacity. J Strength Cond Res. 2015 Jul;29(7):1943-7.

Fortner HA, Salgado JM, Holmstrup AM, Holmstrup ME. Cardiovascular and Metabolic Demads of the Kettlebell Swing using Tabata Interval versus a Traditional Resistance Protocol. Int J Exerc Sci. 2014 Jul 1;7(3):179-185.

García-Soidán JL, Giraldez VA, Cachón Zagalaz J, Lara-Sánchez AJ. Does pilates exercise increase physical activity, quality of life, latency, and sleep quantity in middle-aged people? Percept Mot Skills. 2014 Dec;119(3):838-50.

Gomes Neto M, Conceição CS, Oliveira Carvalho V, Brites C. Effects of Combined Aerobic and Resistance Exercise on Exercise Capacity, Muscle Strength and Quality of Life in HIV-Infected Patients: A Systematic Review and Meta-Analysis. PLoS One. 2015 Sep 17;10(9):e0138066.

Gomes Neto M, Ogalha C, Andrade AM, Brites C. A systematic review of effects of concurrent strength and endurance training on the health-related quality of life and cardiopulmonary status in patients with HIV/AIDS. Biomed Res Int. 2013;2013:319524.

Gorenstein C, Andrade L. Validation of a Portuguese version of the Beck Depression Inventory and the State–Trait Anxiety Inventory in Brazilian subjects. Braz J Med Biol Res 1996:453–7.

Greenwald S, Seger E, Nichols D, Ray AD, Rideout TC, Gosselin LE. Effect of an Acute Bout of Kettlebell Exercise on Glucose Tolerance in Sedentary Men: A Preliminary Study. Int J Exerc Sci. 2016 Oct 1;9(3):524-535.

Hale BS, Koch KR, Raglin JS. State anxiety responses to 60 minutes of cross training. Br J Sports Med. 2002 Apr;36(2):105-7.

Holmstrup ME, Jensen BT, Evans WS, Marshall EC. Eight Weeks of Kettlebell Swing Training Does not Improve Sprint Performance in Recreationally Active Females. Int J Exerc Sci. 2016 Oct 1;9(3):437-444.

Jaggers JR, Hand GA, Dudgeon WD, Burgess S, Phillips KD, Durstine JL, Blair SN. Aerobic and resistance training improves mood state among adults living with HIV. Int J Sports Med. 2015 Feb;36(2):175-81.

Jay K, Frisch D, Hansen K, Zebis MK, Andersen CH, Mortensen OS, Andersen LL. Kettlebell training for musculoskeletal and cardiovascular health: a randomized controlled trial. Scand J Work Environ Health. 2011 May;37(3):196-203.

Jayakody K, Gunadasa S, Hosker C. Exercise for anxiety disorders: systematic review. Br J Sports Med. 2014 Feb;48(3):187-96.

Kamahara K, Homma T, Naito A, Matsumura T, Nakayama M, Kadono K, Kai S, Inoue M, Satoh H, Sekizawa K. Circuit training for elderly patients with chronic obstructive pulmonary disease: a preliminary study. Arch Gerontol Geriatr. 2004 Sep-Oct;39(2):103-10.

Kofotolis N, Kellis E, Vlachopoulos SP, Gouitas I, Theodorakis Y. Effects of Pilates and trunk strengthening exercises on health-related quality of life in women with chronic low back pain. J Back Musculoskelet Rehabil. 2016 Nov 21;29(4):649-659.

Lake JP, Lauder MA. Kettlebell swing training improves maximal and explosive strength. J Strength Cond Res. 2012 Aug;26(8):2228-33.

Liebenson C. Functional training with the kettlebell. J Bodyw Mov Ther. 2011 Oct;15(4):542-4.

Melchiorri G, Ronconi M, Triossi T, Viero V, De Sanctis D, Tancredi V, Salvati A, Padua E, Alvero Cruz JR. Detraining in young soccer players. J Sports Med Phys Fitness. 2014 Feb;54(1):27-33.

Morgan WP, Brown DR, Raglin JS, O’Connor PJ, Ellickson KA. Psychological monitoring of overtraining and staleness. Br J Sports Med 1987;21:107-14.

Morgan WP, Costill DL, Flynn MG, Raglin JS, O’Connor PJ. Mood disturbance following increased training in swimmers. Med Sci Sports Exerc 1988;20:408-14.

Morgan WP. Prediction of performance in athletics. In: Klavora P, Daniel JV (Eds). Coach, athlete and the sport psychologist. Champaign, IL:Human Kinetics 1979:172-86.

Mujika I, Padilla S. Detraining: loss of training-induced physiological and performance adaptations. Part I: short term insufficient training stimulus. Sports Med. 2000 Aug;30(2):79-87.

Otto WH 3rd, Coburn JW, Brown LE, Spiering BA. Effects of weightlifting vs. kettlebell training on vertical jump, strength, and body composition. J Strength Cond Res. 2012 May;26(5):1199-202.

Sañudo B, Carrasco L, de Hoyo M, McVeigh JG. Effects of exercise training and detraining in patients with fibromyalgia syndrome: a 3-yr longitudinal study. Am J Phys Med Rehabil. 2012 Jul;91(7):561-9; quiz 570-3.

Shobeiri F, Masoumi SZ, Nikravesh A, Heidari Moghadam R, Karami M. The Impact of Aerobic Exercise on Quality of Life in Women with Breast Cancer: A Randomized Controlled Trial. J Res Health Sci. 2016 Summer;16(3):127-132.

Silva-Batista C, Campos de Brito L, Corcos DM, Roschel H, Túlio de Mello M, Pimentel Piemonte ME, Tricoli V, Ugrinowitsch C. Resistance Training Improves Sleep Quality In Subjects With Moderate Parkinson's Disease. J Strength Cond Res. 2016 Oct 13.

Stanton R, Happell BM. An exercise prescription primer for people with depression. Issues Ment Health Nurs. 2013 Aug;34(8):626-30.

Stanton R, Reaburn P, Happell B. Is cardiovascular or resistance exercise better to treat patients with depression? A narrative review. Issues Ment Health Nurs. 2013 Jul;34(7):531-8.

Tokmakidis SP, Touvra AM, Douda HT, Smilios I, Kotsa K, Volaklis KA. Training, detraining, and retraining effects on glycemic control and physical fitness in women with type 2 diabetes. Horm Metab Res. 2014 Dec;46(13):974-9.

Vieira FT, Faria LM, Wittmann JI, Teixeira W, Nogueira LA. The influence of Pilates method in quality of life of practitioners. J Bodyw Mov Ther. 2013 Oct;17(4):483-7.

Williams BM, Kraemer RR. Comparison of Cardiorespiratory and Metabolic Responses in Kettlebell High-Intensity Interval Training Versus Sprint Interval Cycling. J Strength Cond Res. 2015 Dec;29(12):3317-25.

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6. CONSIDERAÇÕES FINAIS E PERSPECTIVAS FUTURAS

Avaliamos a influência de um programa de treinamento sistematizado com *kettlebell* sobre a força máxima e os níveis de potência em mulheres jovens saudáveis e fisicamente ativas e sem experiência com *kettlebell*. Avaliamos também, a influência do treinamento com *kettlebell* sobre os níveis de ansiedade e depressão, perfil do estado de humor e qualidade de vida e sono na mesma população. Além disso, analisamos o efeito do destreinamento de curto prazo sobre todas variáveis.

Dessa maneira, concluímos que o treinamento com *kettlebell* de 10 semanas impactou positivamente os níveis de força máxima de membros inferiores, força explosiva, força isométrica e os sinais e sintomas de depressão de mulheres jovens saudáveis e fisicamente ativas. Além disso, o destreinamento de curto prazo de 4 semanas não impactou de forma expressiva essas variáveis.

Isso é interessante, uma vez que o *kettlebell* é um método alternativo de treinamento, relativamente barato, não exige muito espaço físico sendo acessível para pessoas que não têm muito tempo ou acesso a locais com equipamentos de treinamento sofisticados de força e condicionamento. No entanto, cuidado deve ser tomado com relação à técnica de execução dos exercícios específicos, bem como o estado de saúde para uma prática segura.

Adicionalmente, esses achados possuem pontos fortes, pois possibilitaram estabelecer valores de referência de variáveis relacionadas a aptidão física e parâmetros de saúde e qualidade de vida em mulheres jovens saudáveis.

Finalmente, é importante destacar que ainda existem lacunas a serem preenchidas sobre a eficácia do treinamento com *kettlebell*. Estudos futuros devem investigar com clareza o efeito do treinamento com *kettlebell* de forma randomizada e controlada em outras populações.

7. REFERÊNCIAS

ARAÚJO, D. S. M. S. DE; ARAÚJO, C. G. S. DE. Aptidão física, saúde e qualidade de vida relacionada à saúde em adultos. **Revista Brasileira de Medicina do Esporte**, v. 6, n. 5, p. 194–203, out. 2000.

BELTZ, N. et al. Effects Of Kettlebell Training On Aerobic Capacity, Muscular Strength, Balance, Flexibility, And Body Composition. **Journal of fitness research**, p. 4-13, 2013.

BORG, A. Psychophysical bases of perceived exertion. **Medicine and Science in Sports and Exercise** , v. 14, n. 5, p. 377-381, 1982.

CARMER , J. T.; COBURN, J. W. **Fitness testing protocols and norms. In R.W. Earle & T. R. (Eds.) NSCA's essentials of personal training (pp. 217-263)**. Champaign IL: Human Kinetics, 2004.

FALATIC, J. A. et al. Effects of Kettlebell Training on Aerobic Capacity. **Journal of Strength and Conditioning Research**, v. 29, n. 7, p. 1943–1947, jul. 2015.

GARBER, C. E. et al. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. **Medicine and Science in Sports and Exercise**, v. 43, n. 7, p. 1334–1359, 2011.

HULSEY, C. R. et al. Comparison of Kettlebell Swings and Treadmill Running at Equivalent Rating of Perceived Exertion Values. **Journal of Strength and Conditioning Research**, v. 26, n. 5, p. 1203–1207, maio 2012.

KRAMER, K. et al. The effects of kettlebells versus battle ropes on upper and lower body anaerobic power in recreationally active college students. **Journal of Undergraduate Kinesiology Research**, v. 10, p. 31–41, 2015.

MEIER, J.; QUEDNOW , J.; SEDLAK, T. The Effects of High Intensity Interval-Based Kettlebells and Battle Rope Training on Grip Strength and Body Composition in College-Aged Adults. **International Journal of Exercise Science**, v. 8, n. 2, p. 124-133, 2015.

POLLOCK, M L; WILMORE, J H. Exercícios na Saúde e na Doença: Avaliação e Prescrição para Prevenção e Reabilitação. 2. ed. Rio de Janeiro: **Medsi**, 1993.

RIBEIRO , A. M.; FERNADES , F. J.; NOVAES , J. S. A eficácia de três exercícios abdominais para testes de resistência muscular localizada. **Fitness & Performance Jounal**, v. 1, n. 1, p. 37-43, 2002.

TIGGEMANN, C. ; PINTO, S.; KRUEL, L. F.. A Percepção de Esforço no Treinamento de Força. **Revista Brasileira de Medicina do Esporte**, v. 16, n. 4, p. 301-309, 2010.

ANEXO A

UNIVERSIDADE FEDERAL DO ESPÍRITO SANTO

CENTRO DE EDUCAÇÃO FÍSICA E DESPORTOS

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Você está sendo convidada a participar, como voluntária, em uma pesquisa. Após ser esclarecida sobre as informações a seguir, no caso de aceitar fazer parte do estudo, assine ao final deste documento, que está em duas vias. Uma delas é sua e a outra é do pesquisador responsável. As informações obtidas através dessa pesquisa serão confidenciais e asseguramos o sigilo sobre sua participação. Os dados não serão divulgados de forma a possibilitar sua identificação. Em caso de recusa você não será penalizada de forma alguma. Em caso de dúvida você pode procurar o Comitê de Ética em Pesquisa da Universidade Federal do Espírito Santo pelo telefone (27) 3335-7211.

Dados de identificação

Título do Projeto: **Efeitos do treinamento com kettlebell em variáveis cardiopulmonares e de força.**

Pesquisador Responsável: Prof. Dr. Anselmo José Perez e Prof. Dr. Rodrigo Luiz Vancini

Instituição a que pertence o Pesquisador Responsável: UFES

Telefones para contato: (27) 3335-2624 (27) 3335-2638

Pesquisadores participantes: Carla Zimerer e Weverton Rufo Tavares da Silva

O *kettlebell* é uma bola de ferro com uma alça e utilizado na Rússia em competições para avaliar a força muscular. Ao longo dos anos, difundiu-se pelo mundo como ferramenta de treinamento funcional, que tem se mostrado como alternativa para melhorar a força muscular e o condicionamento aeróbio.

Embora estudos já tenham comprovado adaptações do sistema cardiovascular, bem como aumento de força a esse tipo de treino, pouco se tem estudado sobre o quanto essas alterações representam dentro de cada sistema metabólico. Portanto, investigaremos as respostas cardiopulmonares e de força crônicas ao exercício com *kettlebell* em indivíduos do sexo feminino, mensurando a magnitude dessas respostas em relação ao treinamento aplicado.

CRITÉRIOS DE INCLUSÃO NA PESQUISA

Os indivíduos deverão ser do sexo feminino, não ter experiência com a prática de *kettlebell*, estar em condições físicas adequadas aos testes e à participação no programa de treinamento (ausência de qualquer quadro de dor) e evitar exercícios de alta intensidade nos dias dos testes. Nenhuma participante poderá ser fumante, utilizar algum tipo de medicamento, utilizar suplemento ergogênico ou suplemento nutricional, conhecidos por afetar o metabolismo ou o desempenho de exercícios resistidos.

PROCEDIMENTO DOS TESTES

No primeiro dia, no laboratório de fisiologia do exercício (LAFEX) na UFES, faremos uma *anamnese* para coleta de informações básicas sobre o indivíduo. Em sequência será encaminhado para o teste cardiopulmonar e medida das variáveis metabólicas na esteira. No segundo dia, será realizado o teste de 10 repetições máximas no Leg 45º. Objetivando reduzir a margem de erro no teste de 10 RMs adotaram-se as seguintes estratégias: instruções padronizadas serão oferecidas antes do teste, de modo que o avaliado esteja ciente de todo a rotina que envolve a coleta de dados. O avaliado será instruído sobre a técnica de execução do exercício, inclusive realizando-o algumas vezes sem carga, para reduzir um possível efeito do aprendizado nos escores obtidos. O avaliado realizará um número de repetições necessárias para sentir-se seguro na execução do exercício. O avaliador estará atento quanto à posição adotada pelo praticante no momento da medida. Pequenas variações no posicionamento das articulações envolvidas no movimento poderão acionar outros músculos, levando a interpretações errôneas dos escores obtidos. As cargas que serão utilizadas no estudo serão checados em balança previamente calibrada. Uma repetição 10 RMs será definida como a quantidade máxima de peso levantado durante um ciclo completo de 10 repetições

CONSENTIMENTO DA PARTICIPAÇÃO DA PESSOA COMO SUJEITO

Eu, ____,

RG________________ CPF______________________________, abaixo assinado, concordo em participar do estudo supracitado, como sujeito. Fui devidamente informada e esclarecida pelo pesquisador ________________________________ sobre a pesquisa, os procedimentos nela envolvidos, assim como os possíveis riscos e benefícios decorrentes de minha participação. Foi-me garantido que posso retirar meu consentimento a qualquer momento, sem que isto leve a qualquer penalidade ou interrupção de meu acompanhamento/ assistência/tratamento.

Vitória, ____________________________ de 2015.

____

Nome e assinatura do paciente ou seu responsável legal

____

Nome e assinatura do responsável por obter o consentimento

____

Testemunha

____

Testemunha

ANEXO B

UNIVERSIDADE FEDERAL DO ESPÍRITO SANTO - UFES - CAMPUS GOIABEIRA

Plataforma Brasil

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Efeitos do treinamento com kettlebell em variáveis cardiopulmonares e de força.

Pesquisador: Anselmo José Perez
Área Temática:
Versão: 1
CAAE: 43203015.8.0000.5542
Instituição Proponente: Centro de Educação Física e Desportos da Universidade Federal do Espírito
Patrocinador Principal: UNIVERSIDADE FEDERAL DO ESPIRITO SANTO

DADOS DO PARECER

Número do Parecer: 1.038.512
Data da Relatoria: 17/04/2015

Apresentação do Projeto:
a pesquisa pretende realizar um estudo referente ao kettlebell que é um instrumento bastante utilizado na prática do treinamento físico tanto por atletas de alto rendimento quanto por não atletas, porém embora estudos já tenham comprovado adaptações do sistema cardiovascular, bem como aumento de força, pouco se tem estudado sobre o quanto essas alterações representam dentro de cada sistema metabólico.

Objetivo da Pesquisa:
Investigar as respostas e adaptações cardiopulmonares e de força ao treinamento periodizado com kettlebell em indivíduos do sexo feminino.

Avaliação dos Riscos e Benefícios:
Riscos: deve haver cuidado em relação aos implementos de kettlebell, que devem ser manipulados com atenção.
Os benefícios dizem respeito aos efeitos cardiovasculares e neuromusculares positivos que contribuem para a saúde.

Comentários e Considerações sobre a Pesquisa:
Não há.

Endereço: Av. Fernando Ferrari,514-Campus Universitário, Prédio Administrativo do CCHN
Bairro: Goiabeiras **CEP:** 29.090-075
UF: ES **Município:** VITORIA
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